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**U.S. Department of Agriculture**  
***Biofuels & Sustainability***  
***Literature, Programs, Research and Results***

**AGRICOLA (NAL) Database Search**

Lamb, J.F.S., Jung, H.J.G., Sheaffer, C.C., Samac, D.A. Alfalfa Leaf Protein and Stem Cell Wall Polysaccharide Yields under Hay and Biomass Management Systems. *Crop science*. 2007 July-Aug, v. 47, no. 4; p. 1407-1415.  
<http://dx.doi.org/10.2135/cropsci2006.10.0665>

ABSTRACT: Alfalfa (*Medicago sativa* L.) has been proposed as a biofuel feedstock in which the stems would be processed to produce ethanol and the leaves sold separately as a livestock feed. Our objectives were to evaluate the effects of management strategy on leaf crude protein (CP), and stem carbohydrate concentrations and yields of alfalfa germplasm differing in genetic background. Two hay-type and two biomass-type alfalfas were established at 450 plants m<sup>-2</sup> and harvested at early bud (hay management system) and at 180 plants m<sup>-2</sup> and harvested at green pod (biomass management system) in three environments. The biomass-type alfalfas under the biomass management had lower leaf CP, higher stem cell wall polysaccharide, and higher stem lignin concentrations, comparable leaf CP yield, and 37% greater stem cell wall polysaccharide yields compared to the hay-type alfalfas under the hay management treatment. The impact of altered stem cell wall composition and increased stem dry matter yield of a biomass-type alfalfa under the biomass system compared to a hay-type alfalfa under the hay system increased the theoretical potential ethanol yield by 99%.

CALL NUMBER: DNAL 64.8 C883

ARS national research programs for bioenergy and biobased products. Agricultural research.

<http://www.ars.usda.gov/is/AR/archive/apr07/research0407.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: Agricultural Research Service ; research programs ; biobased products ; bioenergy ; renewable energy sources ; United States

Sanderson, M.A., Martin, N.P., Adler, P. Biomass, energy, and industrial uses of forages. *Forages: the science of grassland agriculture / under the editorial authorship of Robert F. Barnes ... [et al.] ; with 94 contributing authors.* Ames, Iowa: Blackwell, c2007.

CALL NUMBER: DNAL SB193 .F65 2007

DESCRIPTORS: forage crops ; forage production ; crop yield ; cultivars ; genetic variation ; energy resources ; biofuels ; energy conversion ; nonfood products ; industrial applications ; literature reviews ; United States ; Europe

Peabody, E. Breaking down walls. *Agricultural research*. 2007 Apr., v. 55, no. 4: p. 4-7.

<http://www.ars.usda.gov/is/AR/archive/apr07/walls0407.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: cell wall components ; cell walls ; biofuels ; lignin ; cellulose ; hemicellulose ; lignification ; low input agriculture ; grasses ; alfalfa ; *Medicago sativa* ; biomass ; *Panicum virgatum* ; *Cynodon dactylon* ; *Paspalum notatum* ; *Pennisetum purpureum* ; *Pennisetum glaucum*

Dailey, Oliver D. Jr., Prevost, Nicolette Conversion of Methyl Oleate to Branched-Chain Derivatives. *Journal of the American Oil Chemists' Society*. Berlin/Heidelberg: Springer-Verlag, 2007 June, v. 84, no. 6: p. 565-571.

<http://hdl.handle.net/10113/2927>

<http://dx.doi.org/10.1007/s11746-007-1077-x>

ABSTRACT: Studies were conducted in the synthetic conversion of oleic acid to mid-chain branched fatty acids. Methyl oleate was brominated in the allylic positions. Reaction of the allylic bromides with lithium dimethylcuprate gave primarily the desired branched-chain derivatives (93% of product mixture). The product had a significantly lower crystallization temperature in comparison with methyl oleate. Reaction of the allylic bromides with lithium di-n-butylcuprate or lithium di-sec-butylcuprate also gave branched-chain derivatives, but in this instance there was the

complication of attack on the ester functionality in the fashion of a Grignard reagent. Details of the syntheses and the properties of the products (with emphasis on low-temperature properties) are discussed.

CALL NUMBER: DNAL 307.8 J82

DESCRIPTORS: vegetable oil ; oleic acid ; methylation ; branched chain fatty acids ; bromination ; chemical analysis ; chemical structure ; spectral analysis ; biodiesel

Moser, Bryan R., Sharma, Brajendra K., Doll, Kenneth M., Erhan, Sevim Z. Diesters from Oleic Acid: Synthesis, Low Temperature Properties, and Oxidation Stability. *Journal of the American Oil Chemists' Society*.

Berlin/Heidelberg: Springer-Verlag, 2007 July, v. 84, no. 7: p. 675-680.

<http://hdl.handle.net/10113/2800>

<http://dx.doi.org/10.1007/s11746-007-1083-z>

ABSTRACT: Several diesters were prepared from commercially available oleic acid and common organic acids. The key step in the three step synthesis of oleo chemical diesters entails a ring opening esterification of alkyl 9,10-epoxyoctadecanoates (alkyl: propyl, isopropyl, octyl, 2-ethylhexyl) using propionic and octanoic acids without the need for either solvent or catalyst. Each synthetic diester was evaluated for both low temperature operability and oxidation stability through measurement of cloud point, pour point, oxidation onset temperature, and signal maximum temperature. It was discovered that increasing chain length of the mid-chain ester and branching in the end-chain ester had a positive influence on the low temperature properties of diesters. Improved oxidation stability is achieved when the chain length of the mid-chain ester is decreased. Additionally, the mid-chain ester plays a larger role in oxidation stability than the end-chain ester. These products may prove useful in the search for bio-based industrial materials, such as lubricants, surfactants, and fuel additives.

CALL NUMBER: DNAL 307.8 J82

DESCRIPTORS: vegetable oil ; soybean oil ; esters ; oleic acid ; oxidation ; structure-activity relationships ; biodiesel

Follett, R.F. Economic and societal benefits of soil carbon management: cropland and grazing land systems

Soil carbon management: economic, environmental and societal benefits / edited by J.M. Kimble ... [et al.].

Boca Raton, FL: CRC Press, c2007. p. 99-128.,

<http://hdl.handle.net/10113/3655>

CALL NUMBER: DNAL S592.6.C35 S64 2007

DESCRIPTORS: oil organic carbon ; pastures ; rangelands ; agricultural land ; carbon sequestration ; grazing ; land use ; history ; economic impact ; social benefit ; crop yield ; crop production ; crop residues ; biofuels ; cover crops ; cattle manure ; literature reviews ; United States

Baker, A., Zahmiser, S. Ethanol Reshapes the Corn Market. *Amber waves: the economics of food, farming, natural resources, and rural America*. 2007 May

<http://www.ers.usda.gov/AmberWaves/May07SpecialIssue/Features/Ethanol.htm>

CALL NUMBER: DNAL aHD1751 .A52

DESCRIPTORS: agricultural policy ; Zea mays ; corn ; crop production ; ethanol ; biofuels ; commodity prices ; commodity exchange ; cellulose ; energy costs ; renewable energy sources ; distillers grains ; new technology ; research and development ; United States

Moser, B.R., Haas, M.J., Winkler, J.K., Jackson, M.A., Erhan, S.Z., List, G.R. Evaluation of partially hydrogenated methyl esters of soybean oil as biodiesel. *European journal of lipid science and technology*. 2007 Jan., v. 109, issue 1: p. 17-24.

<http://hdl.handle.net/10113/3240> ; <http://dx.doi.org/10.1002/ejlt.200600215>

ABSTRACT: Biodiesel, an alternative fuel derived from vegetable oils or animal fats, continues to undergo rapid worldwide growth. Specifications mandating biodiesel quality, most notably in Europe (EN 14214) and the USA (ASTM D6751), have emerged that limit feedstock choice in the production of biodiesel fuel. For instance, EN 14214 contains a specification for iodine value (IV; 120 g I<sub>2</sub>/100 g maximum) that eliminates soybean oil as a potential feedstock, as it generally has an IV >120. Therefore, partially hydrogenated soybean oil methyl esters (PHSME; IV = 116) were evaluated as biodiesel by measuring a number of fuel properties, such as oxidative stability, low-temperature performance, lubricity, kinematic viscosity, and specific gravity. Compared to soybean oil methyl esters (SME), PHSME were found to have superior oxidative stability, similar specific gravity, but inferior low-temperature performance, kinematic viscosity, and lubricity. The kinematic viscosity and lubricity of PHSME, however, were within the prescribed US and European limits. There is no universal value for low-temperature performance in biodiesel specifications, but PHSME have superior cold flow behavior when compared to other alternative feedstock fuels, such as palm oil, tallow and grease methyl esters. The production of PHSME from refined soybean oil would increase biodiesel production costs by US\$ 0.04/L (US\$ 0.15/gal) in comparison to SME. In summary, PHSME are

within both the European and American standards for all properties measured in this study and deserve consideration as a potential biodiesel fuel.

CALL NUMBER: DNAL TP670 .F472

DESCRIPTORS: vegetable oil ; soybean oil ; esters ; hydrogenation ; biodiesel ; physicochemical properties ; oxidative stability ; chemical composition ; fatty acid composition ; gas chromatography ; spectral analysis ; viscosity ; differential scanning calorimetry

Crooks, A. Evolving technology may generate profit from biodiesel glycerin glut. *Rural cooperatives*. 2007 July-Aug, v. 74, no. 4: p. 30-32, 37.

<http://www.rurdev.usda.gov/rbs/pub/jul07/jul07.pdf>

CALL NUMBER: DNAL aHD1491.U6R87

McGinnis, L. Fueling America--without petroleum. *Agricultural Research*. 2007 Apr., v. 55, no. 4: p. 10-13.

<http://www.ars.usda.gov/is/AR/archive/apr07/petro0407.htm>

Suszkiw, J., Wood, M. Genetic snapshots help brighten switchgrass's future. *Agricultural research*. 2007 Apr., v. 55, no. 4: p. 14-15.

<http://www.ars.usda.gov/is/AR/archive/apr07/grass0407.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: *Panicum virgatum* ; bioenergy ; plant genetics ; messenger RNA ; complementary DNA ; nucleotide sequences ; sequence analysis

Johnson, J.M.F., Sharratt, B.S., Reicosky, D.C., Lindstrom, M. Impact of High-Lignin Fermentation Byproduct on Soils with Contrasting Organic Carbon Content. *Soil Science Society of America journal*. 2007 July-Aug, v. 71, no. 4: p. 1151-1159.

<http://hdl.handle.net/10113/1928> ; <http://dx.doi.org/10.2136/sssaj2006.0172>

ABSTRACT: Agricultural biomass is a potential renewable biofuel that may partially replace nonrenewable fossil fuels. Corn Stover is rich in cellulose and hemicellulose, both of which can be converted to sugars and fermented to ethanol. This fermentation process results in a high-lignin fermentation byproduct (HLFB) that could be converted to energy products or used as a soil amendment. We had two objectives: (i) to determine whether HLFB (0.1, 1.0, or 10 kg m<sup>-2</sup>) could improve soil properties in two soils with contrasting levels of soil organic carbon (SOC); and (ii) to assess the impact of HLFB on crop growth. These goals were addressed with separate experiments. In the soil experiment, two soils were amended with HLFB or ground corn (*Zea mays* L.) stover and then incubated in pots for 118 d. Flux of CO<sub>2</sub> was monitored and soil properties were measured after incubation. In the plant experiment, corn and soybean [*Glycine max* (L.) Merr.] were grown in pots, without amendment or amended with 1.0 kg m<sup>-2</sup> corn stover or 1.0 kg m<sup>-2</sup> HLFB. The soil experiment indicated that the addition of 10 kg m<sup>-2</sup> HLFB increased CO<sub>2</sub> emission, humic acid concentration, and water-stable aggregates, and decreased bulk density (Db). No adverse impacts on crop growth were measured when HLFB was applied at a rate of 1.0 kg m<sup>-2</sup>. Much of the HLFB may be used by the energy industry, but perhaps a percentage could be returned to the field to reduce the impact of corn stover removal on soil C.

CALL NUMBER: DNAL 56.9 So3

DESCRIPTORS: lignin ; fermentation ; corn ; *Zea mays* ; soybeans ; *Glycine max* ; carbon dioxide ; gas emissions ; humic acids ; soil aggregates ; bulk density ; plant growth ; crop production ; biofuels ; soil organic carbon ; corn stover ; crop residues ; soil properties

Jordan, D.B., Braker, J.D. Inhibition of the two-subsite  $\beta$ -D-xylosidase from *Selenomonas ruminantium* by sugars: Competitive, noncompetitive, double binding, and slow binding modes. *Archives of biochemistry and biophysics* ABB. 2007 Sept., v. 465, issue 1: p. 231-246.

<http://hdl.handle.net/10113/3178> ; <http://dx.doi.org/10.1016/j.abb.2007.05.016>

ABSTRACT: The active site of the GH43 $\beta$ -xylosidase from *Selenomonas ruminantium* comprises two subsites and a single access route for ligands. Steady-state kinetic experiments that included enzyme (E), inhibitory sugars (I and X) and substrate (S) establish examples of EI, EII, EIX, and EIS complexes. Protonation states of catalytic base (D14, pK<sub>a</sub> 5) and catalytic acid (E186, pK<sub>a</sub> 7) govern formation of inhibitor complexes and strength of binding constants: e.g., EII, EIX, and EIS occur only with the D14-E186H enzyme and d-xylose binds to D14-E186- better than to D14-E186H. Binding of two equivalents of l-arabinose to the D14-E186H enzyme is differentiated by the magnitude of equilibrium K<sub>i</sub> values (first binds tighter) and kinetically (first binds rapidly; second binds slowly). In applications, such as saccharification of herbaceous biomass for subsequent fermentation to biofuels, the highly efficient hydrolase

can confront molar concentrations of sugars that diminish catalytic effectiveness by forming certain enzyme-inhibitor complexes.

CALL NUMBER: DNAL 381 Ar2

DESCRIPTORS: Selenomonas ruminantium ; xylan 1,4-beta-xylosidase ; alpha-N-arabinofuranosidase ; active sites ; enzyme kinetics ; enzyme activity ; sugars ; glycosides ; arabinose ; enzyme inhibitors

Ash, M., Dohlman, E. International Trade, Biofuel Initiatives Reshaping the Soybean Sector. Amber waves: the economics of food, farming, natural resources, and rural America. 2007 May.

<http://www.ers.usda.gov/AmberWaves/May07SpecialIssue/Findings/International.htm>

CALL NUMBER: DNAL aHD1751 .A52

DESCRIPTORS: agricultural policy ; soybeans ; international trade ; trade policy ; market prices ; biofuels ; United States

Adler, P.R., Del Grosso, S.J., Parton, W.J. Life-cycle assessment of net greenhouse-gas flux for bioenergy cropping systems. Ecological applications: a publication of the Ecological Society of America. 2007 Apr., v. 17, no. 3: p. 675-691.

<http://hdl.handle.net/10113/7752>

ABSTRACT: Bioenergy cropping systems could help offset greenhouse gas emissions, but quantifying that offset is complex. Bioenergy crops offset carbon dioxide emissions by converting atmospheric CO<sub>2</sub> to organic C in crop biomass and soil, but they also emit nitrous oxide and vary in their effects on soil oxidation of methane. Growing the crops requires energy (e.g., to operate farm machinery, produce inputs such as fertilizer) and so does converting the harvested product to usable fuels (feedstock conversion efficiency). The objective of this study was to quantify all these factors to determine the net effect of several bioenergy cropping systems on greenhouse-gas (GHG) emissions. We used the DAYCENT biogeochemistry model to assess soil GHG fluxes and biomass yields for corn, soybean, alfalfa, hybrid poplar, reed canarygrass, and switchgrass as bioenergy crops in Pennsylvania, USA. DAYCENT results were combined with estimates of fossil fuels used to provide farm inputs and operate agricultural machinery and fossil-fuel offsets from biomass yields to calculate net GHG fluxes for each cropping system considered. Displaced fossil fuel was the largest GHG sink, followed by soil carbon sequestration. N<sub>2</sub>O emissions were the largest GHG source. All cropping systems considered provided net GHG sinks, even when soil C was assumed to reach a new steady state and C sequestration in soil was not counted. Hybrid poplar and switchgrass provided the largest net GHG sinks, >200 g CO<sub>2</sub>e-C-m<sup>-2</sup>-yr<sup>-1</sup> for biomass conversion to ethanol, and >400 g CO<sub>2</sub>e-C-m<sup>-2</sup>-yr<sup>-1</sup> for biomass gasification for electricity generation. Compared with the life cycle of gasoline and diesel, ethanol and biodiesel from corn rotations reduced GHG emissions by 40%, reed canarygrass by 85%, and switchgrass and hybrid poplar by 115%.

CALL NUMBER: DNAL QH540.E23

DESCRIPTORS: biogeochemical cycles ; biofuels ; crop production ; crop yield ; biomass ; Zea mays ; Glycine max ; Medicago sativa ; Populus ; Panicum virgatum ; Phalaris arundinacea ; crop rotation ; greenhouse gases ; gas emissions ; simulation models ; mathematical models ; gas exchange ; nitrous oxide ; cropping systems ; soil organic matter ; carbon sequestration ; Pennsylvania

Pitman, L. Renewable fuels industry rife with opportunity for co-ops. Rural cooperatives. 2007 Jan-Feb, v. 74, no. 1: p. 18-21, 41.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; renewable energy sources ; biofuels ; United States

Crooks, A. Shouldering the risk. Rural cooperatives. 2007 May-June, v. 74, no. 3: p. 14-18, 40.

<http://www.rurdev.usda.gov/rbs/pub/may07/may07.pdf>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cellulose ; cooperatives ; ethanol ; biofuels ; risk assessment ; risk management ; United States

Doll, K.M., Moser, B.R., Erhan, S.Z. Surface Tension Studies of Alkyl Esters and Epoxidized Alkyl Esters Relevant to Oleochemically Based Fuel Additives. Energy & fuels. 2007 Sept., v. 21, no. 5: p. 3044-3048.

<http://hdl.handle.net/10113/6165> ; <http://dx.doi.org/10.1021/ef700213z>

ABSTRACT: There are several reports on the synthesis of fuel additives based on oleochemical esters, and physical data on some of these compounds is lacking. Herein, we report the surface tension of several epoxidized oleochemicals and their comparable fatty esters, at temperatures between 25 and 60 °C. Surface tensions of the olefins measured at 40 °C range from 25.9 mN m<sup>-1</sup>, for isobutyl oleate, to 28.4 mN m<sup>-1</sup> for methyl linoleate. The epoxy versions of the same compounds displayed higher surface tensions of 28.1 and 32.1 mN m<sup>-1</sup>, respectively. Branched ester compounds also



had surface tensions between 27.4 and 30.2 mN m<sup>-1</sup>. Several trends and observations were elucidated. More epoxidation or unsaturation leads to higher surface tension. Epoxidation has a larger effect on surface tension than unsaturation. Linear alkyl head groups on fatty esters have similar surface tensions, but branched head groups gave slightly lower surface tensions. Soy methyl esters, or epoxy soy methyl esters, give surface tensions which are between that of their two main components. Overall, the results show that all of these compounds have surface tensions which make them suitable for use as biofuel additives.

CALL NUMBER: DNAL TP315

DESCRIPTORS: Glycine max ; soybeans ; biofuels ; renewable resources ; esters ; epoxides ; oleic acid ; surface tension ; physical properties

Suszkiw, J. We Reap What We Sow. *Agricultural research*. 2007 July, v. 55, no. 6: p. 12-13.

<http://hdl.handle.net/10113/2424> ; <http://www.ars.usda.gov/is/AR/archive/jul07/sow0707.pdf>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: agricultural research ; Agricultural Research Service ; cost benefit analysis ; corn stover ; bioenergy ; ethanol production ; renewable energy sources ; soil conservation ; agricultural management ; radiation use efficiency ; United States

Stanturf, J. Worldwide Benefits of Short-Rotation Woody Crops. *Compass: recent publications of the Southern Research Station*. 2007 Mar., issue 8: p. 8-11.

<http://www.srs.fs.usda.gov/compass/issue8/issue8.pdf>

CALL NUMBER: DNAL aSD11 .U55

DESCRIPTORS: agroforestry ; Populus ; woody plants ; trees ; phytoremediation ; bioenergy ; biofuels ; land restoration ; soil stabilization

Knothe, Gerhard. Analyzing biodiesel: standards and other methods. *Journal of the American Oil Chemists' Society*. Berlin/Heidelberg: Springer-Verlag. 2006 Oct., v. 83, no. 10: p. 823-833.

<http://dx.doi.org/10.1007/s11746-006-5033-y>

ABSTRACT: Biodiesel occupies a prominent position among the alternatives to conventional petrodiesel fuel owing to various technical and economic factors. It is obtained by reacting the parent vegetable oil or fat with an alcohol ( transesterification) in the presence of a catalyst to give the corresponding monoalkyl esters, which are defined as biodiesel. Because of the nature of the starting material, the production process, and subsequent handling, various factors can influence biodiesel fuel quality. Fuel quality issues are commonly reflected in the contaminants or other minor components of biodiesel. This work categorizes both the restricted species in biodiesel and the physical properties prescribed by the standards, and details the standard reference methods to determine them as well as other procedures. Other aspects of biodiesel analysis, including production monitoring and assessing biodiesel/petrodiesel blends, are also addressed. The types of analyses include chromatographic, spectroscopic, physical properties-based, and wet chemical methods. The justifications for specifications in standards are also addressed.

CALL NUMBER: DNAL 307.8 J82

Adler, P.R., Sanderson, M.A., Boateng, A.A., Weimer, P.J., Jung, H.J.G. Biomass Yield and Biofuel Quality of Switchgrass Harvested in Fall or Spring. *Agronomy journal*. 2006 Nov-Dec, v. 98, no. 6: p. 1518-1525.

<http://hdl.handle.net/10113/3966> ; <http://dx.doi.org/10.2134/agronj2005.0351>

ABSTRACT: Seasonal time of switchgrass (*Panicum virgatum* L.) harvest affects yield and biofuel quality and balancing these two components may vary depending on conversion system. A field study compared fall and spring harvest measuring biomass yield, element concentration, carbohydrate characterization, and total synthetic gas production as indicators of biofuel quality for direct combustion, ethanol production, and gasification systems for generation of energy. Switchgrass yields decreased almost 40% (from about 7-4.4 Mg ha<sup>-1</sup>) in winters with above average snowfall when harvest was delayed over winter until spring. The moisture concentration also decreased (from about 350-70 g kg<sup>-1</sup>) only reaching low enough levels for safe storage by spring. About 10% of the yield reduction during winter resulted from decreases in tiller mass; however, almost 90% of the yield reduction was due to an increase in biomass left behind by the baler. Mineral element concentrations generally decreased with the delay in harvest until spring. Energy yield from gasification did not decrease on a unit biomass basis, whereas ethanol production was variable depending on the assessment method. When expressed on a unit area basis, energy yield decreased. Biofuel conversion systems may determine harvest timing. For direct combustion, the reduced mineral concentrations in spring-harvested biomass are desirable. For ethanol fermentation and gasification systems, however, lignocellulose yield may be more important. On conservations lands, the wildlife cover provided by switchgrass over the winter may increase the desirability of spring harvest along with the higher biofuel quality.

CALL NUMBER: DNAL 4 AM34P

DESCRIPTORS: Panicum virgatum ; crop production ; crop yield ; harvest date ; spring ; autumn ; crop quality ; overwintering ; biofuels ; ethanol production ; energy content ; energy conversion ; gasification ; Pennsylvania

Blanco-Canqui, H., Lal, R., Post, W.M., Owens, L.B. Changes in Long-Term No-Till Corn Growth and Yield under Different Rates of Stover Mulch. *Agronomy journal*. 2006 July-Aug, v. 98, no. 4: p. 1128-1136.

<http://hdl.handle.net/10113/3615> ; <http://dx.doi.org/10.2134/agronj2006.0005>

ABSTRACT: Removal of corn (*Zea mays* L.) stover for biofuel production may affect crop yields by altering soil properties. A partial stover removal may be feasible, but information on appropriate rates of removal is unavailable. We assessed the short-term impacts of stover management on long-term no-till (NT) continuous corn grown on a Rayne silt loam (fine loamy, mixed, active, mesic Typic Hapludults) at Coshocton, Hoytville clay loam (fine, illitic, mesic Mollic Epiaqualfs) at Hoytville, and Celina silt loam (fine, mixed, active, mesic Aquic Hapludalfs) at South Charleston in Ohio, and predicted corn yield from soil properties using principal component analysis (PCA). The study was conducted in 2005 on the ongoing experiments started in May 2004 under 0 (T0), 25 (T25), 50 (T50), 75 (T75), 100 (T100), and 200 (T200)% of stover corresponding to 0, 1.25, 2.50, 3.75, 5.00, and 10.00 Mg ha<sup>-1</sup> of stover, respectively. Stover removal promoted early emergence and rapid seedling growth ( $P < 0.01$ ). Early-emerging plants grew taller than late-emerging plants up to about 50 d, and then the heights reversed at Coshocton and were comparable at other two sites. Stover management affected corn yield only at the Coshocton site where average grain and stover yields in the T200, T100, T75, and T50 (10.8 and 10.3 Mg ha<sup>-1</sup>) were higher than those in the T0 and T25 treatments (8.5 and 6.5 Mg ha<sup>-1</sup>) ( $P < 0.01$ ), showing that stover removal at rates as low as 50% (2.5 Mg ha<sup>-1</sup>) decreased crop yields. Soil properties explained 71% of the variability in grain yield and 33% of the variability in stover yield for the Coshocton site. Seventeen months after the start of the experiment, effects of stover management on corn yield and soil properties were site-specific.

CALL NUMBER: DNAL 4 AM34P

DESCRIPTORS: Zea mays ; corn ; no-tillage ; plant growth ; grain yield ; corn stover ; crop residue management ; long term experiments ; biofuels ; soil fertility ; principal component analysis ; seedling emergence ; seedling growth ; height ; geographical variation ; application rate ; Ohio

Dien, B.S., Jung, H.J.G., Vogel, K.P., Casler, M.D., Lamb, J.F.S., Iten, L., Mitchell, R.B., Sarath, G. Chemical composition and response to dilute-acid pretreatment and enzymatic saccharification of alfalfa, reed canarygrass, and switchgrass. *Biomass and bioenergy*. 2006 Oct., v. 30, issue 10: p. 880-891.

<http://hdl.handle.net/10113/982> ; <http://dx.doi.org/10.1016/j.biombioe.2006.02.004>

ABSTRACT: Alfalfa stems, reed canarygrass, and switchgrass; perennial herbaceous species that have potential as biomass energy crops in temperate regions; were evaluated for their bioconversion potential as energy crops. Each forage species was harvested at two or three maturity stages and analyzed for carbohydrates, lignin, protein, lipid, organic acids, and mineral composition. The biomass samples were also evaluated for sugar yields following pretreatment with dilute sulfuric followed by enzymatic saccharification using a commercial cellulose preparation. Total carbohydrate content of the plants varied from 518 to 655 g kg<sup>-1</sup> dry matter (DM) and cellulose concentration from 209 to 322 g kg<sup>-1</sup> DM. Carbohydrate and lignin contents were lower for samples from early maturity samples compared to samples from late maturity harvests. Several important trends were observed in regards to the efficiency of sugar re-recovery following treatments with dilute acid and cellulase. First, a significant amount of the available carbohydrates were in the form of soluble sugars and storage carbohydrates (4.3-16.3% wt/wt). Recovery of soluble sugars following dilute acid pretreatment was problematic, especially that of fructose. Fructose was found to be extremely labile to the dilute acid pretreatments. Second, the efficiency at which available glucose was recovered was inversely correlated to maturity and lignin content. However, total glucose yields were higher for the later maturities because of higher cellulose contents compared to the earlier maturity samples. Finally, cell wall polysaccharides, as determined by the widely applied detergent fiber system were found to be inaccurate. The detergent fiber method consistently over-estimated cellulose and hemicellulose and underestimated lignin by substantial amounts.

CALL NUMBER: DNAL TP360

DESCRIPTORS: crop residues ; stems ; Medicago sativa ; Phalaris arundinacea ; Panicum virgatum ; biomass ; cell wall components ; cellulose ; polysaccharides ; acid treatment ; sulfuric acid ; enzymatic treatment ; cellulases ; saccharification ; sugars ; glucose ; monosaccharides ; yields

Thompson, S.A. Co-op rendering operation yields biodiesel & more. *Rural cooperatives*. 2006 Mar-Apr, v. 73, no. 2: p. 21-22.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; rendering ; biofuels ; business management ; Minnesota



Blanco-Canqui, H., Lal, R., Post, W.M., Izaurralde, R.C., Owens, L.B. Corn stover impacts on near-surface soil properties of no-till corn in Ohio. *Soil Science Society of America journal*. 2006 Jan-Feb, v. 70, no.: p. 266-278. <http://hdl.handle.net/10113/4136>

ABSTRACT: Corn (*Zea mays* L.) stover is a primary biofuel feedstock and its expanded use could help reduce reliance on fossil fuels and net CO<sub>2</sub> emissions. Excessive stover removal may, however, negatively impact near-surface soil properties within a short period after removal. We assessed changes in soil crust strength, bulk density ( $\rho(b)$ ), and water content over a 1-yr period following a systematic removal or addition of stover from three no-till soils under corn in Ohio. Soils from ongoing experiments at the North Appalachian Experimental Watershed (NAEW), Western Agricultural Experiment Station (WAES), and Northwestern Agricultural Experiment Station (NWAES) of Ohio Agricultural Research and Development Center (OARDC) were studied. Six stover treatments of 0 (T0), 25 (T25), 50 (T50), 75 (T75), 100 (T100), and 200 (T200)% were imposed on 3 by 3 m plots corresponding to 0, 1.25, 2.50, 3.75, 5.00, and 10.00 Mg ha<sup>-1</sup> of stover, respectively. Cone index (CI), shear strength (SHEAR),  $\rho(b)$ , and volumetric water content ( $\theta(v)$ ) were measured monthly from June through December 2004 and in May 2005. Effects of stover removal on increasing CI and SHEAR were soil-specific. Stover removal consistently increased  $\rho(b)$  and decreased  $\theta(v)$  across soils ( $P < 0.01$ ). Compared with the normal stover treatment (T100), doubling the amount of stover (T200) did not significantly affect soil properties except  $\theta(v)$  where, after 1 yr, T200 increased  $\theta(v)$  by 1.3 to 1.6 times compared with T100 across all sites ( $P < 0.05$ ). After 1 yr, complete stover removal (T0) increased CI by 1.4 times and SHEAR by 1.3 times at NAEW compared with T100 and T75, but CI increases at other sites were nonsignificant. At NWAES, T0 increased SHEAR by 26% compared with T100 ( $P < 0.05$ ). The T0 decreased  $\theta(v)$  by two to four times except in winter months and increased  $\rho(b)$  by about 10% compared with T100 ( $P < 0.05$ ). In a short-term test, stover removal resulted in increased soil crust strength and reduced soil water content.

CALL NUMBER: DNAL 56.9 So3

DESCRIPTORS: *Zea mays* ; corn stover ; silt loam soils ; clay loam soils ; soil crusts ; bulk density ; soil water content ; no-tillage ; Ohio

Nichols, N.N. ; Lopez, M.J. ; Dien, B.S. ; Bothast, R.J. Culture containing biomass acid hydrolysate and *Coniochaeta ligniaria* fungus. United States Department of Agriculture patents. 2006 June 27, no. US 7,067,303 B1; 11 p.

<http://hdl.handle.net/10113/6942>

ABSTRACT: Agricultural biomass hydrolysate is detoxified by culturing in the presence of the fungus *Coniochaeta ligniaria* (teleomorph) or its *Lecythophora* (anamorph) state. This organism is capable of significantly depleting the toxicant levels of furans, particularly furfural and 5-hydroxymethylfurfural. A new strain of the fungus has been isolated and deposited in the Agricultural Research Culture Collection (NRRL) in Peoria, Ill., as Accession No. NRRL 30616. The detoxified agricultural biomass hydrolysate is useful as a substrate for industrial fermentation processes, especially in saccharification treatments for bioethanol production.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: waste utilization ; plant residues ; hydrolysis ; hydrolysates ; decontamination ; furans ; biodegradation ; fungi ; ethanol production ; cellulolytic microorganisms ; biomass ; biofuels ; patents ; USDA ; United States

SUBJECT: *Coniochaeta ligniaria* ; *Lecythophora* ; AgSpace

Schmer, M.R. ; Vogel, K.P. ; Mitchell, R.B. ; Moser, L.E. ; Eskridge, K.M. ; Perrin, R.K. Establishment stand thresholds for switchgrass grown as a bioenergy crop. *Crop science*. 2006 Jan-Feb, v. 46, no. 1; p. 157-161.

<http://hdl.handle.net/10113/3534>

ABSTRACT: Switchgrass (*Panicum virgatum* L.) is a warm-season (C<sub>4</sub>) perennial grass and a potential bioenergy crop. On-farm switchgrass field scale trials, which were initiated to obtain economic production information for switchgrass grown as a bioenergy crop in the northern Plains, provided information on establishment year stands and post-establishment year yields and stands both within and across fields and were used to determine if a stand threshold exists for switchgrass grown as a biomass energy crop. Switchgrass was seeded in 10 cropland fields, ranging in size from 3 to 9.5 ha, in Nebraska, South Dakota, and North Dakota in 2000 and 2001. The fields were selected to be representative of their region and eligible for the Conservation Reserve Program (CRP). Twelve sites within each field were geo-referenced, and switchgrass stand frequency was measured at each sample site. Biomass yields were estimated in late summer at the same within-field sites using a clipped quadrat. Fields with low initial switchgrass stand frequencies showed a linear relationship between initial switchgrass stands and second year stands and biomass yields. Results from the 10 field, three-state study indicated that establishment year stand frequency level of 40% or greater, determined by a frequency grid, can be considered an establishment year stand threshold for establishment success and subsequent post-planting year biomass yields for switchgrass. An establishment year stand frequency of 25% would be adequate for a switchgrass conservation planting in which no harvests would be planned for several years.

1022647867

CALL NUMBER: DNAL 64.8 C883

DESCRIPTORS: Panicum virgatum ; biofuels ; grasses ; plant establishment ; plant density ; crop yield ; biomass ; plant adaptation ; Nebraska ; South Dakota ; North Dakota

SUBJECT: establishment year ; stand frequency ; establishment stand threshold ; AgSpace

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Zhan, X. ; Wang, D. ; Bean, S.R. ; Mo, X. ; Sun, X.S. ; Boyle, D. Ethanol production from supercritical-fluid-extrusion cooked sorghum. *Industrial crops and products*. 2006 May, v. 23, issue 3; p. 304-310.

<http://hdl.handle.net/10113/4339> ; <http://dx.doi.org/10.1016/j.indcrop.2005.09.001>

ABSTRACT: Sorghum (*Sorghum bicolor* (L.) Moench) is a starch-rich grain similar to maize (*Zea mays* L.), but sorghum has been underutilized for biobased products and bioenergy. This study was designed to investigate the effects of supercritical-fluid-extrusion (SCFX) of sorghum on ethanol production. Morphology, chemical composition, and thermal properties of extruded sorghum were characterized. Analysis of extruded sorghum showed increased measurable starch content, free sugar content, and high levels of gelatinized starch. SCFX cooked and non-extruded sorghum were further liquefied, saccharified, and fermented to ethanol by using *Saccharomyces cerevisiae*. The ethanol yield increased as sorghum concentration increased from 20 to 40% for both extruded and non-extruded sorghum. Ethanol yields

CALL NUMBER: DNAL SB13.I52

DESCRIPTORS: grain sorghum ; ethanol production ; fuel production ; ethanol ; supercritical fluid extraction ; cooking ; biofuels ; extrusion ; chemical composition ; thermal properties ; starch ; sugar content ; starch gels ; alcoholic fermentation ; *Saccharomyces cerevisiae* ; processing technology

SUBJECT: supercritical fluid extrusion ; AgSpace

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Baker, A. ; Zahniser, S. Ethanol reshapes the corn market. *Amber waves: the economics of food, farming, natural resources, and rural America*. 2006 Apr., v. 4, no. 2; p. 30-35.

<http://purl.access.gpo.gov/GPO/LPS27344>

CALL NUMBER: DNAL aHD1751 .A52

DESCRIPTORS: *Zea mays* ; corn ; crop production ; ethanol ; biofuels ; commodity prices ; commodity exchange ; cellulose ; energy costs ; renewable energy sources ; distillers grains ; new technology ; research and development

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Campbell, D. A farm-supply co-op view of ethanol. *Rural cooperatives*. 2006 Sept-Oct, v. 73, no. 5; p. 8-9.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: ethanol ; cooperatives ; corn ; biofuels ; Missouri

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Campbell, D. Fuel farming. *Rural cooperatives*. 2006 Sept-Oct, v. 73, no. 5; p. 4-7, 39.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: ethanol ; corn ; ethanol production ; Missouri

SUBJECT: energy crops ; Internet resource

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Ash, M. ; Dohlgan, E. International trade, biofuel initiatives reshaping the soybean sector.

*Amber waves: the economics of food, farming, natural resources, and rural America*. 2006 Sept., v. 4, no. 4; p. 8.

<http://purl.access.gpo.gov/GPO/LPS27344>

CALL NUMBER: DNAL aHD1751 .A52

DESCRIPTORS: soybeans ; international trade ; trade policy ; market prices ; biofuels ; United States

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Ganesan, V. ; Rosentrater, K.A. ; Muthukumarappan, K. Methodology to Determine Soluble Content in Dry Grind Ethanol Coproduct Streams. *Applied engineering in agriculture*. 2006 Nov., v. 22, no. 6; p. 899-903.

<http://hdl.handle.net/10113/1925>

ABSTRACT: Distillers grains and syrup are coproducts from fuel ethanol dry grind processing. Ethanol manufacturing is dramatically increasing in the United States, primarily in Midwestern states, and thus the availability of these feed products is also growing. Confusion currently exists in industrial nomenclature regarding "solubles" in these streams because no standards are in place. In our study, dissolved materials were considered soluble matter. We developed a methodology to determine the dry basis soluble content in condensed distillers solubles (CDS) and distillers dried grains with solubles (DDGS). A mass balance analytical approach was initially used, but results were not in good agreement with experimental data. This method was thus deemed a poor predictor of final soluble content. This led to the development of a new methodology for determining, as well as predicting, soluble content for various coproduct

streams, which produced results with  $R^2 > 0.96$ . This approach is applicable for all dry grind ethanol coproduct streams and is useful for value-added product development research.

CALL NUMBER: DNAL S671.A66

DESCRIPTORS: distillers grains ; proximate composition ; dry matter content ; syrups ; biomass ; solubility ; plant byproducts ; chemical analysis

SUBJECT: distillers dried grains with solubles ; condensed distillers solubles ; dry basis soluble content ; mass balance ; AgSpace

Kwiatkowski, J.R. ; McAloon, A.J. ; Taylor, F. ; Johnston, D.B. Modeling the process and costs of fuel ethanol production by the corn dry-grind process. *Industrial crops and products*. 2006 May, v. 23, issue 3; p. 288-296.

<http://hdl.handle.net/10113/4338> ; <http://dx.doi.org/10.1016/j.indcrop.2005.08.004>

ABSTRACT: The corn dry-grind process is the most widely used method in the U.S. for generating fuel ethanol by fermentation of grain. Increasing demand for domestically produced fuel and changes in the regulations on fuel oxygenate have led to increased production of ethanol mainly by the dry-grind process. Fuel ethanol plants are being commissioned and constructed at an unprecedented rate based on this demand, though a need for a more efficient and cost-effective plant still exists. A process and cost model for a conventional corn dry-grind processing facility producing 119 million kg/year (40 million gal/year) of ethanol was developed as a research tool for use in evaluating new processing technologies and products from starch-based commodities. The models were developed using SuperPro Designer® software and they handle the composition of raw materials and products, sizing of unit operations, utility consumptions, estimation of capital and operating costs, and there venues from products and coproducts. The model is based on data gathered from ethanol producers, technology suppliers, equipment manufacturers, and engineers working in the industry. Intended applications of this model including Descriptors: evaluating existing and new grain conversion technologies, determining the impact of alternate feedstocks, and sensitivity analysis of key economic factors. In one sensitivity analysis, the cost of producing ethanol increased from US\$ 0.235 l-1 to US\$0.365 l-1 (US\$ 0.89 gal-1 to US\$ 1.38 gal-1) as the price of corn increased from US\$ 0.071 kg-1 to US\$ 0.125kg-1 (US\$ 1.80 bu-1 to US\$ 3.20 bu-1). Another example gave a reduction from 151 to 140 million l/year as the amount of starch in the feed was lowered from 59.5% to 55% (w/w). This model is available on request from the authors for non-commercial research and educational use to show the impact on ethanol production costs of changes in the process and coproducts of the ethanol from starch process.

CALL NUMBER: DNAL SB13.I52

DESCRIPTORS: ethanol ; ethanol production ; fuel production ; dry milling ; factories ; corn ; process control ; simulation models ; cost analysis ; processing technology ; computer software ; raw materials ; chemical composition ; profitability ; plant byproducts

SUBJECT: coproducts ; AgSpace

Robertson, G.H. ; Wong, D.W.S. ; Lee, C.C. ; Wagschal, K. ; Smith, M.R. ; Orts, W.J. Native or raw starch digestion: a key step in energy efficient biorefining of grain. *Journal of agricultural and food chemistry*. 2006 Jan. 25, v. 54, no. 2; p. 353-365.

<http://hdl.handle.net/10113/913>

ABSTRACT: Improved molecular disassembly and depolymerization of grain starch to glucose are key to reducing energy use in the bioconversion of glucose to chemicals, ingredients, and fuels. In fuel ethanol production, these biorefining steps use 10-20% of the energy content of the fuel ethanol. The need to minimize energy use and to raise the net yield of energy can be met by replacing high-temperature, liquid-phase, enzymatic digestion with low temperature, solid-phase, enzymatic digestion. Also called cold hydrolysis, the approach is a step toward a "green" method for the production of fuel ethanol. There has been substantial prior and increased recent interest in this approach that is presented in this first review of the subject. We include incentives, developmental research, fundamental factors of raw starch digestion, and novel approaches in enzymology and processing. The discussion draws on resources found in enzymology, engineering, plant physiology, cereal chemistry, and kinetics.

CALL NUMBER: DNAL 381 J8223

DESCRIPTORS: small grains ; starch ; enzymatic hydrolysis ; alpha-amylase ; glucan 1,4-alpha-glucosidase ; saccharification ; fermentation ; sugars ; glucose ; alcoholic fermentation ; ethanol ; heat treatment ; biofuels ; ethanol production

SUBJECT: raw starch ; AgSpace

Dunn, R.O. Oxidative Stability of Biodiesel by Dynamic Mode Pressurized-Differential Scanning Calorimetry (P-DSC). *Transactions of the ASABE*. 2006 Sept-Oct, v. 49, no. 5; p. 1633-1641.

<http://hdl.handle.net/10113/364>

ABSTRACT: Biodiesel, an alternative diesel fuel made from transesterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters. During long-term storage, oxidation caused by contact with ambient air presents legitimate concerns for monitoring fuel quality. Extended oxidative degradation can affect kinematic viscosity, cetane number, and acid value of the fuel. This work investigates the suitability of dynamic mode (positive air purge) pressurized-differential scanning calorimetry (P-DSC) as a means for evaluating the oxidation reaction during non-isothermal heating scans. Methyl oleate, methyl linoleate, and soybean oil fatty acid methylesters (FAME) were analyzed by P-DSC and the results compared with those from thermogravimetric analyses (TGA), conventional DSC, and static mode (zero purge gas flow) P-DSC scans. Results from TGA showed that ambient air pressure was too low to allow measurable oxidation during analyses. Although some degree of oxidation was detected for DSC and static mode P-DSC heating scans, results demonstrated that the highest degree of oxidation occurred during dynamic mode P-DSC scans. For DSC and P-DSC analyses, oxidation onset temperature (OT) increased with relative oxidative stability, with the highest values being observed for methyl oleate. Treating soybean oil FAME with antioxidants increased their relative oxidative stability, resulting in an increase in OT. Statistical comparison of response factors (R(F)) relative to methyl oleate obtained from non-isothermal heating scans with those obtained from OSI analyses showed the highest degree of correlation ( $P=0.79$ ) with respect to dynamic mode P-DSC.

CALL NUMBER: DNAL S671 .A452  
 DESCRIPTORS: biodiesel ; oxidative stability ; oxidation ; analytical methods ; differential scanning calorimetry ; fatty acid esters ; soybean oil ; temperature ; thermogravimetry ; antioxidants  
 SUBJECT: methyl oleate ; methyl linoleates ; AgSpace

Holt, G.A. ; Blodgett, T.L. ; Nakayama, F.S. Physical and combustion characteristics of pellet fuel from cotton gin by-products produced by select processing. *Treatments Industrial crops and products*. 2006 Nov., v. 24, issue 3; p. 204-213.

<http://hdl.handle.net/10113/4330> ; <http://dx.doi.org/10.1016/j.indcrop.2006.06.005>

ABSTRACT: Agricultural plant wastes when properly processed into useful commodities can become an economic asset. It has been estimated that over 2.04 million Mg of cotton by-products are generated each year in the United States. On average, disposal of these byproducts costs the cotton gin approximately \$ 1.65 (U.S.) per Mg. One means of changing a financial liability into a potential revenue generator is to process the by-products into renewable, compact pellet-type fuel that can be used at the site or transported to the consumer. Furnace and water heaters that can burn pelletized plant materials have become popular and their safety, low pollution, and reasonable operational costs have been demonstrated. Also, the drastic increases in the price of liquefied fuel and its uncertain supply place a premium for finding and using alternate, low-cost, cellulose-based fuels. The objectives of our study were to fabricate pellet fuel from cotton gin by-products using select processing techniques, determine its physical properties, and measure the emissions when fired in a commercial pellet stove used for residential heating. By-products from two cotton gins were collected and processed into fuel pellets. A total of seven different pellet fuels were evaluated, six from cotton gin by-products and one from wood. The treatments resulted from using different material streams from the ginning process as well as varying quantities of starch and/or crude cottonseed oil during the fuel pellet manufacturing process. The fuel pellet density from the various treatments ranged from 488 to 678 kg/m<sup>3</sup>. The various treatments were burned in a conventional pellet stove (four replications) and the gaseous and particulate emissions measured. The average calorific value of the pellets ranged from 17.9 to 20.9 MJ/kg(HHV). The ash content for the various treatments ranged from a low of 4.88% to a high of 9.75%. The sodium content indicated concentration ranges from 91 to 282ppm depending on the treatment. The emissions from the cotton gin by-product pellets were higher than for a premium grade wood pellet. The emissions measured during testing were CO, NO, NO<sub>2</sub>, SO<sub>2</sub>, and particulates. The pellet stove was setup following the manufacturer's recommendation to burn wood pellets, but was not adjusted for the cotton gin fuel pellets. By utilizing various additives and processing techniques, cotton gin by-products could be used to manufacture a pellet fuel that has commercial potential. However, work remains to minimize the ash content and determine the optimal settings for maximizing combustion.

CALL NUMBER: DNAL SB13.I52

DESCRIPTORS: pellets ; cotton gin trash ; cotton ginning ; renewable energy sources ; biofuels ; physical properties ; combustion ; Gossypium ; plant residues ; biomass ; research and development  
 SUBJECT: fuel pellets ; AgSpace

Biswas, A. ; Saha, B.C. ; Lawton, J.W. ; Shogren, R.L. ; Willett, J.L. Process for obtaining cellulose acetate from agricultural by-products. *Carbohydrate polymers*. 2006 Apr. 19, v. 64, issue 1; p. 134-137.

<http://hdl.handle.net/10113/532> ; <http://dx.doi.org/10.1016/j.carbpol.2005.11.002>

ABSTRACT: Agricultural residues such as corn fiber, rice hulls and wheat straw can be used as abundant low-cost feedstock for production of fuel ethanol. However, the cost of cellulase enzymes to saccharify cellulose to glucose is a major hindrance. As an alternative, a novel process to obtain industrially important cellulose acetate from these by-



products after removing hemicellulosic sugars was developed. Rice-straw, wheat hull and corn fiber were treated with dilute acid at a moderate temperature to hydrolyze the hemicellulose to monomeric sugars that can be fermented to ethanol. The cellulose was then treated with acetic anhydride and catalytic amount of sulfuric acid to make cellulose acetate. The production of cellulose acetate was confirmed by NMR analysis. The pretreatment used to hydrolyze the hemicellulose was also useful for cellulose acetate production. Without the pretreatment cellulose acetate conversions from wheat straw, corn fiber, and rice hulls were 0.5, 1.8 and 13.5, respectively. After pretreatment the conversion rate increased to about 25 wt% for all three agricultural residues used.

CALL NUMBER: DNAL QD320.C35

DESCRIPTORS: crop residues ; byproducts ; cellulose acetate  
AgSpace

Thompson, S. Promise of renewable energy focus of St. Louis conference. *Rural cooperatives*. 2006 Nov-Dec, v. 73, no. 6; p. 8-10, 38-39.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: renewable energy sources ; biodiesel ; issues and policy ; United States

SUBJECT: renewable energy industry ; Internet resource

Renewable energy sparks surge of new co-ops. *Rural cooperatives*. 2006 July-Aug, v. 73, no. 4; p. 18-19, 30.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; renewable energy sources ; biofuels ; United States

Rosentrater, K.A. Some Physical Properties of Distillers Dried Grains With Solubles (DDGS). *Applied engineering in agriculture*. 2006 July, v. 22, no. 4; p. 589-595.

<http://hdl.handle.net/10113/3124>

ABSTRACT: With the rapid growth in the fuel ethanol industry in recent years, considerable research is being devoted to determining distillers dried grains with solubles (DDGS) nutritional properties and to optimizing their inclusion in livestock diets; physical properties of these materials, however, have been largely ignored. Using standard laboratory methods, several physical properties for typical DDGS streams were determined, including moisture content, water activity, thermal properties (conductivity, resistivity, and diffusivity), bulk density, angle of repose, and color. The DDGS samples in this study were golden-brown in color and exhibited physical properties similar to other dry feed ingredients, such as hominy feed, corn gluten feed, and other corn-based materials. As a first step, the numerical data generated during this study will help fill a current void in design information for the ethanol and livestock industries.

CALL NUMBER: DNAL S671.A66

DESCRIPTORS: distillers grains ; corn ; byproducts ; moisture content ; water activity ; thermal properties ; bulk density ; color ; thermal conductivity ; thermal diffusivity ; processing residues ; feed industry ; feed processing ; angle of repose

SUBJECT: distillers dried grains with solubles ; thermal resistivity ; AgSpace

Sanderson, M.A. ; Adler, P.R. ; Boateng, A.A. ; Casler, M.D. ; Sarath, G. Switchgrass as a biofuels feedstock in the USA. *Canadian journal of plant science = Revue Canadienne de phytotechnie*. 2006 Dec., v. 86, no. 5; p. 1315-1325.

<http://pubs.nrc-cnrc.gc.ca/aic-journals/cjps.html>

CALL NUMBER: DNAL 450 C16

DESCRIPTORS: Panicum virgatum ; grasses ; range management ; stand management ; crop production ; crop yield ; biofuels ; USDA ; Agricultural Research Service ; research projects ; literature reviews ; United States

Comis, D. Switching to switchgrass makes sense. *Agricultural research*. 2006 July, v. 54, no. 7; p. 19.

<http://www.ars.usda.gov/is/AR/archive/jul06/grass0706.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: agricultural research ; Agricultural Research Service ; Panicum virgatum ; biofuels ; carbon sequestration ; United States

Moser, Bryan R. ; Erhan, Sevim Z. Synthesis and evaluation of a series of  $\alpha$ -hydroxy ethers derived from isopropyl oleate. *Journal of the American Oil Chemists' Society*. Berlin/Heidelberg: Springer-Verlag  
2006 Nov., v. 83, no. 11; p. 959-963.

<http://hdl.handle.net/10113/8048> ; <http://dx.doi.org/10.1007/s11746-006-5053-7>

ABSTRACT: Several fatty derivatives with bulky moieties were prepared by treatment of epoxidized isopropyl oleate with a number of alcohols in the presence of sulfuric acid catalyst to provide a series of  $\gamma$ -hydroxy ethers in good yield. The materials were analyzed for cold flow performance through cloud point and pour point determinations. The most promising  $\gamma$ -hydroxy ether produced in this study, with respect to both low temperature behavior and economic criteria, was isopropyl 9(10)-(2-ethylhexoxy) 10(9)-hydroxy stearate, which has a cloud point of  $-23^{\circ}\text{C}$  and pour point of  $-24^{\circ}\text{C}$ .

CALL NUMBER: DNAL 307.8 J82

DESCRIPTORS: ethers ; oleic acid ; hydroxylation ; biodiesel  
AgSpace

Comis, D. Wind and sun and farm-based energy sources. *Agricultural research*. 2006 Aug., v. 54, no. 8; p. 4-7.

<http://www.ars.usda.gov/is/AR/archive/aug06/energy0806.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: agricultural research ; Agricultural Research Service ; renewable energy sources ; wind power ; solar energy ; biofuels ; Minnesota ; Texas ; Alaska

Bioenergy, dairy producers among recipients of \$14.6 million in VAPGs. *Rural cooperatives*. 2005 Nov-Dec, v. 72, no. 6; p. 9, 34.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: value added ; grants ; USDA ; cooperatives ; United States

SUBJECT: value added producer grants ; USDA Rural Development ; Internet resource

Cassida, K.A. ; Muir, J.P. ; Hussey, M.A. ; Read, J.C. ; Venuto, B.C. ; Ocumpaugh, W.R. Biofuel component concentrations and yields of switchgrass in south central U.S. environments. *Crop science*. 2005 Mar-Apr, v. 45, no. 2; p. 682-692.

<http://hdl.handle.net/10113/3393>

ABSTRACT: Optimizing biofuel production and quality from switchgrass (*Panicum virgatum* L.) may require matching of ecotype and morphological type to environments, particularly in southern regions. Nine genotypes from four combinations of ecotype and morphological switchgrass type were harvested from 1998 to 2000 in five sites across Texas, Arkansas, and Louisiana that varied in latitude and precipitation. An additive main effects and multiplicative interaction (AMMI) method was used to evaluate genotype x environment interaction (G x E) patterns for traits important to biofuel production. Compared with upland genotypes across all site-years, lowland genotypes had greater lignocellulose yields (3.26 vs. 7.40 Mg ha<sup>-1</sup>), greater removal rates of soil N (41 vs. 83 kg ha<sup>-1</sup>) and P (6 vs. 12 kg ha<sup>-1</sup>), greater concentrations of moisture (394 vs. 452 g kg<sup>-1</sup>) and cellulose (388 vs. 394 g kg<sup>-1</sup>), and lower concentrations of N (6.3 vs. 5.7 g kg<sup>-1</sup>) and ash (48 vs. 40 g kg<sup>-1</sup>). Compared with northern ecotypes, southern ecotypes had greater lignocellulose yields (4.95 vs. 6.85 Mg ha<sup>-1</sup>), greater removal rates of soil N (60 vs. 76 kg ha<sup>-1</sup>) and P (8 vs. 11 kg ha<sup>-1</sup>), greater moisture concentrations (417 vs. 445 g kg<sup>-1</sup>), and lower ash concentrations (45 vs. 40 g kg<sup>-1</sup>). Lignocellulose yield paralleled dry matter yield (DMY) patterns. Switchgrass biofuel production efforts in the south-central USA should focus on improving DMY of southern lowland genotypes to maximize lignocellulose yields, but management factors may be more effective in optimizing moisture, ash, and mineral concentrations for combustion.

CALL NUMBER: DNAL 64.8 C883

DESCRIPTORS: *Panicum virgatum* ; biofuels ; crop production ; crop yield ; yield components ; genotype ; genotype-environment interaction ; lignocellulose ; nutrient uptake ; nitrogen ; cellulose ; nitrogen content ; phosphorus ; ecotypes ; dry matter accumulation ; Texas ; Arkansas ; Louisiana  
SUBJECT: biofuel crops ; lowland genotype ; upland genotype ; AgSpace

Cassida, K.A. ; Muir, J.P. ; Hussey, M.A. ; Read, J.C. ; Venuto, B.C. ; Ocumpaugh, W.R. Biomass yield and stand characteristics of switchgrass in south central U.S. environments. *Crop science*. 2005 Mar-Apr, v. 45, no. 2; p. 673-681.

<http://hdl.handle.net/10113/3392>

ABSTRACT: Optimizing feedstock production from switchgrass (*Panicum virgatum* L.) requires careful matching of genotype to environment, especially for southern U.S. regions. Nine genotypes from four combinations of ecotype and morphological type were harvested once yearly in autumn for 3 or 4 yr at five locations across Texas, Arkansas, and Louisiana that varied in latitude and precipitation. Genotypes were evaluated for dry matter yield (DMY), plant density, tiller density, lodging, and rust (caused by *Puccinia* spp.) infection. Genotype x environment (GxE) interactions were identified for most traits. Biomass yield of all genotypes tended to increase with latitude, but lowland morphological



types may have been more sensitive than upland morphological types to differences in moisture availability. Yield (5.82 vs. 14.97 Mg ha<sup>-1</sup>), respectively) and persistence (final stand density, 3.99 vs. 5.96 plants m<sup>-2</sup>) were lower for upland than for lowland genotypes, particularly at higher rainfall and more southern sites. Lowland genotypes were often able to compensate for stand thinning by increasing individual plant size, but upland genotypes were not. Lodging and rust scores were higher for upland than for lowland genotypes. Yield (13.65 vs. 9.75 Mg ha<sup>-1</sup>) and final plant density (5.58 vs. 4.95 plants m<sup>-2</sup>) were higher for southern than northern ecotypes. The southern-lowland combination exhibited the best yield and persistence over the study region, and genotypes within this group exhibited variability in yield among sites. Therefore, development of switchgrass cultivars for biomass production in the southern USA should focus on the southern-lowland genotypes.

CALL NUMBER: DNAL 64.8 C883

DESCRIPTORS: *Panicum virgatum* ; biofuels ; crop production ; crop yield ; dry matter accumulation ; genotype ; genotype-environment interaction ; agronomic traits ; lodging ; rust diseases ; plant density ; tillers ; ecotypes ; Texas ; Arkansas ; Louisiana

SUBJECT: biofuel crops ; lowland genotype ; upland genotype ; AgSpace

Berdahl, J.D. ; Frank, A.B. ; Krupinsky, J.M. ; Carr, P.M. ; Hanson, J.D. ; Johnson, H.A. Biomass yield, phenology, and survival of diverse switchgrass cultivars and experimental strains in western North Dakota. *Agronomy journal*. 2005 Mar-Apr, v. 97, no. 2; p. 549-555.

<http://hdl.handle.net/10113/3789>

CALL NUMBER: DNAL 4 AM34P

DESCRIPTORS: *Panicum virgatum* ; biofuels ; crops ; crop yield ; phenology ; cultivars ; mortality ; field experimentation ; plant development ; plant adaptation ; harvesting ; genotype-environment interaction ; harvest date ; soil water content ; North Dakota

SUBJECT: yield potential ; AgSpace

Knothe, G. Dependence of biodiesel fuel properties on the structure of fatty acid alkyl esters. *Fuel processing technology*. 2005 June 25, v. 86, issue 10; p. 1059-1070.

<http://hdl.handle.net/10113/272> ; <http://dx.doi.org/10.1016/j.fuproc.2004.11.002>

ABSTRACT: Biodiesel, defined as the mono-alkyl esters of vegetable oils or animal fats, is an "alternative" diesel fuel that is becoming accepted in a steadily growing number of countries around the world. Since the source of biodiesel varies with the location and other sources such as recycled oils are continuously gaining interest, it is important to possess data on how the various fatty acid profiles of the different sources can influence biodiesel fuel properties. The properties of the various individual fatty esters that comprise biodiesel determine the overall fuel properties of the biodiesel fuel. In turn, the properties of the various fatty esters are determined by the structural features of the fatty acid and the alcohol moieties that comprise a fatty ester. Structural features that influence the physical and fuel properties of a fatty ester molecule are chain length, degree of unsaturation, and branching of the chain. Important fuel properties of biodiesel that are influenced by the fatty acid profile and, in turn, by the structural features of the various fatty esters are cetane number and ultimately exhaust emissions, heat of combustion, cold flow, oxidative stability, viscosity, and lubricity.

CALL NUMBER: DNAL TP315

DESCRIPTORS: biodiesel ; fatty acid esters ; chemical composition ; chemical structure ; energy content ; oxidative stability ; viscosity ; physicochemical properties ; emissions

SUBJECT: fatty acid alkyl esters ; cetane number ; lubricity ; heat of combustion ; fuel properties ; AgSpace

Casler, M.D. Ecotypic variation among switchgrass populations from the northern USA. *Crop science*. 2005 Jan-Feb, v. 45, no. 1; p. 388-398.

<http://hdl.handle.net/10113/3386>

ABSTRACT: Switchgrass (*Panicum virgatum* L.) is a widely adapted warm-season perennial that has considerable potential as a biofuel crop. Broad species adaptation, natural selection, and photoperiodism have combined to create considerable ecotypic differentiation in switchgrass. The objective of this study was to characterize phenotypic variability among switchgrass ecotypes collected from prairie remnants in the northern USA. Thirty-eight switchgrass collections from 33 prairie-remnant sites and 11 switchgrass cultivars were evaluated for 2 yr at two locations (Arlington and Marshfield, WI) for nine variables: biomass yield, survival, dry matter, lodging, maturity, plant height, holocellulose, lignin, and ash. Autocorrelations, measuring spatial variation, and correlations between phenotypic distances and geographic distances were all nonsignificant. A small amount of variation for maturity, lodging, holocellulose, lignin, and ash could be attributed to latitude and/or longitude of the collection site. Populations from several of the western most collection sites clustered with cultivars from the Great Plains, suggesting an ecological basis for some of the phenotypic variation observed. However, there was a considerable amount of phenotypic

variability between populations from collection sites in close proximity to each other. Hardiness zones (defined largely by temperature extremes) and eco regions (defined largely by soil type and historic vegetation) partly define the phenotypic characteristics for many switchgrass populations collected from prairie remnants. Most switchgrass populations can be utilized for conservation and restoration projects throughout a combined eco region and hardiness zone without undue concern over contaminating, diluting, or swamping the local switchgrass gene pool.

CALL NUMBER: DNAL 64.8 C883

DESCRIPTORS: *Panicum virgatum* ; ecotypes ; plant genetic resources ; cultivars plant growth ; agronomic traits ; chemical constituents of plants ; phenotypic variation ; geographical variation ; Indiana ; Michigan ; Minnesota ; Ohio ; Wisconsin ; New York

AgSpace

Dunn, R.O. Effect of antioxidants on the oxidative stability of methyl soyate (biodiesel). *Fuel processing technology*. 2005 June 25, v. 86, issue 10; p. 1071-1085.

<http://hdl.handle.net/10113/273> ; <http://dx.doi.org/10.1016/j.fuproc.2004.11.003>

ABSTRACT: Biodiesel, an alternative diesel fuel derived from transesterification of vegetable oils or animal fats, is composed of saturated and unsaturated long-chain fatty acid alkyl esters. When exposed to air during storage, autoxidation of biodiesel can cause degradation of fuel quality by adversely affecting properties such as kinematic viscosity, acid value and peroxide value. One approach for increasing resistance of fatty derivatives against autoxidation is to treat them with oxidation inhibitors (antioxidants). This study examines the effectiveness of five such antioxidants, tert-butylhydroquinone (TBHQ), butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PrG) and  $\alpha$ -Tocopherol in mixtures with soybean oil fatty acid methyl esters (SME). Antioxidant activity intervals of increasing oxidation onset temperature (OT) was determined by non-isothermal pressurized-differential scanning calorimetry (P-DSC). Analyses were conducted in static (zero gas flow) and dynamic (positive gas flow) mode under 2000 kPa (290 psig) pressure and 5 °C/min heating scan rate. Results showed that PrG, BHT and BHA were most effective and  $\alpha$ -Tocopherol least effective in increasing OT. Increasing antioxidant loading (concentration) showed sharp increases in activity for loadings up to 1000 ppm followed by smaller increases in activity at higher loadings. Phase equilibrium studies were also conducted to test physical compatibility of antioxidants in SME-No. 2 diesel fuel (D2) blends. Overall, this study recommends BHA or TBHQ (loadings up to 3000 ppm) for safeguarding biodiesel from effects of autoxidation during storage. BHT is also suitable at relatively low loadings (210 ppm after blending). PrG showed some compatibility problems and may not be readily soluble in blends with larger SME ratios. Although  $\alpha$ -Tocopherol showed very good compatibility in blends, it was significantly less effective than the synthetic antioxidants screened in this work.

CALL NUMBER: DNAL TP315

DESCRIPTORS: biodiesel ; oxidative stability ; fatty acid esters ; autoxidation ; antioxidants ; butylated hydroxytoluene ; butylated hydroxyanisole ; propyl gallate ;  $\alpha$ -tocopherol ; differential scanning calorimetry  
SUBJECT: tert-butylhydroquinone ; fatty acid methyl esters ; pressurized-differential scanning calorimetry ; methyl soyate ; AgSpace

Crooks, A. ; Dunn, J. Fuel ethanol industry structure, past & present. *Rural cooperatives*. 2005 Nov-Dec, v. 72, no. 6; p. 18-19.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: ethanol ; cooperatives ; industry

Knothe, G. ; Steidley, K.R. Lubricity of Components of Biodiesel and Petrodiesel. *The Origin of Biodiesel Lubricity Energy & fuels*. 2005 May, v. 19, no. 3; p. 1192-1200.

<http://hdl.handle.net/10113/271> ; <http://dx.doi.org/10.1021/ef049684c>

ABSTRACT: An alternative diesel fuel that is steadily gaining attention and significance is biodiesel, which is defined as the monoalkyl esters of vegetable oils and animal fats. Previous literature states that low blend levels of biodiesel can restore lubricity to (ultra-)low-sulfur petroleum-derived diesel (petrodiesel) fuels, which have poor lubricity. This feature has been discussed as a major technical advantage of biodiesel. In this work, the lubricity of numerous fatty compounds was studied and compared to that of hydrocarbon compounds found in petrodiesel. The effects of blending compounds found in biodiesel on petrodiesel lubricity were also studied. Lubricity was determined using the high-frequency reciprocating rig (HFRR) test. Dibenzothiophene, which is contained in nondesulfurized petrodiesel, does not enhance petrodiesel lubricity. Fatty compounds possess better lubricity than hydrocarbons, because of their polarity-imparting O atoms. Neat free fatty acids, monoacylglycerols, and glycerol possess better lubricity than neat esters, because of their free OH groups. Lubricity improves somewhat with the chain length and the presence of double bonds. An order of oxygenated moieties enhancing lubricity (COOH > CHO > OH > COOCH<sub>3</sub> > C=O > C-O-C) was

obtained from studying various oxygenated C10 compounds. Results on neat C3 compounds with OH, NH<sub>2</sub>, and SH groups show that oxygen enhances lubricity more than nitrogen and sulfur. Adding commercial biodiesel improves lubricity of low-sulfur petrodiesel more than neat fatty esters, indicating that other biodiesel components cause lubricity enhancement at low biodiesel blend levels. Adding glycerol to a neat ester and then adding this mixture at low blend levels to low-lubricity petrodiesel did not improve petrodiesel lubricity. However, adding polar compounds such as free fatty acids or monoacylglycerols improves the lubricity of low-level blends of esters in low-lubricity petrodiesel. Thus, some species (free fatty acids, monoacylglycerols) considered contaminants resulting from biodiesel production are responsible for the lubricity of low-level blends of biodiesel in (ultra-)low-sulfur petrodiesel. Commercial biodiesel is required at a level of 1%-2% in low-lubricity petrodiesel, which exceeds the typical additive level, to attain the lubricity-imparting additive level of biodiesel contaminants in petrodiesel.

CALL NUMBER: DNAL TP315

DESCRIPTORS: biodiesel ; diesel fuel ; mixtures ; contaminants ; free fatty acids ; monoacylglycerols ; glycerol ; hydrocarbons ; esters

SUBJECT: lubricity ; neat fatty esters ; neat fatty acids ; AgSpace

Henson, C.A. ; Muslin, E.H. ; Clark, S.E. Modified barley  $\beta$ -glucosidase. United States Department of Agriculture patents. 2005 Feb. 1, no. US 6,849,439 B2; 21 p.

<http://hdl.handle.net/10113/7564>

ABSTRACT: Barley  $\beta$ -glucosidase is an important enzyme in the conversion of barley starch to fermentable sugars during the industrial production of ethanol, as in brewing and fuel ethanol production. The enzyme is, however, relatively thermolabile, a disadvantage for an enzyme useful in industrial processes which are preferably conducted at elevated temperatures. Site directed mutagenesis has been conducted to make mutant forms of barley  $\beta$ -glucosidase which have improved thermostability. The sites for this site-directed mutagenesis were selected by sequence comparisons with the sequences of other  $\beta$ -glucosidase proteins which are more thermostable. The recombinant mutant enzymes thus produced have been demonstrated to improve the thermostability of the enzyme.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: Hordeum vulgare ; barley ; plant proteins ; alpha-glucosidase ; site-directed mutagenesis ; amino acid substitution ; recombinant fusion proteins ; enzyme activity ; thermal stability ; glycosylation ; amino acid sequences ; USDA ; patents ; United States

SUBJECT: molecular sequence data ; AgSpace

Core, J. New method simplifies biodiesel production. Agricultural research. 2005 Apr., v. 53, no. 4; p. 13.

<http://www.ars.usda.gov/is/AR/archive/apr05/diesel0405.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: new methods ; biofuels ; biological production ; soybean oil ; extraction ; hexane ; flakes ; Glycine max ; soybeans ; methanol ; sodium hydroxide ; transesterification ; costs and returns

Core, J. New varieties and techniques make barley better for fuel and food. Agricultural research. 2005 July, v. 53, no. 7; p. 20-21.

<http://www.ars.usda.gov/is/AR/archive/jul05/barley0705.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: varieties ; barley ; Hordeum vulgare ; ethanol production ; barley starch ; new methods ; feed processing ; processing technology ; plant byproducts ; beta-glucans ; distillers grains ; soluble fiber ; food processing

Macias-Corral, M.A. ; Samani, Z.A. ; Hanson, A.T. ; DelaVega, R. ; Funk, P.A. Producing energy and soil amendment from dairy manure and cotton gin waste. Transactions of the ASAE. 2005 July-Aug, v. 48, no. 4; p. 1521-1526.

<http://hdl.handle.net/10113/5518>

ABSTRACT: Millions of tonnes of feedlot manure and cotton gin waste are generated in the U.S. each year. Dairy and feedlot operations in New Mexico produce 1.2 million tonnes of manure annually. Traditionally, manure has been used as a soil amendment in agriculture. However, land application of manure is limited in New Mexico due to problems with salinity, potential ground water contamination, and limited availability of agricultural land. Waste treatment alternatives are sought. A two-phase anaerobic digestion system was used to evaluate the feasibility of producing methane and soil amendment from mixed agricultural wastes. Cotton gin waste and dairy manure were combined and used as feedstock. Under mesophilic conditions, 48% of the combined waste was converted into biogas. The gas yield was 87 m<sup>3</sup> of methane per tonne of mixed waste. Methane concentration in the biogas averaged 72%. Gas production with mixed waste increased 35% compared to digesting dairy waste alone. Nutrient analyses of the residuals showed that they could be used as soil amendments. Residual solid material from the two-phase anaerobic digester had a considerably higher nitrogen and lower sodium content than aerobically composted manure. Anaerobic digestion lasted

from one to three months and required 0.15 m<sup>3</sup> of water per 1 m<sup>3</sup> of waste. Aerobic composting of similar waste in New Mexico takes eight to nine months and consumes 1.2 m<sup>3</sup> of water per 1 m<sup>3</sup> of waste.

CALL NUMBER: DNAL 290.9 Am32T

DESCRIPTORS: cotton gin trash ; cattle manure ; dairy cattle ; anaerobic digestion ; animal manure management ; methane production ; biogas ; soil amendments ; methane ; nitrogen content

Vogt, K.A. ; Andreu, M.G. ; Vogt, D.J. ; Sigurdardottir, R. ; Edmonds, R.L. ; Schiess, P. ; Hodgson, K. Societal values and economic return added for forest owners by linking forests to bioenergy production. *Journal of forestry*. 2005 Jan-Feb., v. 103, no. 1; p. 21-27.

CALL NUMBER: DNAL 99.8 F768

DESCRIPTORS: forest ownership ; landowners ; bioenergy ; renewable energy sources ; income

SUBJECT: income generation

Igathinathane, C. ; Womac, A.R. ; Sokhansanj, S. ; Pordesimo, L.O. Sorption equilibrium moisture characteristics of selected corn stover components. *Transactions of the ASAE*. 2005 July-Aug, v. 48, no. 4; p. 1449-1460.

<http://hdl.handle.net/10113/5517>

ABSTRACT: Corn stover equilibrium moisture isotherms were developed to aide biomass engineering of consistent, uniform-quality feedstock supplies for renewable bioenergy and bioproducts. Equilibrium moisture content(EMC) and equilibrium relative humidity (ERH) sorption data of corn leaf, stalk skin, and stalk pith were experimentally determined using the static gravimetric method at six temperatures ranging from 10 degrees C to 40 degrees C and at ten ERH values ranging from 0.11 to 0.98. The greatest EMC values for corn leaf and stalk pith generally corresponded with ERH below and above 0.90, respectively, at all temperatures. Only at some intermediate ERH range at 20 degrees C to 40 degrees C was stalk skin EMC greater than stalk pith EMC. Cornstover components followed a type II isotherm typically observed among food materials. EMC of all components was proportional to ERH and inversely proportional to temperature. Observed EMC ranges were 3.9% to 56.4%, 3.1% to 41.1%, and 2.7% to 71.5% dry basis (d.b.) for corn leaf, stalk skin, and stalk pith, respectively. Calculated whole-stalk EMC values ranged from 3.1% to 49.2% d.b. Isotherm data were fitted with the EMC model of Henderson, and modified versions of Henderson, Chung-Pfost, Halsey, Oswin, and Guggenheim-Anderson-deBoer. The modified Oswin model ( $R^2 > 0.98$ ;  $F > 2085$ ) followed by the modified Halsey model ( $R^2 > 0.97$ ;  $F > 1758$ ) produced the best fit for cornstover components studied. The Henderson, modified Henderson, and modified Chung-Pfost models were not suitable since these models did not produce randomized residuals. The modified Oswin model ( $R^2 = 0.99$ ;  $F = 6274$ ) best described the stalk EMC. Results have practical applications in corn stover collection method and timing; process handling, grinding, and drying requirements; transportation efficiency of dry matter; and necessary storage environment, shelf life, and potential microorganism safety hazards. For example, results indicated that higher EMC values for corn stover leaf may result in greater propensity for the onset of mold growth and may determine minimal storage requirements or potential advantages in separating leaf from stalk fractions.

CALL NUMBER: DNAL 290.9 Am32T

DESCRIPTORS: corn stover ; biomass ; moisture content ; sorption isotherms ; relative humidity ; storage conditions ; bioenergy ; biofuels ; leaves ; stems ; equations ; mathematics and statistics

SUBJECT: biomass feedstocks ; equilibrium moisture content ; equilibrium relative humidity ; AgSpace

Campbell, D. (ed.). Balancing act: risk-hedging strategy big part of Iowa ethanol co-op's success. *Rural cooperatives*. 2004 July-Aug., v. 71, no. 4; p. 18-20.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; ethanol ; corn ; business management ; Iowa

Jobe, J. Biodiesel project looks promising for Iowa co-op. *Rural cooperatives*. 2004 Mar-Apr, v. 71, no. 2; p. 9, 30.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; biofuels ; soybean products ; Iowa

Thompson, S. Biodiesel with altitude - Colorado's Blue Sun Co-op grows rapeseed for biodiesel production. *Rural cooperatives*. 2004 Nov-Dec, v. 71, no. 6; p. 4-6, 34.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: biofuels ; cooperatives ; rapeseed ; business management ; Colorado

Richter, S. Buying biodiesel 'off the rack': CHS investing in new injection technology to streamline biodiesel blending process. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 28-29.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: biofuels ; soybeans ; cooperatives ; new products

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Thompson, S. Community investments helped launch plant. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 21, 45.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: cooperatives ; ethanol ; farmers ; investment ; South Dakota

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Campbell, D. Fueling a rural revival: ethanol co-op supports farmer income while providing lift to rural community. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 10-14.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: cooperatives ; ethanol ; rural communities ; biofuels ; farm income ; Minnesota

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Thompson, S. Great expectations: ethanol is hot, but what is the long-term outlook for biofuel? Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 14-18.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: biofuels ; ethanol ; cooperatives ; economic outlook and situation ; Midwestern United States ; Great Plains region

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Thompson, S. Hard lessons: Tri-State Ethanol struggling to overcome difficult start. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 32-33.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: cooperatives ; ethanol ; ethanol production ; economic outlook and situation  
 SUBJECT: limited liability corporation ; Internet resource

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Bouton, J.H. Improving switchgrass as a bioenergy crop for the Southeastern USA. Proceedings. 2004, v. 13; p. 348-351.  
 CALL NUMBER: DNAL SB193.F59  
 DESCRIPTORS: Panicum virgatum ; bioenergy ; cultivars ; plant breeding ; Southeastern United States  
 SUBJECT: breeding programs

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Crooks, A.C. Lost horizon: membership 'horizon' problem preceded demise of MCP. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 22-25, 47.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: cooperatives ; corn ; corn products ; business management

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Searcy, D. MFA oil committed to development and marketing of renewable fuels. Rural cooperatives. 2004 July-Aug., v. 71, no. 4; p. 26-27.  
<http://purl.access.gpo.gov/GPO/LPS5331>  
 CALL NUMBER: DNAL aHD1491.U6R87  
 DESCRIPTORS: renewable energy sources ; cooperatives ; biofuels ; Missouri

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Core, J. New milling methods improve corn ethanol production. Agricultural research. 2004 July, v. 52, no. 7; p. 16-17.  
<http://www.ars.usda.gov/is/AR/archive/jul04/corn0704.htm>  
 CALL NUMBER: DNAL 1.98 Ag84  
 DESCRIPTORS: wet milling ; ethanol production ; biofuels ; new methods ; corn ; Zea mays ; dry milling ; continuous fermentation ; costs and returns ; econometric models

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Campbell, D. Put a soybean in your tank. *Rural cooperatives*. 2004 July-Aug., v. 71, no. 4: p. 2.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: biofuels ; ethanol ; cooperatives ; Minnesota

Cohen, M.F., Mazzola, M. A reason to be optimistic about biodiesel: seed meal as a valuable soil amendment.

*Trends in biotechnology*. 2004 May, v. 22, no. 5: p. 211-212.

CALL NUMBER: DNAL TA166.T72

DESCRIPTORS: rapeseed meal ; soil amendments ; disease control ; root diseases ; *Thanatephorus cucumeris* ; plant pathogenic fungi ; *Malus domestica* ; apples

Hastings, A. The right thing: GROWMARK's Kelly says time is right for renewable fuels to gain larger share of market. *Rural cooperatives*. 2004 July-Aug., v. 71, no. 4: p. 30-31.

URL: <http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: renewable energy sources ; cooperatives ; biofuels ; markets ; United States

USDA grants support home-grown fuels. *Rural cooperatives*. 2004 July-Aug., v. 71, no. 4: p. 34-37.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: USDA ; rural economics ; biofuels ; ethanol ; governmental programs and projects ; United States

Thompson, S. USDA study boosts fuel conversion efficiency rating for ethanol. *Rural cooperatives*. 2004 Sept-Oct, v. 71, no. 5: p. 13.

URL: <http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: ethanol ; USDA ; biofuels

Dien, B.S., Cotta, M.A., Jeffries, T.W. Bacteria engineered for fuel ethanol production: current status.

*Applied microbiology and biotechnology*. 2003 Dec., v. 63, no. 3: p. 258-266.

URL: <http://hdl.handle.net/10113/2625>

ABSTRACT: The lack of industrially suitable microorganisms for converting biomass into fuel ethanol has traditionally been cited as a major technical roadblock to developing a bioethanol industry. In the last two decades, numerous microorganisms have been engineered to selectively produce ethanol. Lignocellulosic biomass contains complex carbohydrates that necessitate utilizing microorganisms capable of fermenting sugars not fermentable by brewers' yeast. The most significant of these is xylose. The greatest successes have been in the engineering of Gram-negative bacteria: *Escherichia coli*, *Klebsiella oxytoca*, and *Zymomonas mobilis*. *E. coli* and *K. oxytoca* are naturally able to use a wide spectrum of sugars, and work has concentrated on engineering these strains to selectively produce ethanol. *Z. mobilis* produces ethanol at high yields, but ferments only glucose and fructose. Work on this organism has concentrated on introducing pathways for the fermentation of arabinose and xylose. The history of constructing these strains and current progress in refining them are detailed in this review.

CALL NUMBER: DNAL QR1.E9

DESCRIPTORS: genetically engineered microorganisms ; *Escherichia coli* ; *Klebsiella oxytoca* ; *Zymomonas mobilis* ; *Pectobacterium chrysanthemi* ; carbohydrate metabolism ; alcoholic fermentation ; biofuels ; literature reviews

Leathers, T.D. Bioconversions of maize residues to value-added coproducts using yeast-like fungi FEMS yeast research. 2003 Apr., v. 3, issue 2: p. 133-140.

URL: <http://hdl.handle.net/10113/2546> ; [http://dx.doi.org/10.1016/S1567-1356\(03\)00003-5](http://dx.doi.org/10.1016/S1567-1356(03)00003-5)

ABSTRACT: Agricultural residues are abundant potential feedstocks for bioconversions to industrial fuels and chemicals. Every bushel of maize (approximately 25 kg) processed for sweeteners, oil, or ethanol generates nearly 7 kg of protein- and fiber-rich residues. Currently these materials are sold for very low returns as animal feed ingredients. Yeast-like fungi are promising biocatalysts for conversions of agricultural residues. Although corn fiber (pericarp) arabinoxylan is resistant to digestion by commercially available enzymes, a crude mixture of enzymes from the yeast-like fungus *Aureobasidium* partially saccharifies corn fiber without chemical pretreatment. Sugars derived from corn fiber can be converted to ethanol or other valuable products using a variety of naturally occurring or recombinant yeasts. Examples are presented of *Pichia guilliermondii* strains for the conversion of corn fiber hydrolysates to the alternative sweetener xylitol. Corn-based fuel ethanol production also generates enormous volumes of low-value stillage residues. These nutritionally rich materials are prospective substrates for numerous yeast fermentations. Strains



of *Aureobasidium* and the red yeast *Phaffia rhodozyma* utilize stillage residues for production of the polysaccharide pullulan and the carotenoid astaxanthin, respectively.

CALL NUMBER: DNAL QR151 .F46

DESCRIPTORS: yeasts ; Endomycetales ; biotransformation ; value-added products ; crop residues ; agricultural wastes ; lignocellulosic wastes ; sugars ; alcoholic fermentation ; ethanol production ; carbohydrate metabolism ; xylitol ; polysaccharides ; biotechnology ; waste utilization ; literature reviews

Knothe, G., Matheaus, A.C., Ryan, T.W. III. Cetane numbers of branched and straight-chain fatty esters determined in an ignition quality tester. *Fuel*. 2003 May, v. 82, issue 8: p. 971-975.

URL: <http://hdl.handle.net/10113/2555> ; [http://dx.doi.org/10.1016/S0016-2361\(02\)00382-4](http://dx.doi.org/10.1016/S0016-2361(02)00382-4)

ABSTRACT: The cetane number is a widely used diesel fuel quality parameter related to the ignition delay time (and combustion quality) of a fuel. It has been applied to alternative diesel fuels such as biodiesel and its components. In this work, the cetane numbers of numerous straight-chain and branched fatty acid esters were determined. Specifically, 29 samples of esters of methyl, ethyl, n-propyl, n-butyl, iso-propyl, iso-butyl, 2-butyl, and 2-ethylhexyl esters of palmitic, stearic, oleic and linoleic acid were investigated. It was found that branching in the ester moiety does not significantly affect cetane number compared to the straight-chain esters. Therefore, branched esters, which have been suggested as a possible improvement for the cold-flow properties of biodiesel, can be employed without significantly affecting ignition properties compared to the more common methyl esters. Unsaturation in the fatty acid chain was again observed to be the most significant factor causing lower cetane numbers. Cetane numbers were determined in an Ignition Quality Tester (IQT) which is a newly developed, automated rapid method using only small amounts of material for determining cetane numbers. The IQT is as applicable to biodiesel and its components as previous cetane-testing methods.

CALL NUMBER: DNAL TP315

DESCRIPTORS: biodiesel ; fatty acid esters ; energy content ; combustion ; product quality

Barkdoll, A. Integrated system of organic food production and urban food waste recycling using on-farm anaerobic digestion and fertigation. Sustainable Agriculture Research and Education (SARE) research projects. Southern Region. 2003, PROJECT LS98-090, SARE Project Number: LS98-090.

CALL NUMBER: DNAL S441.S8552

DESCRIPTORS: anaerobic digestion ; waste treatment ; biogas ; biological treatment ; crop yield ; economic analysis ; fertigation ; food wastes ; food processing wastes ; liquid fertilizers ; methane ; organic fertilizers ; organic production ; recycling ; waste utilization ; Florida

Comis, D., Hardin, B., Stelljes, K.B. Bioenergy today. *Agricultural research* . Apr 2002. v. 50 (4): p. 4-8.

<http://www.ars.usda.gov/is/AR/archive/apr02/bio0402.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: bioenergy ; biogas ; ethanol production ; USDA ; fermentation ; enzymes ; biotechnology ; corn ; industrial microbiology ; United States

Biofuel gets less expensive. *Agricultural research*. Apr 2002. v. 50 (4): p. 9.

<http://www.ars.usda.gov/is/AR/archive/apr02/biofuel0402.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: biogas ; prices ; fatty acid esters ; enzymes

Haas, M.J., Bloomer, S., Scott, K. Process for the production of fatty acid alkyl esters

United States Department of Agriculture patents. 2002 June 4, no. US 6,399,800 B1

<http://hdl.handle.net/10113/6976>

ABSTRACT: A method for producing fatty acid alkyl esters from a feedstock, involving: (a) saponifying the feedstock with an alkali to form a saponified feedstock, (b) removing the water from the saponified feedstock to form a dried saponified feedstock containing no more than about 10% water, (c) esterifying the dried saponified feedstock with an alcohol in the presence of an inorganic acid catalyst to form fatty acid alkyl esters even with water present at levels up to about 3 wt %, and (d) recovering the fatty acid alkyl esters.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: vegetable oil ; soybeans ; soapstock ; soybean oil ; biodiesel ; renewable resources ; triacylglycerols ; fatty acids ; esters ; saponification ; drying ; esterification ; patents ; USDA ; United States

McGraw, L. Biodiesel jet fuels. *Agricultural research* . July 2001. v. 49 (7): p. 22.

URL: <http://www.ars.usda.gov/is/AR/archive/jul01/jet0701.htm>

CALL NUMBER: DNAL 1.98 Ag84

DESCRIPTORS: biomass ; fuels ; soybean oil ; air transportation ; cold ; temperature

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Thompson, S. Bovine biogas: dairy co-op sees major potential in methane gas recovery technology. Rural cooperatives. Nov/Dec 2001. v. 68 (6): p. 16-20.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: dairy cooperatives ; methane ; biogas ; cattle ; cattle manure ; Oregon

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Thompson, S. Bovine biogas: dairy co-op sees major potential in methane gas recovery technology. Rural cooperatives. Nov/Dec 2001. v. 68 (5): p. 16-20.

<http://purl.access.gpo.gov/GPO/LPS5331>

CALL NUMBER: DNAL aHD1491.U6R87

DESCRIPTORS: cooperatives ; dairy cattle ; biogas ; methane  
Oregon

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Hespell, R.B., Wyckoff, H.A., Dien, B.S., Bothast, R.J. Stabilization of PET operon plasmids and ethanol production in bacterial strains lacking lactate dehydrogenase and pyruvate formate lyase activities. United States Department of Agriculture patents. 2001 Aug. 28, no. US 6,280,986 B1:

<http://hdl.handle.net/10113/6303>

ABSTRACT: Recombinant bacteria are disclosed which are transformed with heterologous DNA coding for alcohol dehydrogenase (adh) and pyruvate decarboxylase (pdc), and which are effective for use in the production of ethanol, but which do not require the presence of antibiotics in the culture medium to maintain genetic stability and high ethanol productivity. These recombinant bacteria are produced using mutant host strains which are substantially deficient in the ability to fermentatively reduce pyruvate. When grown in an anaerobic environment, the recombinant pyruvate mutants transformed with the adh and pdc genes are genetically stable, maintaining the inserted genes and ethanol productivity even in the absence of antibiotics.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: biofuels ; ethanol production ; bacteria ; fermentation ; genetic engineering ; genetic recombination ; genes ; plasmids ; lactate dehydrogenase ; pyruvate decarboxylase ; enzyme activity ; anaerobic conditions ; culture media ; antibiotics ; patents ; USDA ; United States

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USDA to expand use of biodiesel, ethanol fuels. California grower ; avocados, citrus, subtropicals. Oct 2001. v. 25 (9): p. 6, 11.

CALL NUMBER: DNAL SB379.A9A9

DESCRIPTORS: ethanol ; USDA ; United States

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Grabowski, J. Analysis of the potential for using Caucasian bluestem as a biofuel crop in the southeastern United States. Technical publications. Oct 2000. v. 15 (1/7): p. 37-50.

CALL NUMBER: DNAL aS627.P55T43

DESCRIPTORS: Bothriochloa bladhii ; plant growth ; crop production ; biomass ; biofuels ; plant cultural practices ; crop yield ; dry matter accumulation ; cutting ; harvesting

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Douglas, J. Eastern gamagrass as a potential biofuel crop. Technical publications. Oct 2000. v. 15 (1/7): p. 27-35.

CALL NUMBER: DNAL aS627.P55T43

DESCRIPTORS: Tripsacum dactyloides ; plant growth ; regrowth ; cutting ; harvesting ; nitrogen fertilizers ; fertilizer application ; application rate ; biomass ; biofuels ; dry matter accumulation ; genotype ; crop production

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Campbell, J.B. New markets for bio-based energy and industrial feedstocks. Biodiesel: will there be enough? Proceedings of Agricultural Outlook Forum, 2000.

<http://purl.access.gpo.gov/GPO/LPS47571>

CALL NUMBER: DNAL aHD1755.A376

DESCRIPTORS: fuel oils ; soybean oil ; supply ; United States

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Slaughter, B. A refiner's perspective on biofuels. Proceedings of Agricultural Outlook Forum, 2000.

<http://purl.access.gpo.gov/GPO/LPS47571>

CALL NUMBER: DNAL aHD1755.A376

DESCRIPTORS: fuel oils ; United States

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Edwards, S. Weeping lovegrass as a potential bioenergy crop. Technical publications. Oct 2000. v. 15 (1/7): p. 51-58.  
CALL NUMBER: DNAL aS627.P55T43  
DESCRIPTORS: Eragrostis curvula ; plant growth ; biomass ; biofuels ; plant cultural practices ; crop yield ; dry matter accumulation ; harvesting

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Saha, B.C., Bothast, R.J. Thermostable  $\alpha$ -L-arabinofuranosidase from Aureobasidium pullulans  
United States Department of Agriculture patents. 1999 Mar. 16, no. 5,882,905  
URL: <http://hdl.handle.net/10113/5884>  
ABSTRACT: An  $\alpha$ -L-arabinofuranosidase enzyme which is highly thermostable, and is effective for the hydrolysis of arabinofuranosyl residues from L-arabinose containing polysaccharides and hemicelluloses is disclosed. The enzyme is produced by color variant Aureobasidium pullulans strain NRRL Y-21792. This  $\alpha$ -L-arabinofuranosidase may be used in conjunction with xylanolytic enzymes for the treatment of hemicellulosic materials to produce fermentable sugars, particularly xylose and L-arabinose.  
CALL NUMBER: DNAL aT223.V4A4  
DESCRIPTORS: Zea mays ; corn ; biofuels ; arabinose ; polysaccharides ; hemicellulose ; hydrolysis ; fermentation ; ethanol production ; alpha-N-arabinofuranosidase ; enzyme activity ; xylanolytic microorganisms ; Aureobasidium pullulans ; thermal stability ; patents ; USDA ; United States

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McCraw, L.C. Better cold-weather starts for biodiesel fuel. Agricultural research. Apr 1998. v. 46 (4); p. 21.  
<http://www.ars.usda.gov/is/AR/archive/apr98/cold0498.pdf>  
CALL NUMBER: DNAL 1.98 Ag84

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Zhang, X., Peterson, C., Reece, D., Haws, R., Moller, G. Biodegradability of biodiesel in the aquatic environment. Transactions of the ASAE. Sept/Oct 1998. v. 41 (5): p. 1423-1430.  
ABSTRACT: The biodegradability of various biodiesel fuels was examined by the CO<sub>2</sub> evolution method (EPA 560/6-82-003), BOD<sub>5</sub> (EPA 405.1), COD (EPA 410), and gas chromatography (GC) analyses in an aquatic systems. The fuels examined included the methyl- and ethyl-esters of rapeseed oil and soybean oil, neat rapeseed oil, neat soybean oil and Phillips 2-D low sulfur, reference petroleum diesel. Blends of biodiesel/petroleum diesel at different volumetric ratios, including 80/20, 50/50, and 20/80, were also examined. The results demonstrate that all the biodiesel fuels are "readily biodegradable". Moreover, in the presence of REE, the degradation rate of petroleum diesel increased to twice that of petroleum diesel alone. The pattern of biodegradation in the blends and reasons why biodiesel is more readily degradable than petroleum diesel are discussed. The biodegradation monitoring results from both CO<sub>2</sub> evolution and GC methods are compared.  
CALL NUMBER: DNAL 290.9 Am32T  
DESCRIPTORS: fuels ; biodegradation ; chemical oxygen demand ; gas chromatography

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Thompson, J.C. ; Peterson, C.L. ; Reece, D.L. ; Beck, S.M. Two-year storage study with methyl and ethyl esters of rapeseed. Transactions of the ASAE. July/Aug 1998. v. 41 (4) ; p. 931-939.  
ABSTRACT: Methyl and ethyl esters, prepared from various vegetable oils by the process of transesterification, have shown much promise as fuels for all types of diesel engines. Very limited information is available on possible deterioration of biodiesel in storage. This project was designed to determine the extent of deterioration of Rape Methyl Ester (RME) and Rape Ethyl Ester (REE) in storage. The study involved triplicate samples of RME and REE stored in glass and steel containers at room temperature (inside) and at the local ambient outdoor temperatures (outside). The study was conducted for 24 months. At the beginning of the study and at three-month intervals, samples were taken for measurement of peroxide value, acid value, density, viscosity, and heat of combustion. At the conclusion of the study, engine performance tests were conducted with the two year stored REE and RME, new REE and RME, and low sulfur diesel reference fuel. On the average, the esters increased over time in all of the previously mentioned properties with the exception of heat of combustion, which decreased. Regression models are presented to predict the deterioration with time. Engine power varied less than 2% for both Biodiesel fuels compared to the stored counterparts while smoke density decreased 3.2% for the stored RME and increased 17.5% for stored REE.  
CALL NUMBER: DNAL 290.9 Am32T  
DESCRIPTORS: esters ; fuels ; storage ; duration ; physical properties ; rapeseed ; biofuels  
SUBJECTS: fuel crops ; fuel analysis

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De Hoof, C.F. ; Kleit, S. ; Chang, S.J. ; Gazo, R. ; Buchart, M.E. Survey and mapping of wood residue users and producers in Louisiana. Forest products journal. Mar 1997. v. 47 (3) ; p. 31-37.

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ABSTRACT: Natural by-products of the forest products industry are biomass residues such as bark, wood chips, and sawdust. Disposing of them poses problems for the air and water. One popular waste management solution is to use them for fuel. To measure the potential for using wood residue for fuel and other uses, a study was conducted of the primary and secondary wood processors in Louisiana. The study revealed that while some firms use wood residues for their own boilers, or sell it to others for fuel, there is still unused waste. One reason for this may be the lower cost of competing energy sources. A geographic information system (GIS) was used to map all sites claiming to produce and/or consume wood residue. These data are layered with timber supply data from the USDA Forest Service. A hardcopy directory of biomass sites, including cotton gin trash, rice hulls, and sugar bagasse was developed for public distribution.

CALL NUMBER: DNAL 99.9 F7662J

DESCRIPTORS: wastes ; wood residues ; waste utilization ; waste disposal ; fuels ; bioenergy ; surveys ; Louisiana

SUBJECTS: forest products industries

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Peterson, C. ; Reece, D. Emissions characteristics of ethyl and methyl ester of rapeseed oil compared with low sulfur diesel control fuel in a chassis dynamometer test of a pickup truck. Transactions of the ASAE. May/June 1996. v. 39 (3) ; p. 805-816.

ABSTRACT: Comprehensive tests were performed on an on-road vehicle in cooperation with the Los Angeles County Metropolitan Transit Authority emissions test facility. All tests were with a transient chassis dynamometer. Tests included both a double arterial cycle of 768 s duration and an EPA heavy duty vehicle cycle of 1,060 s duration. The test vehicle was a 1994 pickup truck with a 5.9-L turbocharged and intercooled, direct injection diesel engine. Rapeseed methyl (RME) and ethyl esters (REE) and blends were compared with low sulfur diesel control fuel.

Emissions data includes all regulated emissions: hydrocarbons (HC), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), and particulate matter (PM). In these tests the average of 100% RME and 100% REE reduced HC (52.4%), CO (47.6%), NO<sub>x</sub> (10.0%), and increases in CO<sub>2</sub> (0.9%) and PM (9.9%) compared to the diesel control fuel. Also, 100% REE reduced HC (8.7%), CO (4.3%), and NO<sub>x</sub> (3.4%) compared to 100% RME.

CALL NUMBER: DNAL 290.9 Am32T

DESCRIPTORS: rapeseed oil ; ethanol ; diesel engines ; trucks ; hydrocarbons ; carbon monoxide ; carbon dioxide ; nitrogen oxides ; ps ; testing ; chemical composition ; emissions ; California

SUBJECTS: fuel appraisals ; diesel oil ; rapeseed oil methyl esters ; rapeseed oil ethyl esters ; alternative fuels ; hybrid fuels ; particulate matter in exhaust gases ; emission controls ; road testing

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McFarland, M.J. Forage, biomass, and biogas integrated systems for animal waste management. Sustainable Agriculture Research and Education (SARE) research projects. Southern Region. 1996. ; 30 p.

CALL NUMBER: DNAL S441.S8552

DESCRIPTORS: waste utilization ; land application ; Panicum virgatum ; forage ; crop production ; energy resources ; Texas

SUBJECTS: dairy wastes ; energy production

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Wright, D.E. Agricultural editors Wheeler McMillen and Clifford. V. Gregory and the farm chemurgic movement. Agric. hist. Agricultural history. Spring 1995. v. 69 (2) ; p. 272-287.

CALL NUMBER: DNAL 30.98 Ag8

DESCRIPTORS: industrial applications ; agricultural policy ; USDA ; information dissemination ; agrochemicals ; history ; United States

SUBJECTS: journalism ; agricultural production ; gasohol

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Sanderson, M.A. Forage, biomass, and biogas integrated systems for animal waste management.

Agriculture in Concert with the Environment (ACE) research projects. Southern Region. 1995. ; 19 p.

CALL NUMBER: DNAL S441.S8557

DESCRIPTORS: waste utilization ; land application ; Panicum virgatum ; forage ; crop production ; energy resources ; Texas

SUBJECTS: dairy wastes ; energy production

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Wright, D.E. Alcohol wrecks a marriage: the Farm Chemurgic Movement and the USDA in the alcohol fuels campaign in the spring of 1933. Agricultural history. Winter 1993. v. 67 (1) ; p. 36-66.

CALL NUMBER: DNAL 30.98 AG8

DESCRIPTORS: chemistry ; agricultural wastes ; compound fertilizers ; fiberboards ; fuels ; history ; innovation adoption ; politics ; rural development ; USDA ; literature reviews ; United States

SUBJECTS: agricultural crises ; new deal usda

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Dunn, R.O. ; Schwab, A.W. ; Bagby, M.O. Solubilization and related phenomena in nonaqueous triolein/unsaturated long chain fatty alcohol/methanol solutions. ARS reprints collection. 1993. [559] ; 16 p.

CALL NUMBER: DNAL aS441.A77

DESCRIPTORS: triolein ; methanol ; fatty alcohols ; solutions ; solubilization ; viscosity ; fuels ; solubility ; physicochemical properties

SUBJECTS: micelles ; oil miscible concentrates ; unsaturated long chain fatty alcohols ; miscible phase activity ; hybrid fuels research ; miscibility ; interfacial tension ; diesel fuels

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Misra, M.K. ; Ragland, K.W. ; Baker, A.J. Wood ash composition as a function of furnace temperature.

FS reprints collection. 1993. [102] ; 14 p.

CALL NUMBER: DNAL aSD143.F77

DESCRIPTORS: bark ; elements ; softwood ; hardwood ; species differences

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Whitman, C.E. ; Evans, G.R. Biofuels and the carbon balance. Yearbook of agriculture.

1992. ; p. 260-264.

[http://naldr.nal.usda.gov/NALWeb/Agricola\\_Link.asp?Accession=IND93048089](http://naldr.nal.usda.gov/NALWeb/Agricola_Link.asp?Accession=IND93048089)

CALL NUMBER: DNAL 1 AG84Y

DESCRIPTORS: air pollution ; carbon dioxide ; biomass ; biogeochemical cycles ; federal government ; laws and regulations ; United States

SUBJECTS: fuel crops ; Internet resource

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Miller, E.K. Biofuels--January 1986-August 1992. Quick Bibliogr Ser U S Dep Agric Natl Agric Libr U S

Quick bibliography series - U.S. Department of Agriculture, National Agricultural Library (U.S.).

Sept 1992. (92-63) ; 69 p.

CALL NUMBER: DNAL aZ5071.N3

DESCRIPTORS: biomass ; fuels ; energy resources ; bibliographies

SUBJECTS: fuel crops

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Harris, W.L. ; Rosen, H.N. Conversion of biomass to fuel and energy. Yearbook of agriculture. 1992. ; p. 212-221.

[http://naldr.nal.usda.gov/NALWeb/Agricola\\_Link.asp?Accession=IND93048082](http://naldr.nal.usda.gov/NALWeb/Agricola_Link.asp?Accession=IND93048082)

CALL NUMBER: DNAL 1 AG84Y

DESCRIPTORS: biomass ; Zea mays ; milling ; ethanol ; cellulose ; oilseed plants ; United States

SUBJECTS: fuel crops ; Internet resource

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Conway, R.K. ; Moorer, R. ; Dungan, M. Developing biofuels: federal programs. Yearbook of agriculture.

1992. ; p. 200-204.

[http://naldr.nal.usda.gov/NALWeb/Agricola\\_Link.asp?Accession=IND93048080](http://naldr.nal.usda.gov/NALWeb/Agricola_Link.asp?Accession=IND93048080)

CALL NUMBER: DNAL 1 AG84Y

DESCRIPTORS: biomass ; rural development ; United States

SUBJECTS: government research ; fuel crops ; Internet resource

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McClelland, J. ; Farrell, J. Feedstocks for biofuels. Yearbook of agriculture.

1992. ; p. 204-211.

[http://naldr.nal.usda.gov/NALWeb/Agricola\\_Link.asp?Accession=IND93048081](http://naldr.nal.usda.gov/NALWeb/Agricola_Link.asp?Accession=IND93048081)

CALL NUMBER: DNAL 1 AG84Y

DESCRIPTORS: biomass ; Zea mays ; woody plants ; forage crops ; cost benefit analysis ; oilseed plants ; United States

SUBJECTS: fuel crops ; Internet resource

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Stokes, B.J. Harvesting small trees and forest residues. FS reprints collection. 1992. [112] ; 17 p.

CALL NUMBER: DNAL aSD143.F77

DESCRIPTORS: forest trees ; biomass ; fuelwood ; harvesting ; databases ; felling ; logging ; slash ; Canada ; Italy ; New Zealand ; Norway ; Sweden ; Switzerland ; United Kingdom ; United States

SUBJECTS: forestry machinery ; size ; forestry practices

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Gardner, B. New demands for biofuels and alternative products. Outlook - Proc Agric Outlook Conf U S Dep Agric Outlook - Proceedings, Agricultural Outlook Conference, U.S. Department of Agriculture. 1992. (68th) ; p. 23-29.

CALL NUMBER: DNAL 1.90 C2OU8

DESCRIPTORS: fuels ; agricultural products ; cost benefit analysis ; technology ; production costs ; energy resources ; United States

SUBJECTS: energy policy

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Ag center to increase ethanol research. Genetic engineering news. June 1991. v. 11 (6) ; p. 38.

CALL NUMBER: DNAL QH442.G456

DESCRIPTORS: fuels ; ethanol ; biomass ; fermentation ; waste utilization ; research projects ; USDA ; agricultural wastes ; energy resources ; Illinois

SUBJECTS: national center for agricultural utilization research

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AGnews: vine weevil targeted; ag fellowship award; more fuel alcohol. BioEngineering news. Sept 15, 1990. v. 11 (38) ; p. 2, 8.

CALL NUMBER: DNAL A00033

DESCRIPTORS: biological control ; Heterorhabditis bacteriophora ; Xenorhabdus ; Curculionidae ; USDA ; biotechnology ; ethanol production

SUBJECTS: postsecondary education ; news column ; us national corn growers association

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Earle, J.F.K. ; Chynoweth, D.P. ; Nordstedt, R.A. Anaerobic bioconversion: biogasification of municipal solid waste. Bulletin - Florida Cooperative Extension Service, University of Florida. Apr 1990. (267) ; 10 p.

CALL NUMBER: DNAL 275.29 F66

DESCRIPTORS: solid wastes ; United States

SUBJECTS: municipal refuse disposal

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Larson, J.A. Biogas and alcohols from biomass: January 1986-September 1990. Quick bibliography series - U.S. Department of Agriculture, National Agricultural Library (U.S.). Dec 1990. (91-39) ; 81 p. ill.

CALL NUMBER: DNAL aZ5071.N3

DESCRIPTORS: biogas ; alcohols ; biomass ; bibliographies

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Cheney, S. Gasohol January 1982-April 1989. Quick bibliography series - U.S. Department of Agriculture, National Agricultural Library (U.S.). Sept 1989. (89-101) ; 20 p.

CALL NUMBER: DNAL aZ5071.N3

DESCRIPTORS: fuels ; biomass ; alcohols ; bibliographies

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Larson, J.A. Biogas from biomass, 1985-1987. Quick bibliography series - National Agricultural Library (U.S.). Feb 1988. (88-23) ; 44 p. CALL NUMBER: DNAL aZ5071.N3

DESCRIPTORS: biomass ; agricultural wastes ; methane ; methane production

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Fabian, E. Biogas systems for the dairy. 4. Digesters on New York dairies. St. Lawrence County cooperative extension news. Oct 1988. v. 72 (10) ; p. 12. ill.

CALL NUMBER: DNAL S544.3.N7S3

DESCRIPTORS: methane ; methane production ; New York

SUBJECTS: digesters ; farm dairies

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Gill, M. Corn-based ethanol: situation and outlook. Situation Outlook Rep Feed U S Dep Agric Econ Res Serv Situation and outlook report ; Feed - United States Department of Agriculture, Economic Research Service. May 1987. (302) ; p. 30-37. maps.

CALL NUMBER: DNAL aHD9052.U5S67

DESCRIPTORS: corn ; ethanol ; supply balance ; imports ; domestic trade ; sales ; agricultural outlook and situation ; United States

SUBJECTS: fuel inventories

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Brink, D.L. ; Merriman, M.M. ; Gullekson, E.E. Ethanol fuel, organic chemicals, single-cell proteins: a new forest products industry. USDA Forest Service general technical report PSW - United States, Pacific Southwest Forest and Range Experiment Station. Nov 1987. (100) ; p. 237-243.

CALL NUMBER: DNAL aSD11.A325

DESCRIPTORS: ethanol ; proteins ; lignocellulose ; fermentation

SUBJECTS: wood chemical industry ; forest products industries



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Why gasohol can't pass the farm income cost-benefit test. Farmline - United States Dept. of Agriculture, Economic Research Service. Feb 1987. v. 8 (2) ; p. 10-12. ill.

CALL NUMBER: DNAL aHD1401.A2U52

DESCRIPTORS: ethanol ; fuels ; farm income ; economic depression ; United States

SUBJECTS: tax incentives

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Gavett, E.E. ; Grinnell, G.E. ; Smith, N.L. Fuel ethanol and agriculture: an economic assessment. Agricultural economic report - United States Dept. of Agriculture. Aug 1986. (562) ; 54 p.

ABSTRACT: Increased fuel ethanol production from renewable resources like grain through 1995 would raise net farm income benefiting mainly corn and livestock producers. Production of additional byproduct feeds would depress prices of soybeans. Large ethanol subsidies, which are required to sustain the industry, would offset any savings in agricultural commodity programs. Increased ethanol production would also raise consumer expenditures for food. Any benefits of higher income to farmers would be more than offset by increased Government costs and consumer food expenditures. Direct cash payments to corn growers would be more economical than attempting to boost farm income through ethanol subsidies.

CALL NUMBER: DNAL A281.9 AG8A

DESCRIPTORS: ethanol ; economic analysis ; farm income ; laws and regulations ; costs and returns ; cost benefit analysis

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Robertson, G.H. ; Pavlath, A.E. Dehydration of ethanol. United States Department of Agriculture patents. Dec 3, 1985. (4,556,460) ; 1 p. ill.

ABSTRACT: A process and apparatus for dewatering an ethanol-water solution is disclosed wherein a carrier gas is used to vaporize the solution and transport the vapors to a sorbent where water is sorbed in preference to ethanol. The invention is particularly suited for small-scale production of fuel-grade ethanol for blending with gasoline.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: ethanol ; patents ; small businesses ; USDA ; United States

SUBJECTS: fuel moisture content ; dehydration

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Livezey, J. Estimates of corn use for major food and industrial products. Feed outlook and situation report FdS - United States Dept. of Agriculture, Economic Research Service. May 1985. (296) ; p. 12-15.

ABSTRACT: Extract: This presents a historical breakout of corn use for food and industrial products. A discussion of the three major corn processing industries as well as the products they produce is included. Most of the growth in corn use is attributed to steadily increasing demand for high fructose corn syrup and fuel alcohol. The outlook is for continued growth, but at a slower pace.

CALL NUMBER: DNAL 1.941 S8F32

DESCRIPTORS: corn ; foods ; feed grains ; food grains ; corn syrup ; corn oil ; corn gluten meal

SUBJECTS: estimates

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Schwab, A.W. ; Pryde, E.H. Microemulsions from vegetable oil and aqueous alcohol with 1-butanol surfactant as alternative fuel for diesel engines. United States patent - United States Patent Office. July 2, 1985. (4,526,586) ; 1 p. ill.

ABSTRACT: Hybrid fuel microemulsions are prepared from vegetable oil, a C1-C3 alcohol, water, and 1-butanol as the nonionic surfactant. These fuels are characterized by an acceptable viscosity and compare favorably to No. 2 diesel fuel in terms of engine performance properties.

CALL NUMBER: DNAL NO CALL NO. (PAT)

DESCRIPTORS: plant fats and oils ; fuels ; diesel engines ; emulsions ; biomass ; patents ; United States

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Schwab, A.W. ; Pryde, E.H. Microemulsions from vegetable oil and lower alcohol with octanol surfactant as alternative fuel for diesel engines. United States Department of Agriculture patents. Dec 10, 1985. (4,557,734) ; 1 p. ill.

ABSTRACT: Hybrid fuel microemulsions are prepared from vegetable oil, methanol or ethanol, a straight-chain isomer of octanol, and optionally water. The fuels are characterized by a relatively high water tolerance, acceptable viscosity, and performance properties comparable to No. 2 diesel fuel.

CALL NUMBER: DNAL aT223.V4A4

DESCRIPTORS: plant fats and oils ; fuels ; diesel engines ; surfactants ; patents ; USDA ; United States

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Gavett, E.E. Overview of USDA energy policy perspectives. Energy applications of biomass / edited by Michael Z. Lowenstein. London ; Elsevier, c1985. ; p. 75-77.

CALL NUMBER: DNAL TP360.N278 1984

DESCRIPTORS: bioenergy ; renewable resources ; national planning ; USDA ; United States

SUBJECTS: energy policy ; fourth national energy policy plan ; joint usda/doe biomass energy production and use plan for the united states, 1983-1990

---

Gill, M. ; Allen, E. Status of the U.S. ethanol market. Feed outlook and situation report FdS - United States Dept. of Agriculture, Economic Research Service. Aug 1985. (297) ; p. 14-22.

ABSTRACT: Extract: Alcohol fuel production capacity has expanded rapidly due to Federal and State incentives to encourage production from domestically abundant renewable resources. Corn, which can be converted into ethanol, has emerged as the premier source for the foreseeable future. With the EPA phasedown of the use of lead in gasoline, demand has surged for ethanol as an octane-enhancer. Ethanol is competitive with other octane-boosters only because of Federal and State production incentives. Limited production capacity and the long lead time required to install new capacity, will make it difficult for the domestic industry to meet accelerated demand for ethanol. Because imports, especially from Brazil, are an increasing source of U.S. supplies, domestic producers have filed an anti-dumping case, alleging that Brazilian production is heavily subsidized.

CALL NUMBER: DNAL 1.941 S8F32

DESCRIPTORS: ethanol ; markets ; feeds ; octane ; imports ; biomass ; United States

SUBJECTS: energy consumption ; stocks

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Schwab, A.W. Diesel fuel-aqueous alcohol microemulsions. United States patent - United States Patent Office. May 29, 1984. (4,451,265) ; 1 p. ill.

CALL NUMBER: DNAL NO CALL NO. (PAT)

DESCRIPTORS: fatty acids ; emulsions ; alcohols ; fuels ; patents ; United States

SUBJECTS: diesel oil ; citation only

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Rafats, J. Jerusalem artichoke. Quick bibliography series - National Agricultural Library. Sept 1984. (84-67) ; 6 p.

CALL NUMBER: DNAL aZ5071.N3

DESCRIPTORS: Jerusalem artichokes ; bioenergy

SUBJECTS: production

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Tanner, J. The price to be paid for black gold. International agricultural development. Nov/Dec 1984. v. 4 (6) ; p. 22-23.

CALL NUMBER: DNAL aS544.A3I6

DESCRIPTORS: ethanol ; fuelwood ; Brazil ; Zimbabwe ; Nicaragua

SUBJECTS: fuel crops

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Bryan, W.L. Alternate extraction and fermentation processes for sweet sorghum. 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.]. [Washington, D.C. ; The Department, 1983?]. ; p. 147-150. ill.

CALL NUMBER: DNAL aTJ810.S6 1983

---

Harris, F.D. ; Stahl, T. Biogas-ethanol interfacing with an engine/generator set. 3 Annu Solar Biomass Workshop 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.].

[Washington, D.C. ; The Department, 1983?]. ; p. 82-85. ill.

CALL NUMBER: DNAL aTJ810.S6 1983

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A biomass energy production and use plan for the United States, 1983-90. Agricultural economic report - United States Dept. of Agriculture. Nov 1983. (505) ; 17 p.

ABSTRACT: Extract: This report to the President and the Congress assesses the feasibility of achieving the Energy Security Act's goal of producing 8.4 billion gallons of alcohol per year--equal to 10 percent of all U.S. gasoline consumption--by 1990. The goal, though technologically attainable, is not economically feasible even under optimistic market scenarios because it would require \$41 to \$66 billion in government subsidies over the 1983-90 period. A more realistic maximum potential, with existing subsidies, is 1.5 billion gallons of alcohol fuel per year.

CALL NUMBER: DNAL A281.9 AG8A

DESCRIPTORS: biomass ; energy ; petroleum ; ethanol ; wood ; prices ; supply ; demand ; feed grains ; United States

SUBJECTS: incentives ; uses ; production ; Fuel

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Bravo-Ureta, B.E. ; McMahon, G. An economic evaluation of anaerobic digestion on cage layer operations. Bulletin - Cooperative Extension Service, University of Connecticut. 1983. (83-23) ; 14 p.

CALL NUMBER: DNAL 275.29 C76B

DESCRIPTORS: energy costs ; waste utilization ; New England region

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Ureta-Bravo, B.E. ; McMahon, G. An economic evaluation of anaerobic digestion on cage layer operations. Bulletin - Cooperative Extension Service, University of Connecticut. 1983. (83-23) ; 14 p.

ABSTRACT: Extract: This report presents the net present values associated with biogas-to-electricity systems (BES) for five farm sizes under alternative situations. The results show that farm size, electricity price projections, and the quantity of electricity produced had a major effect on the feasibility of the BES investment. Alternative assumptions regarding tax credits and interest rates were also analyzed, but these two factors had only a marginal impact on the investment's feasibility.

CALL NUMBER: DNAL 275.29 C76B

DESCRIPTORS: poultry ; electricity ; capital ; fertilizers

SUBJECTS: Manure

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Garcia, A. III. ; Fischer, J.R. ; Iannotti, E.L. Ethanol research on the Missouri Integrated Energy Farm System. 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.]. [Washington, D.C. ; The Department, 1983?]. ; p. 86-89.

CALL NUMBER: DNAL aTJ810.S6 1983

DESCRIPTORS: Missouri

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Broder, J.D. ; Waddell, E.L. Jr. Farm alcohol/methane production model. 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.]. [Washington, D.C. ; The Department, 1983?]. ; p. 199-201.

CALL NUMBER: DNAL aTJ810.S6 1983

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Gascho, G.J. The potential length of the harvest period for sweet sorghum. 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.]. [Washington, D.C. ; The Department, 1983?]. ; p. 128-131.

CALL NUMBER: DNAL aTJ810.S6 1983

DESCRIPTORS: Georgia

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Moy, J.H. ; Yang, P.Y. A solar-biogas system for food drying. 3rd annual Solar and Biomass Workshop, April 26-28, 1983, Holiday Inn, Atlanta Airport/North Atlanta, Georgia / co-sponsors United States Department of Agriculture ... [et al.]. [Washington, D.C. ; The Department, 1983?]. ; p. 51-54. ill.

CALL NUMBER: DNAL aTJ810.S6 1983

DESCRIPTORS: Hawaii

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Fairbank, W.C. Biogas fuel from manure--some considerations for California agriculture. Leaflet - University of California, Cooperative Extension Service. Feb 1982. (21292) ; 4 p. ill.

CALL NUMBER: DNAL S544.3.C2C3

DESCRIPTORS: California

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Fulhage, C. ; Iannotti, G. Biogas production considerations and experience at the University of Missouri. Energy for production agriculture ; a national symposium for extension specialists, November 16-18, 1982, St. Louis, Missouri / spon. Cooperative Extension Service, Univ. of Mississippi ... [et al.]. St. Louis, Mo. ; University of Missouri, 1982. ; p. 65-70.

CALL NUMBER: DNAL S494.5.E5E57

DESCRIPTORS: pig manure ; Missouri

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Hermanson, R.E. Biogas production from dairy cattle manure. Extension bulletin - Washington State University, Cooperative Extension Service. Mar 1982. (0987) ; 6 p.

CALL NUMBER: DNAL 275.29 W27P

DESCRIPTORS: biogas ; cattle manure ; energy recovery ; waste disposal ; energy resources

SUBJECTS: dairy effluent

Kurtzman, C.P. ; Bothast, R.J. ; Vancauwenberge, J.E. Conversion of D-xylose to ethanol by the yeast *Pachysolen tannophilus*. United States patent - United States Patent Office. Nov 16, 1982. (4,359,534) ; 6 p.

CALL NUMBER: DNAL NO CALL NO. (PAT)

Gill, M. ; Dargan, A.D. Estimated capacity of U.S. ethanol plants. ERS Staff Rep U S Dep Agric Econ Res Serv ERS staff report - United States Dept. of Agriculture, Economic Research Service. Feb 1982. (AGES820210) ; 31 p.

ABSTRACT: Extract: This report presents and explains data on U.S. alcohol fuel production capacity for 1980-83.

The major feedstock used is corn because of its availability and the technical ease of conversion to alcohol by means of the well-known fermentation process. The Corn Belt is currently the leading alcohol fuel production region. The estimates of likely, optimistic, and highly optimistic capacity by the end of 1983 are 1.5, 1.7 and 2 billion gallons, respectively. These estimates indicate that the national alcohol fuel production goal of 60,000 barrels per day (920 million gallons per year) by the end of 1982 will not be achieved.

CALL NUMBER: DNAL 916762(AGE)

DESCRIPTORS: United States

SUBJECTS: projections ; Fuel ; Synthetics

Garthe, J.W. Ethanol fuel programs in the Northeast. Energy for production agriculture ; a national symposium for extension specialists, November 16-18, 1982, St. Louis, Missouri / spon. Cooperative Extension Service, Univ. of Mississippi ... [et al.]. St. Louis, Mo. ; University of Missouri, 1982. ; p. 80-82. maps.

CALL NUMBER: DNAL S494.5.E5E57

SUBJECTS: North Eastern States (USA)

Waelti, H. Extension programs on portable liquid fuel in the Western States. Energy for production agriculture ; a national symposium for extension specialists, November 16-18, 1982, St. Louis, Missouri / spon. Cooperative Extension Service, Univ. of Mississippi ... [et al.]. St. Louis, Mo. ; University of Missouri, 1982. ; p. 83-86.

CALL NUMBER: DNAL S494.5.E5E57

SUBJECTS: Western States (USA)

Livezey, J. Food and industrial demand for corn. Feed situation FdS - United States Dept. of Agriculture, Economic Research Service. Aug 1982. (FdS-286) ; p. 10-12.

ABSTRACT: Extract: Corn used for food and industrial purposes now accounts for almost one-third of the corn purchased for domestic use, up from one-fifth in the early seventies. Rapid growth in production of high fructose corn syrup (HFCS) accelerated the rate of use late in the decade. In addition, since 1979 gasohol subsidies have encouraged ethanol production by corn processors. Food and industrial use of corn is expected to continue to grow in the early eighties, possibly at a faster rate than in the late seventies. Total food and industrial use of corn will likely reach 1 billion bushels by 1985.

CALL NUMBER: DNAL 1.941 S8F32

DESCRIPTORS: demand ; fuels ; milling ; corn

SUBJECTS: food

Hermanson, R.E. How to produce biogas from swine manure. Ext Bull Wash State Univ Coop Ext Serv Extension Bulletin - Washington State University, Cooperative Extension Service. Apr 1982. (1113) ; 8 p. ill.

CALL NUMBER: DNAL 275.29 W27P

LeBlanc, M. ; Prato, A. Producing ethanol from grain: agricultural impacts and feasibility. ERS staff report - United States Dept. of Agriculture, Economic Research Service. Aug 1982. (AGES820329) ; 42 p.

ABSTRACT: Extract: The Energy Security Act sets an alcohol production goal of at least 10 percent of the level of gasoline consumption in 1990. Such a high level of alcohol production, 8.4 billion gallons, is likely to have significant impacts on agricultural production, commodity prices, and farm income. If corn is the primary feedstock for ethanol production, the greatest impacts will occur in the corn and soybean subsectors. The soybean subsector is affected because the process of converting corn to ethanol produces high protein byproducts which can substitute for soybean meal in livestock rations.

CALL NUMBER: DNAL 916762(AGE)

DESCRIPTORS: energy ; economic analysis ; byproducts ; economic feasibility ; grains

SUBJECTS: Alternatives ; Fuel ; Gasoline

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Felker, P. ; Clark, P.R. ; Cannell, G.H. ; Osborn, J.F. Screening Prosopis (Mesquite or Algarrobo) for biofuel production on semiarid lands. USDA Forest Service general technical report PSW - United States, Pacific Southwest Forest and Range Experiment Station. June 1982. (58) ; p. 179-185. ill.  
CALL NUMBER: DNAL aSD11.A325

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Leshner, W.G. Statement by Assistant Secretary of Agriculture William G. Leshner, on H.R. 6142 before the House Agriculture Committee's Subcommittee on Wheat, Soybeans and Feed Grains, September 15, 1982. Major news releases and speeches - United States Department of Agriculture, Office of Governmental and Public Affairs. Sept 3/17, 1982. ; p. 16-19.  
CALL NUMBER: DNAL aS21.A8U51  
DESCRIPTORS: laws and regulations ; United States

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Scarrah, W. Alcohol separation techniques. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 27-32.  
CALL NUMBER: DNAL 275.29 M76C

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Jutila, J. Barley to maltose syrup to alcohol. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 100-101.  
CALL NUMBER: DNAL 275.29 M76C  
DESCRIPTORS: byproducts ; feeds ; Montana

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Ott, S.L. Comparing residual production from two alcohol fuel processes: an economic evaluation. Occasional paper - Ohio State University, Dept. of Agricultural Economics and Rural Sociology, Cooperative Extension Service. Sept 1981. (ESO 863) ; 14 p.  
ABSTRACT: Extract: Alcohol may be produced from corn using one of several alternative processes. In this economic analysis, two processes, each with a somewhat different mix of by-product residues are compared. They are the conventional distillery process and a milling process. The milling process has higher capital and start-up costs, but these are more than offset by lower operating costs and higher by-product values. From a broader societal view the milling process is also favored since its by-products--corn gluten meal, corn gluten feed, fodder yeast, and corn oil--are better feed and food substitutes for soybean products than the distillers' dried grain and solubles produced from the conventional distillery process. This allows greater land substitution between soybeans and corn which results in somewhat lower food price increases at given levels of alcohol production.  
CALL NUMBER: DNAL HD1411.O3  
DESCRIPTORS: production technology  
SUBJECTS: Comparative analysis ; Fuel ; Synthetics

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McConnen, D. Economics of biofuels. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 114-118.  
CALL NUMBER: DNAL 275.29 M76C

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Rask, N. ; Ott, S. An emerging Ohio alcohol industry: impacts on agriculture. Socio-economic information - Cooperative Extension Service, Ohio State Univ, Agricultural Economics and Rural Sociology. July 1981. (635) ; 4 p.  
CALL NUMBER: DNAL 275.29 OH32TI  
DESCRIPTORS: land values ; Ohio ; United States  
SUBJECTS: agricultural production ; production ; Fuel ; Implications ; Synthetics

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Shelhamer, C.V. Engine adjustment and modification for automobile use with alcohol. Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 110-113.  
CALL NUMBER: DNAL 275.29 M76C

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Brensdal, G. Evaluation and wrap-up. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 135-139. ill.  
CALL NUMBER: DNAL 275.29 M76C  
DESCRIPTORS: Montana

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: alcohol from biomass. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0810) ; 3 p.

CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: alcohol fuel production--BATF regulations. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0794) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: alcohol fuel production incentives. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0795) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

DESCRIPTORS: laws and regulations

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Ebeling, J.M. Fuel alcohol: basic fuel properties. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0802) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: butanol/acetone. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0813) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: byproducts--carbon dioxide. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0799) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: cellulose conversion technology. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0811) ; 3 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: chemistry and microbiology. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0800) ; 3 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: continuous fermentation. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0809) ; 3 p. ill.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: diesel engines. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0804) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: distillation principles. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0801) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: extrusion cooking. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0808) ; 3 p.

CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: information sources--general information. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0792) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: methanol. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0812) ; 2 p.

CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: plant design characteristics. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0805) ; 2 p.  
CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: safety. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0807) ; 2 p.  
CALL NUMBER: DNAL 275.29 W27P

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Ebeling, J.M. Fuel alcohol: spark ignition engines. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0803) ; 2 p.  
CALL NUMBER: DNAL 275.29 W27P

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Waelti, H. ; Ebeling, J.M. Fuel alcohol: the production decision and worksheet. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0806) ; 15 p.  
CALL NUMBER: DNAL 275.29 W27P  
DESCRIPTORS: ethanol production

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Brannan, C.F. Fuel alcohol: tips on equipment sales contracts. Extension bulletin - Washington State University, Cooperative Extension Service. June 1981. (0793) ; 3 p.  
CALL NUMBER: DNAL 275.29 W27P

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Jutla, J. Introduction of the Biofuels and other renewable Energy Forum. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 1-2.  
CALL NUMBER: DNAL 275.29 M76C

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Black, J.R. ; Waller, J.C. ; Steinmetz, L.M. ; Ross, J.W. Nutritional requirements and economic value of fuel alcohol by-products. NRAES - Northeast Regional Agricultural Engineering Service, Cooperative Extension. Sept 15/16, 1981. (17) ; p. 49-74.

ABSTRACT: Extract: This paper derives the economic value of the by-products of fuel ethanol production. The focus is upon distillers grains with solubles and its component parts, distillers grains and distillers solubles. The discussion is based on products that have been produced by the beverage alcohol industry. However, the results should apply to the product with higher moisture, providing the moisture content is not excessive and that the product has not molded or spoiled during handling and storage.

CALL NUMBER: DNAL 921856(AGE)

DESCRIPTORS: fuels ; feed formulation ; byproducts ; grains ; feeds

SUBJECTS: production

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Size makes operation of fuel alcohol still on FS farm impractical; continue study. Farmer cooperatives - U.S. Dept. of Agriculture, Agricultural Cooperative Service. Sept 1981. v. 48 (6) ; p. 24-29.

CALL NUMBER: DNAL 166.2 N47

DESCRIPTORS: technology ; United States

SUBJECTS: efficiency ; Alternatives ; Fuel ; On-farm ; Synthetics

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Taraba, J.L. ; Turner, G.M. ; Razor, R. The use of ethanol as an unmixed fuel for internal combustion engines. AEES - University of Kentucky, Cooperative Extension Service. Feb 1981. (14) ; 19 p. ill.  
CALL NUMBER: DNAL S494.5.E5A4

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Larsen, B. What's happening at MSU--current research and the future. Bulletin - Cooperative Extension Service. Montana State University. Apr 1981. (1253) ; p. 10-12.

CALL NUMBER: DNAL 275.29 M76C

DESCRIPTORS: Montana

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Meyer, V.M. Alcohol as a farm engine fuel. PM - Cooperative Extension Service, Iowa State University. Jan 1980. (933b) ; 4 p.

CALL NUMBER: DNAL 275.29 IO9PA

DESCRIPTORS: combustion ; ethanol

SUBJECTS: Alcohol

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Smith, J.L. ; Workman, J.P. Alcohol for motor fuels. Bulletin - Colorado State University, Cooperative Extension Service. Jan 1, 1980. (5.010) ; 2 p. ill.  
CALL NUMBER: DNAL 275.29 C71E  
SUBJECTS: Alcohol ; Organic

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Marley, S.J. ; Smith, R.J. ; Buchele, W.F. ; Tevis, J.W. ; Chaplin, J. ; Smith, D.R. Alcohol production with a farm-size still. Energy in agriculture collection - Michigan State University, Department of Agricultural Engineering. NC:Forum on Alcohol Fuels, LC:Kansas State University, DC:1980. Feb 1980. ; p. 20-24. ill.  
CALL NUMBER: DNAL No Call No. (ENR)  
DESCRIPTORS: ethanol ; fermentation ; distillation  
SUBJECTS: requirements ; 033 ; Organic

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Fairbank, W.C. Biomass-biofuel-biogas - don't be bio-fooled. Economic and social issues - California University, Berkeley, Cooperative Extension Service. June/July 1980. ; 4 p.  
CALL NUMBER: DNAL HD1775.C2C32  
DESCRIPTORS: energy  
SUBJECTS: Fuel ; Synthetics

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Rask, N. Choosing between food and fuel. Energy in agriculture collection - Michigan State University, Department of Agricultural Engineering. NC:Forum on Alcohol Fuels, LC:Kansas State University, DC:1980. Feb 1980. ; p. 63-76. ill.  
CALL NUMBER: DNAL No Call No. (ENR)  
DESCRIPTORS: ethanol ; issues and policy  
SUBJECTS: Alcohol ; Organic ; Social Implications

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United States. Dept. of Agriculture. Economics and Statistics Service. International Economics Division. Consortium on trade research. ESS - United States Dept. of Agriculture, Economics and Statistics Service. Dec 1980. (2)  
ABSTRACT: Membership in the European Community (EC) for Greece, Spain, and Portugal may reduce trade between the United States and the EC in selected commodities; prospects for a North American Common Market are not bright; and the diversion of agricultural crops from export to fuel alcohol production would very likely increase, rather than reduce, balance-of-payment deficits for the United States and Brazil. The first meeting of the Consortium on Trade Research, established by the Economics and Statistics Service's International Economics Division and several universities, focused on and continues to analyze these and other global topics.  
CALL NUMBER: DNAL aHD1751.U56  
DESCRIPTORS: research ; marketing ; trade agreements ; products and commodities ; fuels ; European Union ; trade ; North America ; Greece ; Spain ; Portugal

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Ethanol production and utilization for fuel. Energy in agriculture collection - Michigan State University, Department of Agricultural Engineering. 1980.  
CALL NUMBER: DNAL No Call No. (ENR)  
DESCRIPTORS: ethanol

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Kyle, B.G. Evaluation of gasohol from an energy perspective. Energy in agriculture collection - Michigan State University, Department of Agricultural Engineering. Feb 1980.  
CALL NUMBER: DNAL No Call No. (ENR)  
DESCRIPTORS: ethanol

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Converse, J.C. Facts on power alcohol. Publication - Cooperative Extension Programs, University of Wisconsin Extension. Feb 1980. (A3074)  
CALL NUMBER: DNAL S544.3.W6W53

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Waelti, H., Ebeling, J.M. Fuel alcohol: distillers dried grain-nutritional value. Extension bulletin - Washington State University, Cooperative Extension Service. June 1980. (0798)  
CALL NUMBER: DNAL 275.29 W27P

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Ofoli, B., Stout, B. Making ethanol for fuel on the farm. Extension bulletin E - Michigan State University, Cooperative Extension Service. Dec 1980. (E-1438)  
CALL NUMBER: DNAL 275.29 M58B

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Bentz, L.B. Manure's biogas powers dairy farm. Soil & water conservation news - United States Dept. of Agriculture, Soil Conservation Service. Sept 1980. v. 1 (6): p. 6-9. ill.

CALL NUMBER: DNAL aS622.S6

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Corah, L.R., Allee, G.; Kansas State University. Cooperative Extension Service. Nutritional value of alcohol-fuel by-products for cattle and swine. Energy in agriculture collection - Michigan State University, Department of Agricultural Engineering. 1980.

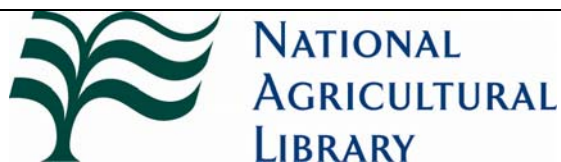
CALL NUMBER: DNAL No Call No. (ENR)

DESCRIPTORS: animal production ; ethanol

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**CRIS  
SEARCH**





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**Current Research Information System (USDA)**

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Item No. 1 of 602

**ACCESSION NO:** 0212376 **SUBFILE:** CRIS  
**PROJ NO:** ALX-BF **AGENCY:** CSREES AL.X  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Vaughan, B.; Bonsi, C.; Mortley, D.; Egnin, M.; Kpombekou, K.; Russell, A.; Ankumah, R.; Alexander, A. D.; Wang, B.; Huang, Z.; Zabawa, R.; Diabate, Y.

**PERFORMING INSTITUTION:**  
AGRICULTURE & HOME ECONOMICS  
TUSKEGEE UNIVERSITY  
TUSKEGEE, ALABAMA 36088

***EVALUATION OF SWEETPOTATO BIOMASS AS FEEDSTOCK FOR BIOFUEL (ETHANOL) PRODUCTION***

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Item No. 2 of 602

**ACCESSION NO:** 0192641 **SUBFILE:** CRIS  
**PROJ NO:** ALX-SRD-1 **AGENCY:** CSREES AL.X  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Zabawa, R.; Baharanyi, N.; Bonsi, E.; Ngandu, M.; Schelhas, J.; Kebede, E.

**PERFORMING INSTITUTION:**  
AGRICULTURE & HOME ECONOMICS  
TUSKEGEE UNIVERSITY  
TUSKEGEE, ALABAMA 36088

***IMPACT OF PROGRAMS, POLICIES AND TECHNOLOGIES FOR SUSTAINABLE RURAL AND COMMUNITY DEVELOPMENT FOR THE BLACK BELT ACCESS***

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Item No. 3 of 602

**ACCESSION NO:** 0202106 **SUBFILE:** CRIS  
**PROJ NO:** ALA02-011 **AGENCY:** CSREES ALA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Fasina, O. O.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS ENGINEERING  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36849

***PROCESSING OF NON-TRADITIONAL AGRICULTURAL MATERIALS FOR VALUE-ADDED UTILIZATION***

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Item No. 4 of 602

**ACCESSION NO:** 0200163 **SUBFILE:** CRIS  
**PROJ NO:** ALA03-055 **AGENCY:** CSREES ALA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Bransby, D. I.; Duffy, P.

**PERFORMING INSTITUTION:**  
AGRONOMY & SOILS  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36849

***AGRICULTURAL AND ENVIRONMENTAL BENEFITS FROM ENERGY, FIBER AND FORAGE CROPS IN ALABAMA***

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Item No. 5 of 602

**ACCESSION NO:** 0209129 **SUBFILE:** CRIS  
**PROJ NO:** ALA080-045 **AGENCY:** CSREES ALA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Loewenstein, E. F.; Smidt, M.; MacKenzie, M.; Zhang, Y.

**PERFORMING INSTITUTION:**  
FORESTY & WILDLIFE SCIENCES  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36849

***BIOMASS FROM THE WASTE STREAM: FEASIBILITY ANALYSIS FOR GENERATION OF ELECTRICITY FROM YARD WASTE***

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Item No. 6 of 602

**ACCESSION NO:** 0209130 **SUBFILE:** CRIS  
**PROJ NO:** ALA080-046 **AGENCY:** CSREES ALA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Teeter, L.; Laband, D.

**PERFORMING INSTITUTION:**  
FORESTY & WILDLIFE SCIENCES  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36849

***BIOMASS: A FOREST-BASED ECONOMIC DEVELOPMENT OPTION FOR THE RURAL SOUTH***

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Item No. 7 of 602

**ACCESSION NO:** 0212249 **SUBFILE:** CRIS  
**PROJ NO:** ALA080-056 **AGENCY:** CSREES ALA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2010

**INVESTIGATOR:** van Santen, E.; Wood, C. W.; Mitchell, C. C.

**PERFORMING INSTITUTION:**  
AGRONOMY & SOILS  
AUBURN UNIVERSITY  
AUBURN, ALABAMA 36849

***IMPROVING NATIVE BIOFUEL PRODUCTION THROUGH AGRONOMY AND PLANT BREEDING***

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Item No. 8 of 602

**ACCESSION NO:** 0210677 **SUBFILE:** CRIS  
**PROJ NO:** ALAR-2007-02186 **AGENCY:** CSREES ALAR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35504-18253 **PROPOSAL NO:** 2007-02186  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$100,000

**INVESTIGATOR:** Taconi, K. A.

**PERFORMING INSTITUTION:**  
UNIVERSITY OF ALABAMA IN HUNTSVILLE  
301 SPARKMAN DRIVE  
HUNTSVILLE, ALABAMA 35899

***BIOLOGICAL CONVERSION OF BIODIESEL-DERIVED CRUDE GLYCEROL TO PRODUCE VALUE-ADDED INDUSTRIAL PRODUCTS***

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Item No. 9 of 602

**ACCESSION NO:** 0212847 **SUBFILE:** CRIS  
**PROJ NO:** ALAX-011-32007 **AGENCY:** CSREES ALAX  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 15 NOV 2007 **TERM:** 15 NOV 2010

**INVESTIGATOR:** Cebert, E.

**PERFORMING INSTITUTION:**  
PLANT & SOIL SCIENCES  
ALABAMA A&M UNIVERSITY  
4900 MERIDIAN STREET  
NORMAL, ALABAMA 35762

***EVALUATION OF ALTERNATIVE FEEDSTOCK FOR SUSTAINABLE BIOFUEL PRODUCTION  
IN AN AGROFORESTRY SYSTEM***

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Item No. 10 of 602

**ACCESSION NO:** 0205170 **SUBFILE:** CRIS  
**PROJ NO:** ALAX-011-606 **AGENCY:** CSREES ALAX  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Bishnoi, U.; Cebert, E.; Ward, R.

**PERFORMING INSTITUTION:**  
PLANT & SOIL SCIENCES  
ALABAMA A & M UNIVERSITY  
NORMAL, ALABAMA 35762

***DEVELOPMENT OF AN INTEGRATED PROGRAM OF BREEDING, PRODUCTION AND PEST  
MANAGEMENT FOR CANOLA***

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Item No. 11 of 602

**ACCESSION NO:** 0204967 **SUBFILE:** CRIS  
**PROJ NO:** ALAZ00033 **AGENCY:** CSREES ALAZ  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Gallagher, T. V.

**PERFORMING INSTITUTION:**  
SCHOOL OF FORESTRY AND WILDLIFE SCIENCES  
AUBURN UNIVERSITY  
108 M. WHITE SMITH HALL  
AUBURN, ALABAMA 36849

***HARVESTING AND TRANSPORTATION OF BIOFUELS***

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Item No. 12 of 602

**ACCESSION NO:** 0211751 **SUBFILE:** CRIS  
**PROJ NO:** ALAZ00044 **AGENCY:** CSREES ALAZ

**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Teeter, L. D.

**PERFORMING INSTITUTION:**  
SCHOOL OF FORESTRY AND WILDLIFE SCIENCES  
AUBURN UNIVERSITY  
108 M. WHITE SMITH HALL  
AUBURN, ALABAMA 36849

*TIMBER AVAILABILITY IN A CHANGING MARKET - NEW OWNERS & NEW OPPORTUNITIES.*

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Item No. 13 of 602

**ACCESSION NO:** 0186580 **SUBFILE:** CRIS  
**PROJ NO:** ALK-00-07 **AGENCY:** CSREES ALK  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-34418-9709 **PROPOSAL NO:** 2000-05880  
**START:** 15 SEP 2000 **TERM:** 14 SEP 2003 **FY:** 2003 **GRANT YR:** 2000  
**GRANT AMT:** \$397,587

**INVESTIGATOR:** Lewis, C. E.; Knight, C. W.

**PERFORMING INSTITUTION:**  
SCHOOL OF AGRICULTURE & LAND RESOURCES MANAGEMENT  
UNIVERSITY OF ALASKA  
FAIRBANKS, ALASKA 99775

*NEW CROPS OPPORTUNITY*

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Item No. 14 of 602

**ACCESSION NO:** 0407505 **SUBFILE:** CRIS  
**PROJ NO:** 5347-21410-004-00D **AGENCY:** ARS 5347  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 24 JUL 2003 **TERM:** 23 JUL 2008 **FY:** 2006

**INVESTIGATOR:** COFFELT T A; DIERIG D A; SALVUCCI M E

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE - US ARID-LAND RESEARCH CENTER  
21881 NORTH CARDON LANE  
MARICOPA, ARIZONA 85239

*EVALUATION, IMPROVEMENT, AND DEVELOPMENT OF NEW/ALTERNATIVE INDUSTRIAL CROPS*

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Item No. 15 of 602

**ACCESSION NO:** 0207034 **SUBFILE:** CRIS  
**PROJ NO:** ARZT-136025-H-25-194 **AGENCY:** CSREES ARZT  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Kroken, S.

**PERFORMING INSTITUTION:**  
PLANT SCIENCE  
UNIVERSITY OF ARIZONA  
TUCSON, ARIZONA 85721

***THE SIGNIFICANCE OF FUNGAL PATHOGENS AND ENDOPHYTES OF TEOSINTE TO UNDERSTANDING AND MITIGATING DISEASE OF CORN***

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Item No. 16 of 602

**ACCESSION NO:** 0207917 **SUBFILE:** CRIS  
**PROJ NO:** ARZT-136220-H-22-129 **AGENCY:** CSREES ARZT  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Cuello, J. L.

**PERFORMING INSTITUTION:**  
AGRI & BIOSYSTEMS ENGINEERING  
UNIVERSITY OF ARIZONA  
TUCSON, ARIZONA 85721

***BIODIESEL PRODUCTION FROM ALGAE***

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Item No. 17 of 602

**ACCESSION NO:** 0182521 **SUBFILE:** CRIS  
**PROJ NO:** ARK01809 **AGENCY:** CSREES ARK  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Popp, M. P.

**PERFORMING INSTITUTION:**  
AGRICULTURAL ECONOMICS & AGRIBUSINESS  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

***DECISION SUPPORT FOR AGRICULTURAL PRODUCTION AND AGRIBUSINESS MANAGEMENT***

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Item No. 18 of 602

**ACCESSION NO:** 0186089 **SUBFILE:** CRIS  
**PROJ NO:** ARK01863 **AGENCY:** CSREES ARK  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2006

**INVESTIGATOR:** Bacon, R. K.

**PERFORMING INSTITUTION:**  
CROP, SOIL & ENVIRONMENTAL SCIENCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*BREEDING AND TESTING OF WINTER GRAIN CROPS*

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Item No. 19 of 602

**ACCESSION NO:** 0194496 **SUBFILE:** CRIS  
**PROJ NO:** ARK01973 **AGENCY:** CSREES ARK  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Pelkki, M. H.

**PERFORMING INSTITUTION:**  
FORESTRY AND NATURAL RESOURCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*USING NUMERICAL METHODS TO IMPROVE ECONOMIC EFFICIENCY OF FOREST  
MANAGEMENT*

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Item No. 20 of 602

**ACCESSION NO:** 0194501 **SUBFILE:** CRIS  
**PROJ NO:** ARK01974 **AGENCY:** CSREES ARK  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 01 FEB 2003 **TERM:** 31 JAN 2008 **FY:** 2006

**INVESTIGATOR:** Mehmood, S.

**PERFORMING INSTITUTION:**  
FORESTRY AND NATURAL RESOURCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*ECONOMIC AND POLICY ASPECTS OF FOREST RESOURCE MANAGEMENT*

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Item No. 21 of 602



**ACCESSION NO:** 0194581 **SUBFILE:** CRIS  
**PROJ NO:** ARK01975 **AGENCY:** CSREES ARK  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Carrier, D. J.; Kim, J. W.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 22 of 602

**ACCESSION NO:** 0195467 **SUBFILE:** CRIS  
**PROJ NO:** ARK01984 **AGENCY:** CSREES ARK  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 01 JAN 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Ficklin, R. L.

**PERFORMING INSTITUTION:**  
FORESTRY AND NATURAL RESOURCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*INTERACTIONS OF ARKANSAS FOREST VEGETATION WITH SOILS RELATIVE TO FOREST  
PRODUCTIVITY AND VALUE*

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Item No. 23 of 602

**ACCESSION NO:** 0207224 **SUBFILE:** CRIS  
**PROJ NO:** ARK02096 **AGENCY:** CSREES ARK  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34317-17584 **PROPOSAL NO:** 2006-06096  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$426,065

**INVESTIGATOR:** Kluender, R. A.

**PERFORMING INSTITUTION:**  
FORESTRY AND NATURAL RESOURCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

*ARKANSAS FOREST RESOURCES CENTER: A CONTINUING PROGRAM, PHASE XIII*

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**ACCESSION NO:** 0208630 **SUBFILE:** CRIS  
**PROJ NO:** ARK02126 **AGENCY:** CSREES ARK  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** West, C. P.; Rosenkrans, C. F.; Gunter, S. A.; Costello, T. A.; Popp, M.

**PERFORMING INSTITUTION:**  
CROP, SOIL & ENVIRONMENTAL SCIENCES  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

***PHYSIOLOGY AND MANAGEMENT OF FORAGE AND BIOENERGY CROP GENETIC  
RESOURCES IN RELATION TO ENVIRONMENTAL CONSTRAINTS***

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Item No. 25 of 602

**ACCESSION NO:** 0210978 **SUBFILE:** CRIS  
**PROJ NO:** ARK02144 **AGENCY:** CSREES ARK  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2008-35503-18663 **PROPOSAL NO:** 2007-02611  
**START:** 15 NOV 2007 **TERM:** 14 NOV 2008 **GRANT YR:** 2008  
**GRANT AMT:** \$25,000

**INVESTIGATOR:** King, J. W.

**PERFORMING INSTITUTION:**  
STATION ADMINISTRATION  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

***ACQUISITION OF A ACCELERATED SOLVENT EXTRACTION UNIT TO ENHANCE RESERACH  
IN SUBCRITICAL WATER PROCESSING OF VALUE-ADDED PRODUTS AND CONVERSI***

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Item No. 26 of 602

**ACCESSION NO:** 0212034 **SUBFILE:** CRIS  
**PROJ NO:** ARK02156 **AGENCY:** CSREES ARK  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Green, S.

**PERFORMING INSTITUTION:**  
STATION ADMINISTRATION  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

***EVALUATION OF SOIL AND WATER QUALITY IMPACTS OF ENERGY AND OTHER  
ALTERNATIVE CROP PRODUCTION SYSTEMS IN EASTERN ARKANSAS***

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Item No. 27 of 602

**ACCESSION NO:** 0209444 **SUBFILE:** CRIS  
**PROJ NO:** ARK09800 **AGENCY:** CSREES ARK  
**PROJ TYPE:** RREA **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Riley, T. L.; Walkingstick, T. L.

**PERFORMING INSTITUTION:**  
EXTENSION  
UNIVERSITY OF ARKANSAS  
FAYETTEVILLE, ARKANSAS 72703

***RREA PROGRAM***

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Item No. 28 of 602

**ACCESSION NO:** 0404615 **SUBFILE:** CRIS  
**PROJ NO:** 5302-13000-009-00D **AGENCY:** ARS 5302  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 27 FEB 2002 **TERM:** 26 FEB 2007 **FY:** 2006

**INVESTIGATOR:** AYARS J E; BANUELOS G S; GAO S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PARLIER, CALIFORNIA 93648

***IRRIGATION AND DRAINAGE WATER MANAGEMENT TO SUSTAIN PRODUCTIVITY AND  
PROTECT WATER QUALITY***

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Item No. 29 of 602

**ACCESSION NO:** 0405477 **SUBFILE:** CRIS  
**PROJ NO:** 5302-13000-009-07T **AGENCY:** ARS 5302  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 JAN 2003 **TERM:** 30 JUN 2005 **FY:** 2004

**INVESTIGATOR:** BANUELOS G S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PARLIER, CALIFORNIA 93648

***DEVELOPING BIOFUEL AND SE-ENRICHED FORAGE FROM CANOLA IRRIGATED WITH SE-  
LADEN DRAINAGE WATERS ON THE WESTSIDE OF CENTRAL CALIFORNIA***

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**ACCESSION NO:** 0407536 **SUBFILE:** CRIS  
**PROJ NO:** 5325-21000-010-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 24 JUL 2003 **TERM:** 23 JUL 2008 **FY:** 2006

**INVESTIGATOR:** ANDERSON O D; MATTHEWS D E; LAZO G R; GU Y Q

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

***DATABASE AND BIOINFORMATIC RESOURCES FOR SMALL GRAINS RESEARCH AND CROP IMPROVEMENT***

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Item No. 31 of 602

**ACCESSION NO:** 0401945 **SUBFILE:** CRIS  
**PROJ NO:** 5325-41000-035-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 MAY 1998 **TERM:** 30 APR 2003 **FY:** 2005

**INVESTIGATOR:** WONG D; VACANT; ZAHNLEY J C; SMITH M R; VACANT; ROBERTSON G H

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

***CONVERSION OF CROPS TO PRODUCTS WITH HIGHER ADDED VALUE THROUGH DIRECTED MOLECULAR EVOLUTION***

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Item No. 32 of 602

**ACCESSION NO:** 0402814 **SUBFILE:** CRIS  
**PROJ NO:** 5325-41000-037-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 12 MAY 1999 **TERM:** 11 MAY 2004 **FY:** 2004

**INVESTIGATOR:** ROBERTSON G H; OFFEMAN R D; ORTS W J; WOOD D F

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

***ENABLING TECHNOLOGIES FOR WHEAT STARCH AND PROTEIN SEPARATION, DRYING, AND UTILIZATION***

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Item No. 33 of 602

**ACCESSION NO:** 0407461 **SUBFILE:** CRIS  
**PROJ NO:** 5325-41000-041-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 MAY 2003 **TERM:** 23 MAR 2005 **FY:** 2005

**INVESTIGATOR:** WONG D; LEE C C; WAGSCHAL K C; SMITH M R; WOOD D F

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

*CONVERSION OF CROPS TO VALUE-ADDED PRODUCTS BY DIRECTED MOLECULAR EVOLUTION*

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Item No. 34 of 602

**ACCESSION NO:** 0408878 **SUBFILE:** CRIS  
**PROJ NO:** 5325-41000-045-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 12 MAY 2004 **TERM:** 06 JUN 2005 **FY:** 2005

**INVESTIGATOR:** ROBERTSON G H; OFFEMAN R D; ORTS W J; WOOD D F

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

*ENABLING TECHNOLOGIES FOR WHEAT STARCH AND PROTEIN SEPARATION, DRYING, AND UTILIZATION*

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Item No. 35 of 602

**ACCESSION NO:** 0409351 **SUBFILE:** CRIS  
**PROJ NO:** 5325-41000-046-00D **AGENCY:** ARS 5325  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 24 MAR 2005 **TERM:** 23 MAR 2010 **FY:** 2006

**INVESTIGATOR:** WONG D; LEE C C; SMITH M R; WAGSCHAL K C; WOOD D F

**PERFORMING INSTITUTION:**  
WESTERN REGIONAL RES CENTER  
ALBANY, CALIFORNIA 94710

*EVOLUTIONARY ENZYME DESIGN FOR IMPROVED BIOREFINING OF CROPS AND RESIDUES*

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Item No. 36 of 602

**ACCESSION NO:** 0209711 **SUBFILE:** CRIS  
**PROJ NO:** CA-B\*-AEC-7626-RR **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1034  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Wright, B. D.; Zilberman, D.

**PERFORMING INSTITUTION:**  
AGRICULTURAL AND RESOURCE ECONOMICS  
UNIV OF CALIFORNIA  
BERKELEY, CALIFORNIA 94720

*IMPACT ANALYSES AND DECISION STRATEGIES FOR AGRICULTURAL RESEARCH*

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Item No. 37 of 602

**ACCESSION NO:** 0202712 **SUBFILE:** CRIS  
**PROJ NO:** CA-B\*-MIC-7378-RR **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** W-1168  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Buchanan, B. B.; Lemaux, P. G.

**PERFORMING INSTITUTION:**  
MICROBIAL BIOLOGY  
UNIV OF CALIFORNIA  
BERKELEY, CALIFORNIA 94720

*ENVIRONMENTAL AND GENETIC DETERMINANTS OF SEED QUALITY AND PERFORMANCE*

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Item No. 38 of 602

**ACCESSION NO:** 0194615 **SUBFILE:** CRIS  
**PROJ NO:** CA-D\*-BAE-7102-RR **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Zhang, R. H.; Jenkins, B. M.; VanderGheynst, J. S.

**PERFORMING INSTITUTION:**  
BIOLOGICAL AND AGRICULTURAL ENGINEERING  
UNIV OF CALIFORNIA  
DAVIS, CALIFORNIA 95616

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 39 of 602

**ACCESSION NO:** 0067383 **SUBFILE:** CRIS  
**PROJ NO:** CA-D\*-MCB-3146-H **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2006

**INVESTIGATOR:** Doi, R. H.

**PERFORMING INSTITUTION:**  
MOLECULAR AND CELLULAR BIOLOGY  
UNIV OF CALIFORNIA  
DAVIS, CALIFORNIA 95616

*STRUCTURE, FUNCTION, AND REGULATION OF CLOSTRIDIUM CELLUVORANS  
CELLULASE*

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Item No. 40 of 602

**ACCESSION NO:** 0195839 **SUBFILE:** CRIS  
**PROJ NO:** CA-D\*-MCB-7165-H **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Wilson, D. K.

**PERFORMING INSTITUTION:**  
MOLECULAR AND CELLULAR BIOLOGY  
UNIV OF CALIFORNIA  
DAVIS, CALIFORNIA 95616

*STRUCTURE-BASED OPTIMIZATION OF ENZYMES COMPOSING A XYLOSE ASSIMILATION  
PATHWAY*

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Item No. 41 of 602

**ACCESSION NO:** 0086877 **SUBFILE:** CRIS  
**PROJ NO:** CA-D\*-PLS-4194-H **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Labavitch, J. M.

**PERFORMING INSTITUTION:**  
PLANT SCIENCES  
UNIV OF CALIFORNIA  
DAVIS, CALIFORNIA 95616

*CELL WALL POLYSACCHARIDE STRUCTURE AND METABOLISM*

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Item No. 42 of 602



**ACCESSION NO:** 0210983 **SUBFILE:** CRIS  
**PROJ NO:** CA-D\*-PLS-7688-H **AGENCY:** CSREES CALB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Berry, A.

**PERFORMING INSTITUTION:**  
PLANT SCIENCES  
UNIV OF CALIFORNIA  
DAVIS, CALIFORNIA 95616

*DEVELOPMENT OF EFFICIENT PLANT-MICROBE SYSTEMS FOR ENERGY ALTERNATIVES*

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Item No. 43 of 602

**ACCESSION NO:** 0200576 **SUBFILE:** CRIS  
**PROJ NO:** CALK-2004-02681 **AGENCY:** CSREES CALK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-33610-15001 **PROPOSAL NO:** 2004-02681  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2007 **GRANT YR:** 2004  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Clough, R. C.

**PERFORMING INSTITUTION:**  
APPLIED BIOTECHNOLOGY INSTITUTE  
SAN LUIS OBISPO, CALIFORNIA 93407

*CELLULASES FOR BIOMASS CONVERSION FROM THE TRANSGENIC MAIZE PRODUCTION SYSTEM*

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Item No. 44 of 602

**ACCESSION NO:** 0203146 **SUBFILE:** CRIS  
**PROJ NO:** CALK-2005-00406 **AGENCY:** CSREES CALK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-15499 **PROPOSAL NO:** 2005-00406  
**START:** 01 MAY 2005 **TERM:** 30 MAR 2007 **GRANT YR:** 2005  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Li, Y.

**PERFORMING INSTITUTION:**  
NaSource Company  
Newbury Park, CALIFORNIA 91320

*LIGNIN-BASED POLYMERIC MATERIALS FROM BYPRODUCT OF BIOMASS CONVERSION*

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**ACCESSION NO:** 0195678 **SUBFILE:** CRIS  
**PROJ NO:** CALR-2003-00664 **AGENCY:** CSREES CALR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35300-13136 **PROPOSAL NO:** 2003-00664  
**START:** 01 JUN 2003 **TERM:** 30 JUN 2006 **FY:** 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$250,000

**INVESTIGATOR:** Groover, A. T.

**PERFORMING INSTITUTION:**  
INSTITUTE OF FOREST GENETICS  
USDA FOREST SERVICE  
1100 WEST CHILES RD.  
DAVIS, CALIFORNIA 95616

*SYSTEMS FOR GENE DISCOVERY AND CHARACTERIZATION IN POPLARS*

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Item No. 46 of 602

**ACCESSION NO:** 0209914 **SUBFILE:** CRIS  
**PROJ NO:** CALZ-148 **AGENCY:** CSREES CALZ  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 APR 2007 **TERM:** 30 SEP 2010

**INVESTIGATOR:** Han, H.

**PERFORMING INSTITUTION:**  
FORESTRY  
HUMBOLDT STATE UNIV  
ARCATA, CALIFORNIA 95521

*INTEGRATED HARVESTING OF SMALL-DIAMETER TREES AND FOREST BIOMASS*

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Item No. 47 of 602

**ACCESSION NO:** 0209403 **SUBFILE:** CRIS  
**PROJ NO:** PSW-4103-01 **AGENCY:** FS PSW  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 24 OCT 2005 **TERM:** 24 OCT 2010 **FY:** 2006

**INVESTIGATOR:** Groover, A. T.

**PERFORMING INSTITUTION:**  
PSW INSTITUTE OF FOREST GENETICS, DAVIS, CA  
PACIFIC SOUTHWEST RESEARCH STATION  
800 BUCHANAN STREET, WEST BLDG  
ALBANY, CALIFORNIA 94710-0011

*DETERMINE THE GENETIC BASIS OF ADAPTIVE AND ECONOMIC TRAITS THROUGH  
DEVELOPMENT AND APPLICATION OF GENOMIC TOOLS.*

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Item No. 48 of 602

**ACCESSION NO:** 0206084 **SUBFILE:** CRIS  
**PROJ NO:** PSW-4202-05 **AGENCY:** FS PSW  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 10 MAR 2005 **TERM:** 10 MAR 2015 **FY:** 2006

**INVESTIGATOR:** Stine, P. A.; Nechodom, M. A.

**PERFORMING INSTITUTION:**  
PSW SIERRA NEVADA RESEARCH, DAVIS, CA  
PACIFIC SOUTHWEST RESEARCH STATION  
800 BUCHANAN STREET, WEST BLDG  
ALBANY, CALIFORNIA 94710-0011

*INSTITUTIONAL AND POLICY PROCESSES*

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Item No. 49 of 602

**ACCESSION NO:** 0404255 **SUBFILE:** CRIS  
**PROJ NO:** 5402-11000-006-00D **AGENCY:** ARS 5402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 26 FEB 2001 **TERM:** 16 NOV 2004 **FY:** 2004

**INVESTIGATOR:** MOSIER A R; HUTCHINSON G L; FOLLETT R F

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
2150 CENTRAL AVENUE, BLDG D  
FORT COLLINS, COLORADO 80526

*LAND USE, LAND MGMT. AND CLIMATE CHG: INTERACTIONS OF C/N CYCL, TRACE GAS  
FLUXES AND SOIL QUAL. AGROE*

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Item No. 50 of 602

**ACCESSION NO:** 0403208 **SUBFILE:** CRIS  
**PROJ NO:** 5402-11000-006-11R **AGENCY:** ARS 5402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 10 SEP 1999 **TERM:** 09 SEP 2004 **FY:** 2004

**INVESTIGATOR:** FOLLETT R F

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
2150 CENTRAL AVENUE, BLDG D  
FORT COLLINS, COLORADO 80526

*IMPLICATIONS OF USING CORN STALKS AS A BIOFUEL SOURCE*

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Item No. 51 of 602

**ACCESSION NO:** 0409098 **SUBFILE:** CRIS  
**PROJ NO:** 5402-11000-007-00D **AGENCY:** ARS 5402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 17 NOV 2004 **TERM:** 16 NOV 2009 **FY:** 2006

**INVESTIGATOR:** FOLLETT R F; DEL GROSSO S J

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
2150 CENTRAL AVENUE, BLDG D  
FORT COLLINS, COLORADO 80526

*INTERACTIONS BETWEEN LAND USE, LAND MGMT, AND CLIMATE CHANGE: RELATIONS  
TO CARBON AND NITROGEN CYCLING, TRACE GASES AND AGROECOSYSTEMS*

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Item No. 52 of 602

**ACCESSION NO:** 0404640 **SUBFILE:** CRIS  
**PROJ NO:** 5402-12130-007-00D **AGENCY:** ARS 5402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 06 MAY 2001 **TERM:** 05 MAY 2006 **FY:** 2006

**INVESTIGATOR:** HALVORSON A D; DELGADO J A; HUNTER W J; MANTER D K; FOLLETT R F

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
2150 CENTRAL AVENUE, BLDG D  
FORT COLLINS, COLORADO 80526

*IMPROVING SOIL AND NITROGEN MANAGEMENT SYSTEMS FOR SUSTAINING LAND AND  
WATER QUALITY*

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Item No. 53 of 602

**ACCESSION NO:** 0410759 **SUBFILE:** CRIS  
**PROJ NO:** 5402-12130-008-00D **AGENCY:** ARS 5402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 06 MAY 2006 **TERM:** 05 MAY 2011 **FY:** 2006

**INVESTIGATOR:** HALVORSON A D; MANTER D K; DELGADO J A; HUNTER W J; FOLLETT R F

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
2150 CENTRAL AVENUE, BLDG D  
FORT COLLINS, COLORADO 80526

***IMPROVING SOIL AND NUTRIENT MANAGEMENT SYSTEMS FOR SUSTAINED  
PRODUCTIVITY AND ENVIRONMENTAL QUALITY***

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Item No. 54 of 602

**ACCESSION NO:** 0404482 **SUBFILE:** CRIS  
**PROJ NO:** 5407-12130-005-00D **AGENCY:** ARS 5407  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 29 JUN 2001 **TERM:** 31 MAY 2006 **FY:** 2006

**INVESTIGATOR:** VIGIL M F; BENJAMIN J G; HENRY W B; CALDERON F J; MIKHA M M;  
NIELSEN D C

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
AKRON, COLORADO 80720

***DRYLAND CROPPING SYSTEMS MANAGEMENT FOR THE CENTRAL GREAT PLAINS***

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Item No. 55 of 602

**ACCESSION NO:** 0205763 **SUBFILE:** CRIS  
**PROJ NO:** COL00221A **AGENCY:** CSREES COL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1026  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Westra, P.

**PERFORMING INSTITUTION:**  
BIOAGRICULTURAL SCIENCES AND PEST MANAGEMENT  
COLORADO STATE UNIVERSITY  
FORT COLLINS, COLORADO 80523

***CHARACTERIZE WEED POPULATION DYNAMICS FOR IMPROVED LONG-TERM WEED  
MANAGEMENT DECISION MAKING***

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Item No. 56 of 602

**ACCESSION NO:** 0155045 **SUBFILE:** CRIS  
**PROJ NO:** COL00662-T **AGENCY:** CSREES COL  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2000 **TERM:** 30 JUN 2003 **FY:** 2003

**INVESTIGATOR:** Karim, M. N.; Linden, J. C.; Henk, L. L.; Schroeder, H. A.

**PERFORMING INSTITUTION:**  
CHEMICAL AND BIORESOURCE ENGINEERING  
COLORADO STATE UNIVERSITY  
FORT COLLINS, COLORADO 80523

**VALUE-ADDED CROP PROCESSING FOR ENZYME AND ETHANOL PRODUCTION**

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Item No. 57 of 602

**ACCESSION NO:** 0151594 **SUBFILE:** CRIS  
**PROJ NO:** COL00672 **AGENCY:** CSREES COL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012 **FY:** 2006

**INVESTIGATOR:** Pearson, C. H.

**PERFORMING INSTITUTION:**  
SOIL AND CROP SCIENCE  
COLORADO STATE UNIVERSITY  
FORT COLLINS, COLORADO 80523

***CROPS AND CROPPING SYSTEMS IN WESTERN COLORADO FOR  
TRADITIONAL/ALTERNATIVE AND INDUSTRIAL/BIOENERGY USES***

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Item No. 58 of 602

**ACCESSION NO:** 0178700 **SUBFILE:** CRIS  
**PROJ NO:** COL00737 **AGENCY:** CSREES COL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012 **FY:** 2006

**INVESTIGATOR:** Byrne, P. F.; Haley, S. D.; Brick, M. A.; Lapitan, N. L.; Schwartz, H. F.; Johnson, J. J.; Pilon-Smits, E. A.

**PERFORMING INSTITUTION:**  
SOIL AND CROP SCIENCE  
COLORADO STATE UNIVERSITY  
FORT COLLINS, COLORADO 80523

***MOLECULAR-MARKER-ASSISTED ANALYSIS OF QUANTITATIVE TRAITS FOR BREEDING  
WHEAT AND BREEDING DRY BEANS***

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Item No. 59 of 602

**ACCESSION NO:** 0206506 **SUBFILE:** CRIS  
**PROJ NO:** COLK-2006-00446 **AGENCY:** CSREES COLK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16838 **PROPOSAL NO:** 2006-00446  
**START:** 15 MAY 2006 **TERM:** 14 JAN 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Elliott, B. J.

**PERFORMING INSTITUTION:**  
TDA RESEARCH, INC.  
12345 WEST 52ND AVENUE  
WHEAT RIDGE, COLORADO 80033

***LOW-COST CONVERSION OF HIGH FREE FATTY ACID OILS AND FATS INTO METHYL ESTERS (BIODIESEL)***

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Item No. 60 of 602

**ACCESSION NO:** 0186141 **SUBFILE:** CRIS  
**PROJ NO:** COLR-2000-01922 **AGENCY:** CSREES COLR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-35504-9369 **PROPOSAL NO:** 2000-01922  
**START:** 15 AUG 2000 **TERM:** 28 FEB 2005 **FY:** 2002 **GRANT YR:** 2000  
**GRANT AMT:** \$200,000

**INVESTIGATOR:** Danna, K. J.

**PERFORMING INSTITUTION:**  
MOLECULAR & CELLULAR BIOLOGY  
UNIVERSITY OF COLORADO  
BOULDER, COLORADO 80309

***TARGETING CELLULASES TO CELLULAR COMPARTMENTS IN PLANTS FOR BIOFUELS PRODUCTION***

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Item No. 61 of 602

**ACCESSION NO:** 0184835 **SUBFILE:** CRIS  
**PROJ NO:** COLR-2000-02778 **AGENCY:** CSREES COLR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 99-35505-8685 **PROPOSAL NO:** 2000-02778  
**START:** 01 APR 2000 **TERM:** 31 MAR 2004 **FY:** 2004 **GRANT YR:** 2000  
**GRANT AMT:** \$300,000

**INVESTIGATOR:** Kompala, D. S.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
UNIVERSITY OF COLORADO  
BOULDER, COLORADO 80309

***MAXIMIZING ETHANOL PRODUCTION BY ENGINEERED PENTOSE-FERMENTING ZYMOMONAS MOBILIS***

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Item No. 62 of 602

**ACCESSION NO:** 0197477 **SUBFILE:** CRIS  
**PROJ NO:** RMRS-4156-1 **AGENCY:** FS RMRS



**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 07 JAN 2000 **TERM:** 07 JAN 2005 **FY:** 2006

**INVESTIGATOR:** Edminster, C. B.

**PERFORMING INSTITUTION:**  
 SW FOREST SCIENCE COMPLEX - FLAGSTAFF, AZ  
 ROCKY MOUNTAIN RESEARCH STATION  
 240 WEST PROSPECT ROAD  
 FORT COLLINS, COLORADO 80526-2098

***ECONOMICS, MARKETING AND UTILIZATION OPPORTUNITIES RELATED TO  
 ALTERNATIVE FOREST HEALTH RESTORATION AND FUELS MANAGEMENT ACTIVITIES***

Item No. 63 of 602

**ACCESSION NO:** 0204224 **SUBFILE:** CRIS  
**PROJ NO:** CONK-2005-03254 **AGENCY:** CSREES CONK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-16114 **PROPOSAL NO:** 2005-03254  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2007 **GRANT YR:** 2005  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Serio, M. A.

**PERFORMING INSTITUTION:**  
 ADVANCED FUEL RESEARCH, INC.  
 87 CHURCH STREET PO BOX 380379  
 EAST HARTFORD, CONNECTICUT 06138

***PROCESSING OF POULTRY MANURE FOR FUEL GAS PRODUCTION***

Item No. 64 of 602

**ACCESSION NO:** 0211231 **SUBFILE:** CRIS  
**PROJ NO:** CONK-2007-02595 **AGENCY:** CSREES CONK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18633 **PROPOSAL NO:** 2007-02595  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$317,525

**INVESTIGATOR:** Gardner, P.

**PERFORMING INSTITUTION:**  
 FREUND'S FARM INC.  
 324 NORFOLK ROAD  
 EAST CANAAN, CONNECTICUT 06024

***DEVELOPMENT OF HORTICULTURAL CONTAINERS FROM ANAEROBICALLY DIGESTED  
 COW MANURE***

**ACCESSION NO:** 0204290 **SUBFILE:** CRIS  
**PROJ NO:** CONR-2005-02659 **AGENCY:** CSREES CONR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-16058 **PROPOSAL NO:** 2005-02659  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$354,818

**INVESTIGATOR:** Parnas, R. S.; Asandei, A.

**PERFORMING INSTITUTION:**  
UNIV OF CONNECTICUT  
STORRS, CONNECTICUT 06269

*INVESTIGATION OF WHEAT GLUTEN FOR INDUSTRIAL COMPOSITES*

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Item No. 66 of 602

**ACCESSION NO:** 0212338 **SUBFILE:** CRIS  
**PROJ NO:** CONS00826 **AGENCY:** CSREES CONS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-506  
**START:** 01 AUG 2007 **TERM:** 31 JUL 2009

**INVESTIGATOR:** Li, Y.

**PERFORMING INSTITUTION:**  
PLANT SCIENCE  
UNIV OF CONNECTICUT  
STORRS, CONNECTICUT 06269

*WOOD UTILIZATION RESEARCH ON US BIOFUELS, BIOPRODUCTS, HYBRID  
BIOMATERIALS COMPOSITES PRODUCTION, AND TRADITIONAL FOREST PRODUCTS*

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Item No. 67 of 602

**ACCESSION NO:** 0208884 **SUBFILE:** CRIS  
**PROJ NO:** DEL00626 **AGENCY:** CSREES DEL  
**PROJ TYPE:** RREA **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Abbott, D. C.

**PERFORMING INSTITUTION:**  
COOPERATIVE EXTENSION  
UNIVERSITY OF DELAWARE  
NEWARK, DELAWARE 19717

*RREA PROGRAM*

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**ACCESSION NO:** 0206482 **SUBFILE:** CRIS  
**PROJ NO:** DELK-2006-00200 **AGENCY:** CSREES DELK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16821 **PROPOSAL NO:** 2006-00200  
**START:** 01 MAY 2006 **TERM:** 31 DEC 2007 **GRANT YR:** 2006  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Stookey, D. J.

**PERFORMING INSTITUTION:**  
COMPACT MEMBRANE SYSTEMS, INC.  
325 WATER STREET  
WILMINGTON, DELAWARE 19804

*AGRICULTURAL EMISSIONS REDUCTION USING BIO-FUELS WITH MEMBRANE SUPPLIED NITROGEN*

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Item No. 69 of 602

**ACCESSION NO:** 0206163 **SUBFILE:** CRIS  
**PROJ NO:** DCR-2006-00658 **AGENCY:** CSREES DC.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-35504-16709 **PROPOSAL NO:** 2006-00658  
**START:** 15 MAR 2006 **TERM:** 14 MAR 2007 **GRANT YR:** 2006  
**GRANT AMT:** \$10,000

**INVESTIGATOR:** Wall, J. D.

**PERFORMING INSTITUTION:**  
AMERICAN SOCIETY FOR MICROBIOLOGY  
1752 N STREET, NW  
WASHINGTON, DISTRICT OF COLUMBIA 20036

*MICROBIAL PRODUCTION OF ENERGY*

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Item No. 70 of 602

**ACCESSION NO:** 0209884 **SUBFILE:** CRIS  
**PROJ NO:** DCR-2007-02449 **AGENCY:** CSREES DC.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35300-17910 **PROPOSAL NO:** 2007-02449  
**START:** 01 APR 2007 **TERM:** 31 MAY 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$15,000

**INVESTIGATOR:** Tang, E.

**PERFORMING INSTITUTION:**  
THE NATIONAL ACADEMIES  
500 FIFTH STREET, NW  
WASHINGTON, DISTRICT OF COLUMBIA 20001

***THE NATIONAL PLANT GENOME INITIATIVE: ACHIEVEMENTS AND FUTURE DIRECTIONS***

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Item No. 71 of 602

**ACCESSION NO:** 0212195 **SUBFILE:** CRIS  
**PROJ NO:** DCW-2007-05016 **AGENCY:** CSREES DC.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-38832-18641 **PROPOSAL NO:** 2007-05016  
**START:** 15 SEP 2007 **TERM:** 14 MAY 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$25,000

**INVESTIGATOR:** Koshel, P.

**PERFORMING INSTITUTION:**  
The National Academy of Sciences  
Washington, DISTRICT OF COLUMBIA 20001

***FEDERAL SUSTAINABILITY RESEARCH AND DEVELOPMENT FORUM***

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Item No. 72 of 602

**ACCESSION NO:** 0406090 **SUBFILE:** CRIS  
**PROJ NO:** GAM-400 **AGENCY:** ERS MTED  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Westcott, P.; Price, J.; Schnepf, R.; Seeley, R.; Shane, M.; Stillman, R.; Sundell, P.; Torgerson, D.; Young, E.

**PERFORMING INSTITUTION:**  
Economic Research Service  
USDA/ERS  
1800 M STREET NW  
WASHINGTON, DISTRICT OF COLUMBIA 20036

***BASELINE ANALYSIS***

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Item No. 73 of 602

**ACCESSION NO:** 0403860 **SUBFILE:** CRIS  
**PROJ NO:** 6621-41000-008-00D **AGENCY:** ARS 6621  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 05 JAN 2000 **TERM:** 15 JUN 2004 **FY:** 2004

**INVESTIGATOR:** WIDMER W W; LUZIO G A; CAMERON R G

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE

600 AVENUE S, N. W.  
WINTER HAVEN, FLORIDA 33881

***ENHANCED UTILIZATION OF PECTIN AND GALACTURONIC ACID DERIVATIVES***

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Item No. 74 of 602

**ACCESSION NO:** 0408510 **SUBFILE:** CRIS  
**PROJ NO:** 6621-41000-011-00D **AGENCY:** ARS 6621  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 16 JUN 2004 **TERM:** 15 JUN 2009 **FY:** 2006

**INVESTIGATOR:** WIDMER W W; LUZIO G A; CAMERON R G; NARCISO J A

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
600 AVENUE S, N. W.  
WINTER HAVEN, FLORIDA 33881

***ENHANCED UTILIZATION OF CARBOHYDRATES AND POLYSACCHARIDES FROM CITRUS  
PROCESSING WASTE STREAMS***

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Item No. 75 of 602

**ACCESSION NO:** 0408779 **SUBFILE:** CRIS  
**PROJ NO:** 6621-41000-011-01T **AGENCY:** ARS 6621  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 JUN 2004 **TERM:** 31 MAY 2007

**INVESTIGATOR:** WIDMER W W; LUZIO G A; CAMERON R G

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
600 AVENUE S, N. W.  
WINTER HAVEN, FLORIDA 33881

***DEVELOPMENT OF A COMMERCIAL SCALE SYSTEM FOR PRODUCTION OF ETHANOL AND  
OTHER BYPRODUCTS FROM CITRUS WASTE***

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Item No. 76 of 602

**ACCESSION NO:** 0408443 **SUBFILE:** CRIS  
**PROJ NO:** 6621-41000-011-02S **AGENCY:** ARS 6621  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** WIDMER W W; LUZIO G A; CAMERON R G

**PERFORMING INSTITUTION:**

STATE OF FLORIDA DEPARTMENT OF CITRUS  
CITRUS RES CENTER, LAKE ALFRED  
700 EXPERIMENT STATION ROAD  
LAKE ALFRED, FLORIDA 33850

***DEVELOPMENT OF NEW PROCESSES TO OBTAIN ETHANOL AND OTHER PRODUCTS FROM CITRUS PROCESSING WASTE STREAMS***

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Item No. 77 of 602

**ACCESSION NO:** 0200684 **SUBFILE:** CRIS

**PROJ NO:** FLA-ABE-04201 **AGENCY:** CSREES FLA

**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW

**CONTRACT/GRANT/AGREEMENT NO:** 2004-34135-14710 **PROPOSAL NO:** 2004-05079

**START:** 15 SEP 2004 **TERM:** 14 SEP 2006 **FY:** 2006 **GRANT YR:** 2004

**GRANT AMT:** \$100,000

**INVESTIGATOR:** Jones, J. W.

**PERFORMING INSTITUTION:**

AGRICULTURAL AND BIOLOGICAL ENGINEERING  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

***IMPROVING ECONOMIC EFFICIENCY AND REDUCING ENVIRONMENTAL IMPACT IN THE U.S. SUGARCANE INDUSTRY THROUGH A SYSTEMS-BASED APPROACH***

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Item No. 78 of 602

**ACCESSION NO:** 0208546 **SUBFILE:** CRIS

**PROJ NO:** FLA-FOR-04548 **AGENCY:** CSREES FLA

**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW

**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Alavalapati, J. R.; Carter, D. R.

**PERFORMING INSTITUTION:**

FOREST RESOURCES AND CONSERVATION  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

***SUSTAINING FORESTED RESOURCES THROUGH MARKET SOLUTIONS***

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Item No. 79 of 602

**ACCESSION NO:** 0211740 **SUBFILE:** CRIS

**PROJ NO:** FLA-MCS-004675 **AGENCY:** CSREES FLA

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** SDC-325

**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Ingram, L. O.; Shanmugam, K. T.; Maupin-Furlow, J. A.; Preston, J. F.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 80 of 602

**ACCESSION NO:** 0187687 **SUBFILE:** CRIS  
**PROJ NO:** FLA-MCS-03861 **AGENCY:** CSREES FLA  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 15 JAN 2001 **TERM:** 30 SEP 2005 **FY:** 2006

**INVESTIGATOR:** Davis, F. C.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*GENETIC ENGINEERING OF ZYMOMONAS MOBILIS FOR FUEL ETHANOL PRODUCTION*

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Item No. 81 of 602

**ACCESSION NO:** 0186471 **SUBFILE:** CRIS  
**PROJ NO:** FLA-MCS-03899 **AGENCY:** CSREES FLA  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-52104-9704 **PROPOSAL NO:** 2000-04834  
**START:** 15 SEP 2000 **TERM:** 30 SEP 2004 **FY:** 2004 **GRANT YR:** 2000  
**GRANT AMT:** \$2,000,000

**INVESTIGATOR:** Ingram, L. O.; Shanmugam, K. T.; Preston, J. F.; Maupin, J. A.; Aldrich, H. C.;  
Buszko, M. L.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*APPLICATION OF FUNCTIONAL GENOMICS TO RECOMBINANT BIOCATALYSTS FOR  
FUELS AND CHEMICALS*

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Item No. 82 of 602

**ACCESSION NO:** 0189177 **SUBFILE:** CRIS  
**PROJ NO:** FLA-MCS-03979 **AGENCY:** CSREES FLA



**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10669 **PROPOSAL NO:** 2001-01410  
**START:** 01 SEP 2001 **TERM:** 31 AUG 2004 **FY:** 2005 **GRANT YR:** 2001  
**GRANT AMT:** \$300,000

**INVESTIGATOR:** Ingram, L. O.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*ENGINEERING BACTERIA FOR FUEL ETHANOL PRODUCTION*

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Item No. 83 of 602

**ACCESSION NO:** 0196467 **SUBFILE:** CRIS  
**PROJ NO:** FLA-MCS-04131 **AGENCY:** CSREES FLA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 02 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Shanmugan, K. T.; Davis, F. C.; Ingram, L. O.; Maupin, J. A.; Preston, J. F.; Aldrich, H. C.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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**ACCESSION NO:** 0208640 **SUBFILE:** CRIS  
**PROJ NO:** FLA-MCS-04581 **AGENCY:** SAES FLA  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2011 **FY:** 2006

**INVESTIGATOR:** INGRAM, L. O.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY AND CELL SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*ENGINEERING BIOCATALYSTS FOR RENEWABLE FUELS AND CHEMICALS FROM BIOMASS*

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Item No. 85 of 602

**ACCESSION NO:** 0192052 **SUBFILE:** CRIS  
**PROJ NO:** FLA-SWS-04015 **AGENCY:** CSREES FLA  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED **MULTISTATE PROJ NO:** S-1000  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2007 **FY:** 2005

**INVESTIGATOR:** Wilkie, A. C.

**PERFORMING INSTITUTION:**  
SOIL AND WATER SCIENCE  
UNIVERSITY OF FLORIDA  
GAINESVILLE, FLORIDA 32610

*ANIMAL MANURE AND WASTE UTILIZATION, TREATMENT AND NUISANCE AVOIDANCE  
FOR A SUSTAINABLE AGRICULTURE*

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Item No. 86 of 602

**ACCESSION NO:** 0405731 **SUBFILE:** CRIS  
**PROJ NO:** 6602-21410-004-00D **AGENCY:** ARS 6602  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 18 SEP 2002 **TERM:** 17 SEP 2007 **FY:** 2006

**INVESTIGATOR:** WILSON J P; MAAS A L; ANDERSON W F; HOLBROOK JR C C

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
TIFTON, GEORGIA 31793

*GENETIC ENHANCEMENT AND MANAGEMENT OF WARM-SEASON GRASS SPECIES FOR  
FORAGE AND ALTERNATIVE USES*

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Item No. 87 of 602

**ACCESSION NO:** 0408769 **SUBFILE:** CRIS  
**PROJ NO:** 6612-11630-002-01T **AGENCY:** ARS 6612  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 MAY 2004 **TERM:** 31 DEC 2008

**INVESTIGATOR:** HARPER L A

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
ATHENS, GEORGIA 30613

*NITROGEN AND CARBON GAS EMISSIONS FROM SWINE PRODUCTION IN UTAH*

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Item No. 88 of 602

**ACCESSION NO:** 0404273 **SUBFILE:** CRIS  
**PROJ NO:** 6612-44000-020-00D **AGENCY:** ARS 6612  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 11 APR 2001 **TERM:** 14 SEP 2004 **FY:** 2004

**INVESTIGATOR:** NELSON S O

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
ATHENS, GEORGIA 30613

***SENSING MOISTURE CONTENT AND QUALITY OF GRAIN AND OTHER AGRICLTRL  
PRODUCTS BY DIELECTRIC PROPERTIES***

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Item No. 89 of 602

**ACCESSION NO:** 0408540 **SUBFILE:** CRIS  
**PROJ NO:** 6612-44000-022-00D **AGENCY:** ARS 6612  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 04 JUN 2004 **TERM:** 03 JUN 2009 **FY:** 2006

**INVESTIGATOR:** AKIN D E

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
ATHENS, GEORGIA 30613

***FLAX FIBER FOR VALUE-ADDED, BIO-BASED PRODUCTS***

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Item No. 90 of 602

**ACCESSION NO:** 0191171 **SUBFILE:** CRIS  
**PROJ NO:** GEO00225 **AGENCY:** CSREES GEO  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED **MULTISTATE PROJ NO:** S-1000  
**START:** 01 DEC 2001 **TERM:** 30 NOV 2007 **FY:** 2006

**INVESTIGATOR:** Newton, G. L.; Hubbard, R. K.; Gascho, G. J.; Risse, M.; Gates, R. N.; Allison, J. R.;  
Dove, C. R.; Bernard, J. K.

**PERFORMING INSTITUTION:**  
ANIMAL & DAIRY SCIENCE  
UNIVERSITY OF GEORGIA  
110 RIVERBEND ROAD  
ATHENS, GEORGIA 30602

***ANIMAL MANURE AND WASTE UTILIZATION, TREATMENT AND NUISANCE AVOIDANCE  
FOR A SUSTAINABLE AGRICULTURE***

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Item No. 91 of 602

**ACCESSION NO:** 0202684 **SUBFILE:** CRIS  
**PROJ NO:** GEO00546 **AGENCY:** CSREES GEO  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 FEB 2005 **TERM:** 31 JAN 2010 **FY:** 2006

**INVESTIGATOR:** Kastner, J. R.; Das, K. C.; Sellers, J.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
UNIVERSITY OF GEORGIA  
110 RIVERBEND ROAD  
ATHENS, GEORGIA 30602

***DEVELOPMENT OF A BIOREFINERY PROCESS FOR ENERGY PRODUCTION, VALUE ADDED PRODUCTS, AND ADVANCED CATALYSTS***

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Item No. 92 of 602

**ACCESSION NO:** 0204195 **SUBFILE:** CRIS  
**PROJ NO:** GEO00566 **AGENCY:** CSREES GEO  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2005 **TERM:** 01 JUL 2009 **FY:** 2006

**INVESTIGATOR:** Thompson, S. A.; Das, K. C.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
UNIVERSITY OF GEORGIA  
110 RIVERBEND ROAD  
ATHENS, GEORGIA 30602

***OPTIMIZING THE ENGINEERING PROPERTIES OF BIOMASS FOR USE AS BIOREFINERY FEEDSTOCK***

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Item No. 93 of 602

**ACCESSION NO:** 0187823 **SUBFILE:** CRIS  
**PROJ NO:** GEO00921 **AGENCY:** CSREES GEO  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 JAN 2001 **TERM:** 31 DEC 2005 **FY:** 2006

**INVESTIGATOR:** Goodrum, J. W.; Sellers, J.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
UNIVERSITY OF GEORGIA  
110 RIVERBEND ROAD  
ATHENS, GEORGIA 30602

***OIL-BASED METHYL ESTERS FOR POTENTIAL USE AS DIESEL LUBRICITY ADDITIVE, BIODIESEL AND GREEN SOLVENT***

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Item No. 94 of 602

**ACCESSION NO:** 0202794 **SUBFILE:** CRIS  
**PROJ NO:** GEOE-2005-00602 **AGENCY:** CSREES GEOE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-51160-02277 **PROPOSAL NO:** 2005-00602  
**START:** 01 APR 2005 **TERM:** 31 MAR 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$99,998

**INVESTIGATOR:** Kanemasu, E. T.; Ames, G. C.; Kisaalita, W. S.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
UNIVERSITY OF GEORGIA  
110 RIVERBEND ROAD  
ATHENS, GEORGIA 30602

*THE GLOBAL UNIVERSITY: PARTNERSHIPS FOR INTERNATIONALIZING STUDENTS,  
FACULTY AND STAKEHOLDERS TO BE GLOBAL CITIZENS*

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Item No. 95 of 602

**ACCESSION NO:** 0196361 **SUBFILE:** CRIS  
**PROJ NO:** GEOR-2003-01080 **AGENCY:** CSREES GEOR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35504-13620 **PROPOSAL NO:** 2003-01080  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$175,000

**INVESTIGATOR:** Ragauskas, A. J.

**PERFORMING INSTITUTION:**  
INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY  
500 10TH STREET, NW  
ATLANTA, GEORGIA 30318-5794

*NOVEL BIOMASS PROCESSING CHEMISTRY*

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Item No. 96 of 602

**ACCESSION NO:** 0201966 **SUBFILE:** CRIS  
**PROJ NO:** GEOR-2004-05743 **AGENCY:** CSREES GEOR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35503-15220 **PROPOSAL NO:** 2004-05743  
**START:** 01 OCT 2004 **TERM:** 30 NOV 2007 **FY:** 2005 **GRANT YR:** 2005  
**GRANT AMT:** \$179,413

**INVESTIGATOR:** Chen, R.

**PERFORMING INSTITUTION:**

SCHOOL OF CHEMICAL AND BIOMOLECULAR ENGINEERING  
Georgia Tech Research Corporation, Georgia Institute of Technology  
Atlanta, GEORGIA 30332

***ENZYMATIC RECOVERY OF FERULIC ACID FROM AGRICULTURAL RESIDUES FOR  
NATURAL VANILLIN PRODUCTION***

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Item No. 97 of 602

**ACCESSION NO:** 0210678 **SUBFILE:** CRIS  
**PROJ NO:** GEOR-2007-02134 **AGENCY:** CSREES GEOR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35504-18254 **PROPOSAL NO:** 2007-02134  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2011 **GRANT YR:** 2007  
**GRANT AMT:** \$496,503

**INVESTIGATOR:** Chen, R.

**PERFORMING INSTITUTION:**

OFFICE OF SPONSORED PROGRAMS  
Georgia Tech Research Corp, Georgia Inst of Technology  
Atlanta, GEORGIA 30332

***DEVELOPMENT OF A SYNERGISTIC HEMICELLULASE SYSTEM FOR COST EFFECTIVE  
BIOMASS PROCESSING***

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Item No. 98 of 602

**ACCESSION NO:** 0206711 **SUBFILE:** CRIS  
**PROJ NO:** GEOW-2006-06228 **AGENCY:** CSREES GEOW  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38869-03552 **PROPOSAL NO:** 2006-06228  
**START:** 01 AUG 2006 **TERM:** 31 JUL 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$825,636

**INVESTIGATOR:** Wilson, D.; Masters, M. H.; Thompson, B.; Cummings, R.; Rowles, K.

**PERFORMING INSTITUTION:**

ALBANY STATE UNIVERSITY  
504 COLLEGE DRIVE  
ALBANY, GEORGIA 31705

***AGRICULTURE WATER POLICY, GEORGIA***

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Item No. 99 of 602

**ACCESSION NO:** 0193849 **SUBFILE:** CRIS  
**PROJ NO:** GEOZ-0111-MS **AGENCY:** CSREES GEOZ

**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 JAN 2003 **TERM:** 31 DEC 2008 **FY:** 2006

**INVESTIGATOR:** Nairn, C. J.

**PERFORMING INSTITUTION:**  
SCHOOL OF FORESTRY & NATURAL RESOURCES  
UNIVERSITY OF GEORGIA  
ATHENS, GEORGIA 30602-2152

***THE ROLE OF GLYCOSYLTRANSFERASES AND TRANSCRIPTION FACTORS IN WOOD  
FORMATION***

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Item No. 100 of 602

**ACCESSION NO:** 0194405 **SUBFILE:** CRIS  
**PROJ NO:** GEOZ-0140-MS **AGENCY:** CSREES GEOZ  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** PENDING REVISION  
**START:** 01 NOV 2007 **TERM:** 31 OCT 2012 **FY:** 2006

**INVESTIGATOR:** Harris, T. G.

**PERFORMING INSTITUTION:**  
SCHOOL OF FORESTRY & NATURAL RESOURCES  
UNIVERSITY OF GEORGIA  
ATHENS, GEORGIA 30602-2152

***GEORGIA'S TIMBER RESOURCE: STATUS, TRENDS AND AVAILABILITY FOR PUBLIC AND  
PRIVATE INVESTMENT***

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Item No. 101 of 602

**ACCESSION NO:** 0196774 **SUBFILE:** CRIS  
**PROJ NO:** HAW00506-1017S **AGENCY:** SAES HAW  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2006

**INVESTIGATOR:** Yang, P. Y.

**PERFORMING INSTITUTION:**  
MOLECULAR BIOSCIENCES & BIOSYSTEMS  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

***MILK PARLOR WASTEWATER TREATMENT/REUSE - A PILOT STUDY FOR THE TROPICAL  
ISLAND APPLICATION***

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Item No. 102 of 602

**ACCESSION NO:** 0202033 **SUBFILE:** CRIS  
**PROJ NO:** HAW00506-1020S **AGENCY:** SAES HAW  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2007

**INVESTIGATOR:** Yang, P. Y.

**PERFORMING INSTITUTION:**  
MOLECULAR BIOSCIENCES & BIOSYSTEMS  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

***MILK PARLOR WASTEWATER TREATMENT/REUSE - A PILOT STUDY FOR THE TROPICAL ISLAND APPLICATION***

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Item No. 103 of 602

**ACCESSION NO:** 0191389 **SUBFILE:** CRIS  
**PROJ NO:** HAW00513-R **AGENCY:** CSREES HAW  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** S-1000  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Yang, P. Y.

**PERFORMING INSTITUTION:**  
MOLECULAR BIOSCIENCES & BIOSYSTEMS  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

***ANIMAL MANURE AND WASTE UTILIZATION, TREATMENT AND NUISANCE AVOIDANCE FOR A SUSTAINABLE AGRICULTURE***

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Item No. 104 of 602

**ACCESSION NO:** 0208275 **SUBFILE:** CRIS  
**PROJ NO:** HAW00578-H **AGENCY:** CSREES HAW  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2007

**INVESTIGATOR:** Fu, P.

**PERFORMING INSTITUTION:**  
MOLECULAR BIOSCIENCES & BIOSYSTEMS  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

***ETHANOL PRODUCTION FROM CYANOBACTERIUM SYNECHNOCYSTIS PCC 6803***

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**ACCESSION NO:** 0208654 **SUBFILE:** CRIS  
**PROJ NO:** HAW00888-H **AGENCY:** CSREES HAW  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Uehara, G.; Deenik, J.; Paull, R. E.

**PERFORMING INSTITUTION:**  
TROPICAL PLANT & SOIL SCIENCE  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

*BIOMASS FOR ETHANOL, BIODIESEL AND BIOCARBON PRODUCTION IN HAWAII*

Item No. 106 of 602

**ACCESSION NO:** 0208025 **SUBFILE:** CRIS  
**PROJ NO:** HAW00892-06G **AGENCY:** CSREES HAW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34135-17576 **PROPOSAL NO:** 2006-04767  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$120,000

**INVESTIGATOR:** Paull, R. E.; Radovich, T.

**PERFORMING INSTITUTION:**  
TROPICAL PLANT & SOIL SCIENCE  
UNIV OF HAWAII  
HONOLULU, HAWAII 96822

*TPSS CRITICAL RESEARCH NEEDS: SUSTAINABLE FARMING SYSTEMS IN HAWAII*

Item No. 107 of 602

**ACCESSION NO:** 0202020 **SUBFILE:** CRIS  
**PROJ NO:** IDA00407-CG **AGENCY:** CSREES IDA  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35101-15348 **PROPOSAL NO:** 2004-04114  
**START:** 15 DEC 2004 **TERM:** 14 DEC 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$613,000

**INVESTIGATOR:** Morra, M.

**PERFORMING INSTITUTION:**  
PLANT SOIL & ENTOMOLOGICAL SCI  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

*MANAGING MORE SUSTAINABLE AGROECOSYSTEMS USING MUSTARDS AND MUSTARD BYPRODUCTS*

**ACCESSION NO:** 0204825 **SUBFILE:** CRIS  
**PROJ NO:** IDA00504-SG **AGENCY:** CSREES IDA  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38624-16503 **PROPOSAL NO:** 2005-06315  
**START:** 15 SEP 2005 **TERM:** 14 SEP 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$184,773

**INVESTIGATOR:** Bohach, G. A.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

*FY 2005 CANOLA RESEARCH-PACIFIC NORTHWEST REGION*

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Item No. 109 of 602

**ACCESSION NO:** 0211901 **SUBFILE:** CRIS  
**PROJ NO:** IDA00701-SG **AGENCY:** CSREES IDA  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-38624-18600 **PROPOSAL NO:** 2007-04136  
**START:** 15 SEP 2007 **TERM:** 14 SEP 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$103,346

**INVESTIGATOR:** Bohach, G. A.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

*CANOLA RESEARCH - PACIFIC NORTHWEST REGION*

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Item No. 110 of 602

**ACCESSION NO:** 0184324 **SUBFILE:** CRIS  
**PROJ NO:** IDA01182 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 1999 **TERM:** 30 JUN 2004 **FY:** 2004

**INVESTIGATOR:** Peterson, C. L.

**PERFORMING INSTITUTION:**  
BIOLOGICAL AND AGRICULTURAL ENGINEERING  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

*ENGINEERING OPPORTUNITIES TO ENHANCE AGRICULTURAL PROFITABILITY*

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Item No. 111 of 602

**ACCESSION NO:** 0185654 **SUBFILE:** CRIS  
**PROJ NO:** IDA01209 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2000 **TERM:** 30 JUN 2006 **FY:** 2006

**INVESTIGATOR:** Makus, L.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***EVALUATING RISK MANAGEMENT ALTERNATIVES FOR THE PACIFIC NORTHWEST***

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Item No. 112 of 602

**ACCESSION NO:** 0192353 **SUBFILE:** CRIS  
**PROJ NO:** IDA01240 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2002 **TERM:** 30 JUN 2007 **FY:** 2006

**INVESTIGATOR:** He, B.

**PERFORMING INSTITUTION:**  
BIOLOGICAL AND AGRICULTURAL ENGINEERING  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***NOVEL PROCESSING AND ISOLATION PROCESSES OF HIGH ERUCIC ACID OILSEEDS FOR VALUE-ADDED INDUSTRIAL PRODUCTS***

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Item No. 113 of 602

**ACCESSION NO:** 0198158 **SUBFILE:** CRIS  
**PROJ NO:** IDA01260 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** W-1147  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Chun, W.

**PERFORMING INSTITUTION:**  
PLANT SOIL & ENTOMOLOGICAL SCI  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***MANAGING PLANT MICROBE INTERACTIONS IN SOIL TO PROMOTE SUSTAINABLE AGRICULTURE***

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Item No. 114 of 602

**ACCESSION NO:** 0202388 **SUBFILE:** CRIS  
**PROJ NO:** IDA01291 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Shrestha, D. S.

**PERFORMING INSTITUTION:**  
BIOLOGICAL AND AGRICULTURAL ENGINEERING  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***FUEL FROM OIL CROPS: PROTECTION, FEASIBILITY AND TECHNOLOGY***

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Item No. 115 of 602

**ACCESSION NO:** 0202836 **SUBFILE:** CRIS  
**PROJ NO:** IDA01296 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Brown, J.

**PERFORMING INSTITUTION:**  
PLANT SOIL & ENTOMOLOGICAL SCI  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***DEVELOPING SUPERIOR OILSEED AND MUSTARD CULTIVARS FOR BRASSICACEAE***

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Item No. 116 of 602

**ACCESSION NO:** 0203992 **SUBFILE:** CRIS  
**PROJ NO:** IDA01309 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2010 **FY:** 2006

**INVESTIGATOR:** Morra, M. J.

**PERFORMING INSTITUTION:**  
PLANT SOIL & ENTOMOLOGICAL SCI  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***IMPROVING SUSTAINABILITY IN AGROECOSYSTEMS USING MUSTARDS***

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**ACCESSION NO:** 0210914 **SUBFILE:** CRIS  
**PROJ NO:** IDA01368 **AGENCY:** CSREES IDA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012

**INVESTIGATOR:** He, B.

**PERFORMING INSTITUTION:**  
BIOLOGICAL AND AGRICULTURAL ENGINEERING  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***VALUE-ADDED PROCESSING OF LOW-GRADE GLYCEROL FROM BIODIESEL PRODUCTION  
TO SUSTAIN THE INDUSTRY AND ENCOURAGE OIL CROP ECONOMY***

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Item No. 118 of 602

**ACCESSION NO:** 0208607 **SUBFILE:** CRIS  
**PROJ NO:** IDA0603-SG **AGENCY:** CSREES IDA  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38624-17711 **PROPOSAL NO:** 2006-06316  
**START:** 15 SEP 2006 **TERM:** 14 SEP 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$175,258

**INVESTIGATOR:** Bohach, G. A.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***FY2006 CANOLA RESEARCH - PACIFIC NORTHWEST REGION***

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Item No. 119 of 602

**ACCESSION NO:** 0200244 **SUBFILE:** CRIS  
**PROJ NO:** IDAE-2004-02760 **AGENCY:** CSREES IDAE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-38411-14743 **PROPOSAL NO:** 2004-02760  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2008 **GRANT YR:** 2004  
**GRANT AMT:** \$284,009

**INVESTIGATOR:** HE, B.; Peterson, C. L.; Huber, K. C.; Yuksel, G. U.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGRICULTURAL ENGINEERING  
UNIV OF IDAHO  
MOSCOW, IDAHO 83843

***CURRICULUM DEVELOPMENT: BIOREFINERY PROCESS ANALYSIS AND DESIGN***

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Item No. 120 of 602

**ACCESSION NO:** 0408563 **SUBFILE:** CRIS  
**PROJ NO:** 0500-00076-001-02G **AGENCY:** ARS 0200  
**PROJ TYPE:** USDA CONTRACT **PROJ STATUS:** NEW  
**START:** 01 AUG 2004 **TERM:** 31 JUL 2008

**INVESTIGATOR:** FIREOVID R L; HICKS K B

**PERFORMING INSTITUTION:**  
SOUTHERN ILLINOIS UNIVERSITY  
EDWARDSVILLE, ILLINOIS 62026

***ARS RESEARCH IN NATIONAL CORN TO ETHANOL PILOT PLANT***

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Item No. 121 of 602

**ACCESSION NO:** 0407632 **SUBFILE:** CRIS  
**PROJ NO:** 0500-00076-001-01S **AGENCY:** ARS 0500  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 01 AUG 2003 **TERM:** 31 JUL 2004

**INVESTIGATOR:** ERBACH D C; HICKS K B

**PERFORMING INSTITUTION:**  
SOUTHERN ILLINOIS UNIVERSITY  
EDWARDSVILLE, ILLINOIS 62026

***ARS RESEARCH AT NATIONAL CORN TO ETHANOL PILOT PLANT***

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Item No. 122 of 602

**ACCESSION NO:** 0403771 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-070-03S **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** TERMINATED  
**START:** 25 SEP 2000 **TERM:** 29 SEP 2004

**INVESTIGATOR:** MOREAU R A; SINGH V; RAUSCH K; JOHNSTON D; HICKS K B

**PERFORMING INSTITUTION:**  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***ENZYMATIC STEEPING PROCESS FOR CORN WET MILLING***

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Item No. 123 of 602

**ACCESSION NO:** 0404776 **SUBFILE:** CRIS  
**PROJ NO:** 3620-22410-005-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2001 **TERM:** 15 JUN 2004 **FY:** 2004

**INVESTIGATOR:** LABEDA D P; O DONNELL K; PETERSON S W; ROONEY A P; KURTZMAN C P; WARD T J

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***DEVELOPMENT AND CHARACTERIZATION OF THE ARS MICROBIAL GERMPLOSM COLLECTION***

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Item No. 124 of 602

**ACCESSION NO:** 0402651 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-080-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 03 MAY 1999 **TERM:** 02 MAY 2004 **FY:** 2004

**INVESTIGATOR:** SKORY C D; TISSERAT B; COTTA M A

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***CONVERSION OF RENEWABLE MATERIALS INTO BIOPRODUCTS THROUGH FUNGAL, ENZYMATIC, AND PLANT TECHNOLOGIES***

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Item No. 125 of 602

**ACCESSION NO:** 0403945 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-084-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 15 DEC 2000 **TERM:** 08 AUG 2004 **FY:** 2004

**INVESTIGATOR:** DIEN B S; NICHOLS N N; LI X; MERTENS J A; JORDAN D B; COTTA M A

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***BIOPROCESS AND METABOLIC ENGINEERING TECHNOLOGIES FOR BIOFUELS AND VALUE-ADDED COPRODUCTS***

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Item No. 126 of 602

**ACCESSION NO:** 0404097 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-087-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 22 DEC 2000 **TERM:** 18 SEP 2004 **FY:** 2004

**INVESTIGATOR:** ERHAN S Z; DUNN R O; HOLSER R A; KNOTHE G H

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*VEGETABLE OIL-BASED ALTERNATIVE DIESEL FUELS, EXTENDERS, AND ADDITIVES*

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Item No. 127 of 602

**ACCESSION NO:** 0405121 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-095-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 30 JAN 2002 **TERM:** 15 JUN 2004 **FY:** 2004

**INVESTIGATOR:** HOU C T; KUO T; KURTZMAN C P

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*BIOCATALYTIC PROCESSES FOR CONVERTING SOYBEAN OIL TO VALUE-ADDED INDUSTRIAL PRODUCTS*

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Item No. 128 of 602

**ACCESSION NO:** 0405376 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-098-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 FEB 2002 **TERM:** 18 SEP 2004 **FY:** 2004

**INVESTIGATOR:** BISCHOFF K M; LIU S; HUGHES S R

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*BIOCATALYSTS TO PRODUCE BIOFUELS*

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Item No. 129 of 602

**ACCESSION NO:** 0405277 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-101-00D **AGENCY:** ARS 3620



**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 16 FEB 2002 **TERM:** 08 AUG 2004 **FY:** 2004

**INVESTIGATOR:** ERHAN S Z; LIU Z

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*CHEMICAL SYSTEMS FOR THE CONVERSION OF VEGETABLE OILS TO INDUSTRIAL PRODUCTS*

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Item No. 130 of 602

**ACCESSION NO:** 0405320 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-104-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 20 APR 2002 **TERM:** 30 SEP 2003 **FY:** 2003

**INVESTIGATOR:** WILLET J L; GORDON S H

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*BIOCHEMICAL MODIFICATIONS AND DEGRADATION OF BIOBASED MATERIALS*

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**ACCESSION NO:** 0408515 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-110-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 03 MAY 2004 **TERM:** 02 MAY 2009 **FY:** 2006

**INVESTIGATOR:** SKORY C D

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*PATHWAY ENGINEERING OF FUNGI FOR IMPROVED BIOPROCESS APPLICATIONS*

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Item No. 132 of 602

**ACCESSION NO:** 0408614 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-113-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 16 JUN 2004 **TERM:** 15 JUN 2009 **FY:** 2006

**INVESTIGATOR:** HOU C T; KUO T; KURTZMAN C P

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*NEW MICROBIAL SYSTEMS FOR UTILIZATION OF GLYCEROL AND PLANT LIPIDS*

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Item No. 133 of 602

**ACCESSION NO:** 0408626 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-114-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 16 JUN 2004 **TERM:** 15 JUN 2009 **FY:** 2006

**INVESTIGATOR:** SHOGREN R L; BISWAS A; FANTA G F; SELLING G W; FELKER F C;  
WILLETT J L

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*MODIFICATION OF NATURAL POLYMERS BY THERMO-MECHANICAL PROCESSING*

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Item No. 134 of 602

**ACCESSION NO:** 0408837 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-115-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 29 JUL 2004 **TERM:** 28 JUL 2009 **FY:** 2006

**INVESTIGATOR:** CERMAK S C; EVANGELISTA R L; HARRY O KURU R E; ISBELL T

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

*INDUSTRIAL PRODUCTS FROM NEW CROPS*

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Item No. 135 of 602

**ACCESSION NO:** 0408864 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-117-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 09 AUG 2004 **TERM:** 08 AUG 2009 **FY:** 2006

**INVESTIGATOR:** ERHAN S Z; DOLL K M; LIU Z

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***CHEMICAL SYSTEMS FOR SOYBEAN OIL CONVERSION TO INDUSTRIAL PRODUCTS***

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Item No. 136 of 602

**ACCESSION NO:** 0408893 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-118-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 09 AUG 2004 **TERM:** 08 AUG 2009 **FY:** 2006

**INVESTIGATOR:** DIEN B S; NICHOLS N N; JORDAN D B; LI X; MERTENS J A; COTTA M A

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***INDUSTRIALLY ROBUST ENZYMES AND MICROORGANISMS FOR PRODUCTION OF SUGARS AND ETHANOL FROM AGRICULTURAL BIOMASS***

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Item No. 137 of 602

**ACCESSION NO:** 0409200 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-118-05R **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 JUN 2007 **FY:** 2005

**INVESTIGATOR:** COTTA M A

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***DEVELOPMENT OF SUSTAINABLE BIOBASED PRODUCTS & BIOENERGY IN COOPERATION WITH MIDWEST CONSORTIUM FOR SUSTAINABLE BIOBASED PRODUCTS & ENERGY***

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Item No. 138 of 602

**ACCESSION NO:** 0408950 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-121-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 19 SEP 2004 **TERM:** 18 SEP 2009 **FY:** 2006

**INVESTIGATOR:** BISCHOFF K M; HUGHES S R; LIU S

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***MICROBIAL CATALYSTS TO PRODUCE FUEL ETHANOL AND VALUE ADDED PRODUCTS***

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Item No. 139 of 602

**ACCESSION NO:** 0408951 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-122-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2009 **FY:** 2006

**INVESTIGATOR:** SAHA B C; QURESHI N; HECTOR R E; COTTA M A

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***COST-EFFECTIVE BIOPROCESS TECHNOLOGIES FOR PRODUCTION OF BIOFUELS FROM LIGNOCELLULOSIC BIOMASS***

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**ACCESSION NO:** 0408989 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-124-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 19 SEP 2004 **TERM:** 18 SEP 2009 **FY:** 2006

**INVESTIGATOR:** ERHAN S Z; DUNN R O; KNOTHE G H; HOLSER R A; MOSER B R; JOHNSEN P B

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***IMPROVING THE PERFORMANCE OF ALTERNATIVE FUELS AND CO-PRODUCTS FROM VEGETABLE OILS***

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Item No. 141 of 602

**ACCESSION NO:** 0403100 **SUBFILE:** CRIS  
**PROJ NO:** 3620-42000-022-00D **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 28 JAN 2000 **TERM:** 25 NOV 2003 **FY:** 2003

**INVESTIGATOR:** KURTZMAN C P; WARD T J; PETERSON S W; O DONNELL K; ROONEY A P; LABEDA D P

**PERFORMING INSTITUTION:**  
NORTHERN REGIONAL RES CENTER  
PEORIA, ILLINOIS 61604

***MOLECULAR GENOMICS OF PLANT PATHOGENS AND FOOD SAFETY MICROORGANISMS***

Item No. 142 of 602

**ACCESSION NO:** 0206855 **SUBFILE:** CRIS  
**PROJ NO:** ILLE-2006-02181 **AGENCY:** CSREES ILLE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38414-16925 **PROPOSAL NO:** 2006-02181  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$48,893

**INVESTIGATOR:** Sanderson, R. L.; Runner, J.; Hanfland, S.

**PERFORMING INSTITUTION:**  
LAKE LAND COLLEGE  
5001 LAKE LAND BLVD.  
MATTOON, ILLINOIS 61938

***INTEGRATING RENEWABLE ENERGY INTO THE SECONDARY AND POSTSECONDARY EDUCATION CURRICULUM***

Item No. 143 of 602

**ACCESSION NO:** 0206608 **SUBFILE:** CRIS  
**PROJ NO:** ILLK-2006-00483 **AGENCY:** CSREES ILLK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16796 **PROPOSAL NO:** 2006-00483  
**START:** 01 MAY 2006 **TERM:** 31 DEC 2007 **GRANT YR:** 2006  
**GRANT AMT:** \$79,998

**INVESTIGATOR:** Plewa, J. S.; Mueth, D. M.; Akcakir, O.; Tanner, E. B.

**PERFORMING INSTITUTION:**  
ARRAYX, INC.  
316 NORTH MICHIGAN AVENUE  
CHICAGO, ILLINOIS 60601

***HOLOGRAPHIC OPTICAL CELL MANIPULATION FOR AUTOMATED DEVELOPMENT OF IMPROVED YEAST STRAINS FOR ETHANOL PRODUCTION***

Item No. 144 of 602

**ACCESSION NO:** 0210649 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-000-531 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-55618-18160 **PROPOSAL NO:** 2007-02945

**START:** 01 SEP 2007 **TERM:** 31 AUG 2010 **GRANT YR:** 2007  
**GRANT AMT:** \$399,001

**INVESTIGATOR:** Agarwal-Tronetti, R.; Khanna, M.; Sonka, S.; Long, S.; Jain, A.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

*ENVIRONMENTAL, ECONOMIC AND BUSINESS OPPORTUNITIES IN THE BIOFUELS  
INDUSTRY FOR SMALL/MEDIUM FARMS*

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**ACCESSION NO:** 0189739 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-470-234 **AGENCY:** SAES ILLU  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2001 **TERM:** 30 JUN 2004 **FY:** 2003

**INVESTIGATOR:** Bullock, D. S.; Ando, M.; Khanna, M.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & CONSUMER ECONOMICS  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

*ETHANOL POLICY IN THE PRESENCE OF OTHER ECONOMIC DISTORTIONS: IS A WIN-WIN  
POLICY CHANGE POSSIBLE?*

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Item No. 146 of 602

**ACCESSION NO:** 0137810 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-470-307 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 1999 **TERM:** 30 SEP 2005 **FY:** 2005

**INVESTIGATOR:** Hornbaker, R. H.; Schmitkey, G. D.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & CONSUMER ECONOMICS  
UNIVERSITY OF ILLINOIS  
URBANA, ILLINOIS 61801

*ECONOMIC AND ENVIRONMENTAL COSTS AND BENEFITS ASSOCIATED WITH PRECISION  
FARMING TECHNOLOGY*

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**ACCESSION NO:** 0201357 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-470-316 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Ando, A. W.; Braden, J. B.; Brozovic, N.; Khanna, M.

**PERFORMING INSTITUTION:**  
 AGRICULTURAL & CONSUMER ECONOMICS  
 UNIVERSITY OF ILLINOIS  
 505 SOUTH GOODWIN AVENUE  
 URBANA, ILLINOIS 61801

*ENVIRONMENTAL ECONOMICS AND POLICY: SPACE, HETEROGENEITY AND AGENT BEHAVIOR*

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**ACCESSION NO:** 0198594 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-470-335 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-213  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Goldsmith, P. D.

**PERFORMING INSTITUTION:**  
 AGRICULTURAL & CONSUMER ECONOMICS  
 UNIVERSITY OF ILLINOIS  
 505 SOUTH GOODWIN AVENUE  
 URBANA, ILLINOIS 61801

*MANAGEMENT OF GRAIN QUALITY AND SECURITY FOR WORLD MARKETS*

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Item No. 149 of 602

**ACCESSION NO:** 0208939 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-470-370 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Bullock, D. S.; Allen-Smith, J.; Nelson, C.; Nelson, G.; Onal, H.; Thompson, R.; Winter-Nelson, A.

**PERFORMING INSTITUTION:**  
 AGRICULTURAL & CONSUMER ECONOMICS  
 UNIVERSITY OF ILLINOIS  
 505 SOUTH GOODWIN AVENUE  
 URBANA, ILLINOIS 61801

***MEASURING THE ECONOMIC IMPACTS OF AGRICULTURAL POLICY AND TECHNOLOGY,  
AND UNDERSTANDING THEIR POLITICAL CAUSES AND CONSEQUENCES***

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**ACCESSION NO:** 0212312 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-483-352 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Goldsmith, P. D.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***THE SOYBEAN DISEASE BIOTECHNOLOGY CENTER***

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**ACCESSION NO:** 0187870 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-538-376 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Morgenroth, E.

**PERFORMING INSTITUTION:**  
ANIMAL SCIENCES  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***CHARACTERIZATION OF PARTICULATE ORGANIC MATTER IN SWINE MANURE -  
AVAILABILITY OF ORGANIC SUBSTRATE FOR BIOLOGICAL NUTRIENT REMOVAL  
PROCESSES***

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Item No. 152 of 602

**ACCESSION NO:** 0186307 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-698-243 **AGENCY:** SAES ILLU  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2000 **TERM:** 30 JUN 2004 **FY:** 2004

**INVESTIGATOR:** Qureshi, N.; Blaschek, H. P.



**PERFORMING INSTITUTION:**  
FOOD SCIENCE & HUMAN NUTRITION  
UNIVERSITY OF ILLINOIS  
URBANA, ILLINOIS 61801

***CONTINUOUS PRODUCTION OF BUTANOL FROM CORN AND RECOVERY BY GAS STRIPPING***

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**ACCESSION NO:** 0196415 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-741-315 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 JUN 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Grift, T. E.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***ADVANCED MACHINERY FOR BIOSYSTEMS APPLICATIONS***

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**ACCESSION NO:** 0206788 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-741-378 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Eckhoff, S. R.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE UNITED STATES GRAIN AND OILSE***

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**ACCESSION NO:** 0205251 **SUBFILE:** CRIS  
**PROJ NO:** ILLU-875-399 **AGENCY:** CSREES ILLU  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Zaborski, E. R.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCES & ENVIRONMENTAL SCIENCES  
UNIVERSITY OF ILLINOIS  
505 SOUTH GOODWIN AVENUE  
URBANA, ILLINOIS 61801

***SOIL MESOSTIGMATA: RELATION TO SOIL CONDITION AND POTENTIAL FOR  
BIOINDICATION***

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**ACCESSION NO:** 0407605 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-118-04S **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 03 SEP 2003 **TERM:** 31 AUG 2007 **FY:** 2003

**INVESTIGATOR:** DIEN B S; MOSIER N; COTTA M A

**PERFORMING INSTITUTION:**  
LAB OF RENEWABLE RESOURCES ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***DEVELOPMENT OF PRETREATMENT TECHNOLOGIES FOR ENHANCED ETHANOL  
PRODUCTION FROM BIOMASS***

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**ACCESSION NO:** 0094801 **SUBFILE:** CRIS  
**PROJ NO:** IND045023 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 01 OCT 2009 **FY:** 2006

**INVESTIGATOR:** Hertel, T. W.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***GLOBAL ECONOMIC ANALYSIS OF TRADE IN FARM AND FOOD PRODUCTS***

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**ACCESSION NO:** 0195992 **SUBFILE:** CRIS  
**PROJ NO:** IND045046 **AGENCY:** CSREES IND

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Alexander, C. E.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*ADDING VALUE TO COMMODITY MARKETS*

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**ACCESSION NO:** 0182958 **SUBFILE:** CRIS  
**PROJ NO:** IND045049 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Doering III, O. C.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*ALTERNATIVE APPROACHES TO REDUCING NEGATIVE ENVIRONMENTAL IMPACTS FROM AGRICULTURE*

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**ACCESSION NO:** 0205057 **SUBFILE:** CRIS  
**PROJ NO:** IND045076H **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Tyner, W.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*ECONOMIC AND POLICY ANALYSIS OF BIOMASS ENERGY ALTERNATIVES*

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**ACCESSION NO:** 0196385 **SUBFILE:** CRIS  
**PROJ NO:** IND045090J **AGENCY:** CSREES IND

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Dooley, F. J.; Gray, A.; Boehlje, M. D.; Patrick, G.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***STRATEGIC DECISION MAKING FOR FARMS AND AGRIBUSINESSES IN AN UNCERTAIN ENVIRONMENT***

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Item No. 162 of 602

**ACCESSION NO:** 0205217 **SUBFILE:** CRIS  
**PROJ NO:** IND046046H **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 01 OCT 2010 **FY:** 2006

**INVESTIGATOR:** Ladisch, M. R.; Mosier, N. S.; Vermerris, W. E.; Tyner, W. E.; Rickus, J. L.; Lu, C.;  
Ileleji, K. E.; Sedlak, M.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***CATALYTIC BIOPROCESSING***

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Item No. 163 of 602

**ACCESSION NO:** 0139101 **SUBFILE:** CRIS  
**PROJ NO:** IND046061 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Tao, B. Y.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***VALUE-ADDED PRODUCTS FROM AGRICULTURAL COMMODITIES***

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Item No. 164 of 602

**ACCESSION NO:** 0190921 **SUBFILE:** CRIS  
**PROJ NO:** IND046061G **AGENCY:** CSREES IND  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-52104-11227 **PROPOSAL NO:** 2001-04077  
**START:** 15 SEP 2001 **TERM:** 30 SEP 2003 **FY:** 2004 **GRANT YR:** 2001  
**GRANT AMT:** \$1,200,000

**INVESTIGATOR:** Tao, B.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***TECHNOLOGY DEVELOPMENT, TRANSFER, AND MARKETING OF INDUSTRIAL PRODUCTS FOR RURAL COMMUNITIES***

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Item No. 165 of 602

**ACCESSION NO:** 0194449 **SUBFILE:** CRIS  
**PROJ NO:** IND046061R **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Tao, B.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 166 of 602

**ACCESSION NO:** 0199225 **SUBFILE:** CRIS  
**PROJ NO:** IND046077 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Mosier, N. S.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

***ENZYME MIMETIC PROCESSING FOR RENEWABLE RESOURCE UTILIZATION***

**ACCESSION NO:** 0202563 **SUBFILE:** CRIS  
**PROJ NO:** IND046083 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Ileleji, K. E.

**PERFORMING INSTITUTION:**  
AG & BIOLOGICAL ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*BIOMASS FEEDSTOCK PROCESSING, HANDLING AND DELIVERY TO SUGAR AND  
THERMOCHEMICAL CONVERSION PLATFORMS*

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Item No. 168 of 602

**ACCESSION NO:** 0090802 **SUBFILE:** CRIS  
**PROJ NO:** IND050081 **AGENCY:** CSREES IND  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Johnson, K. D.

**PERFORMING INSTITUTION:**  
AGRONOMY  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*UTILIZING FORAGES FOR IMPROVED CROP AND LIVESTOCK PRODUCTION SYSTEMS*

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Item No. 169 of 602

**ACCESSION NO:** 0209084 **SUBFILE:** CRIS  
**PROJ NO:** IND059090N **AGENCY:** CSREES IND  
**PROJ TYPE:** RREA **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Miller, B.

**PERFORMING INSTITUTION:**  
FORESTRY & NATURAL RESOURCES  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*SUSTAINING HARDWOOD ECOSYSTEMS, INDUSTRIES, AND LAND USE SYSTEMS*

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**ACCESSION NO:** 0212510 **SUBFILE:** CRIS  
**PROJ NO:** INDE-2007-04363 **AGENCY:** CSREES INDE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-38420-18724 **PROPOSAL NO:** 2007-04363  
**START:** 07 JAN 2008 **TERM:** 31 DEC 2012 **GRANT YR:** 2008  
**GRANT AMT:** \$229,500

**INVESTIGATOR:** Shively, G. E.; Preckel, P. V.; Tyner, W. E.

**PERFORMING INSTITUTION:**  
AGRICULTURAL ECONOMICS  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*GRADUATE FELLOWSHIPS IN THE ECONOMICS OF ALTERNATIVE ENERGY*

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**ACCESSION NO:** 0196896 **SUBFILE:** CRIS  
**PROJ NO:** INDR-2003-01079 **AGENCY:** CSREES INDR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35504-13724 **PROPOSAL NO:** 2003-01079  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$227,003

**INVESTIGATOR:** Ho, N.; Sedlak, M.

**PERFORMING INSTITUTION:**  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

*GENETIC ENGINEERING OF YEAST FOR CO-FERMENTING ALL FIVE CELLULOSIC SUGARS TO ETHANOL*

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**ACCESSION NO:** 0204678 **SUBFILE:** CRIS  
**PROJ NO:** INDR-2005-02718 **AGENCY:** CSREES INDR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-16178 **PROPOSAL NO:** 2005-02718  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$436,412

**INVESTIGATOR:** Ho, N. W.; Sedlak, M.

**PERFORMING INSTITUTION:**  
LAB OF RENEWABLE RESOURCES ENGINEERING  
PURDUE UNIVERSITY  
WEST LAFAYETTE, INDIANA 47907

**DEVELOPMENT OF XYLOSE-SPECIFIC TRANSPORTERS FOR FURTHER IMPROVEMENT  
OF GLUCOSE/XYLOSE CO-FERMENTING SACCHAROMYCES YEAST**

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Item No. 173 of 602

**ACCESSION NO:** 0410769 **SUBFILE:** CRIS  
**PROJ NO:** 3625-11120-003-00D **AGENCY:** ARS 3625  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-174  
**START:** 25 APR 2006 **TERM:** 24 APR 2011 **FY:** 2006

**INVESTIGATOR:** LAIRD D A; LOGSDON S D; OLK D C

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
AMES, IOWA 50011

***BIOGEOCHEMICAL PROCESSES INFLUENCING FORMATION AND STABILIZATION OF SOIL  
ORGANIC MATTER AND SOIL STRUCTURE***

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Item No. 174 of 602

**ACCESSION NO:** 0409570 **SUBFILE:** CRIS  
**PROJ NO:** 3625-12000-012-00D **AGENCY:** ARS 3625  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2011 **FY:** 2006

**INVESTIGATOR:** KARLEN D L; KOVAR J L; LOGSDON S D; CAMBARDELLA C A

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
AMES, IOWA 50011

***ECOLOGICALLY-BASED SOIL MANAGEMENT FOR SUSTAINABLE AGRICULTURE AND  
RESOURCE CONSERVATION***

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Item No. 175 of 602

**ACCESSION NO:** 0403053 **SUBFILE:** CRIS  
**PROJ NO:** 3625-12660-002-01R **AGENCY:** ARS 3625  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 SEP 1999 **TERM:** 31 AUG 2004 **FY:** 2004

**INVESTIGATOR:** HATFIELD J L; MOORMAN T B

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
RR #3 BOX 45B  
AMES, IOWA 50011



***EVALUATION OF SOIL MICROBIOLOGICAL RESPONSE TO REMOVAL OF CORN STALKS  
AS A BIOFUEL***

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Item No. 176 of 602

**ACCESSION NO:** 0182758 **SUBFILE:** CRIS  
**PROJ NO:** IOW03600 **AGENCY:** CSREES IOW  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Dekkers, J. C.; Baas, T. J.; Berger, J. P.; Fernando, R. L.; Harris, D. L.; Koehler, K. J.; Lamont, S. J.; Nettleton, D. S.; Reecy, J. M.; Rothschild, M. F.; Stalder, K. J.; Tuggle, C. K.

**PERFORMING INSTITUTION:**  
ANIMAL SCIENCE  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***GENETIC ENHANCEMENT OF AGRICULTURALLY IMPORTANT ANIMALS***

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Item No. 177 of 602

**ACCESSION NO:** 0191375 **SUBFILE:** CRIS  
**PROJ NO:** IOW03905 **AGENCY:** CSREES IOW  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 01 APR 2002 **TERM:** 30 MAR 2008 **FY:** 2006

**INVESTIGATOR:** Hall, R. B.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCE ECOLOGY & MANAGEMENT  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***FAST GROWING TREES, SHADE-AVOIDANCE, NUTRIENT UPTAKE***

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Item No. 178 of 602

**ACCESSION NO:** 0200717 **SUBFILE:** CRIS  
**PROJ NO:** IOW05001 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34515-14719 **PROPOSAL NO:** 2004-06145  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$207,085

**INVESTIGATOR:** Johnson, L. A.; Wang, K.; Scott, M. P.

**PERFORMING INSTITUTION:**  
CENTER FOR CROPS UTILIZATION RES

IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***PLANT BIOTECHNOLOGY - IOWA: TECHNOLOGIES TO RECOVER RECOMBINANT  
PROTEINS FROM PLANTS FOR USE AS THERAPEUTICS AND INDUSTRIAL ENZYMES YEAR  
2***

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Item No. 179 of 602

**ACCESSION NO:** 0200770 **SUBFILE:** CRIS  
**PROJ NO:** IOW05002 **AGENCY:** CSREES IOW  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1014  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Lence, S. H.; Jolly, R.

**PERFORMING INSTITUTION:**  
ECONOMICS  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***AGRICULTURAL AND RURAL FINANCE MARKETS IN TRANSITION***

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Item No. 180 of 602

**ACCESSION NO:** 0201006 **SUBFILE:** CRIS  
**PROJ NO:** IOW05006 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34531-14969 **PROPOSAL NO:** 2004-06045  
**START:** 01 AUG 2004 **TERM:** 31 JUL 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$125,365

**INVESTIGATOR:** Wintersteen, W. K.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***CAST SCIENTIFIC RESEARCH PUBLICATIONS***

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Item No. 181 of 602

**ACCESSION NO:** 0202934 **SUBFILE:** CRIS  
**PROJ NO:** IOW05037 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34149-15582 **PROPOSAL NO:** 2006-06082  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$506,974

**INVESTIGATOR:** Hayes, D. J.

**PERFORMING INSTITUTION:**  
CENTER FOR AGR & RURAL DEV  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*FOOD & AGRICULTURAL POLICY RESEARCH INSTITUTE*

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Item No. 182 of 602

**ACCESSION NO:** 0204085 **SUBFILE:** CRIS  
**PROJ NO:** IOW05054 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34496-16003 **PROPOSAL NO:** 2005-06032  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$434,288

**INVESTIGATOR:** Glatz, C. E.; Johnson, L. A.; Scott, M. P.; Wang, K.

**PERFORMING INSTITUTION:**  
CENTER FOR CROPS UTILIZATION RES  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*BIOTECHNOLOGY TEST PRODUCTION, IA: RECOVERY AND PURIFICATION OF  
RECOMBINANT PROTEINS FROM PLANTS FOR THERAPEUTICS AND INDUSTRIAL  
ENZYMES*

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Item No. 183 of 602

**ACCESSION NO:** 0204284 **SUBFILE:** CRIS  
**PROJ NO:** IOW05058 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34432-16406 **PROPOSAL NO:** 2005-06147  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$750,977

**INVESTIGATOR:** Johnson, L. A.; Glatz, C. E.; Murphy, P. A.; Myers, D. J.; Jung, S.; Stahly, T.

**PERFORMING INSTITUTION:**  
CENTER FOR CROPS UTILIZATION RES  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*ENZYME-ASSISTED AQUEOUS PROCESSING OF SOYBEANS (YEAR 2)*

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Item No. 184 of 602

**ACCESSION NO:** 0206700 **SUBFILE:** CRIS  
**PROJ NO:** IOW05081 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34432-17128 **PROPOSAL NO:** 2006-06179  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$780,966

**INVESTIGATOR:** Johnson, L. A.; Glatz, C. E.; Jung, S.; Murphy, P. A.; Myers, D. J.; Reitmeier, C. A.; Wang, T.; Spurlock, M.

**PERFORMING INSTITUTION:**  
CENTER FOR CROPS UTILIZATION RES  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*ENZYME-ASSISTED AQUEOUS PROCESSING OF SOYBEANS (YEAR 3)*

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Item No. 185 of 602

**ACCESSION NO:** 0206836 **SUBFILE:** CRIS  
**PROJ NO:** IOW05085 **AGENCY:** CSREES IOW  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38812-03495 **PROPOSAL NO:** 2006-06237  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$551,351

**INVESTIGATOR:** Hayes, D. J.

**PERFORMING INSTITUTION:**  
CENTER FOR AGR & RURAL DEV  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*AGRICULTURAL TRADE ANALYSIS*

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Item No. 186 of 602

**ACCESSION NO:** 0206981 **SUBFILE:** CRIS  
**PROJ NO:** IOW05100 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38411-17034 **PROPOSAL NO:** 2006-03171  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$489,929

**INVESTIGATOR:** Raman, D. R.; Brown, R. C.; Brumm, T. J.; Anex, R. P.; Euken, J. E.; Nokes, S. E.; Crofcheck, C.; Van Gerpen, J.; He, B. B.

**PERFORMING INSTITUTION:**  
AGRI & BIOSYSTEMS ENGINEERING  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***A VIRTUAL EDUCATION CENTER FOR BIORENEWABLE RESOURCES: BUILDING  
CAPACITY AND HUMANIZING DISTANCE EDUCATION***

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Item No. 187 of 602

**ACCESSION NO:** 0212378 **SUBFILE:** CRIS  
**PROJ NO:** IOW05147 **AGENCY:** CSREES IOW  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-506  
**START:** 01 AUG 2007 **TERM:** 31 JUL 2009

**INVESTIGATOR:** Stokke, D. D.; Kuo, M. L.; Kim, T. H.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCE ECOLOGY & MANAGEMENT  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***WOOD UTILIZATION RESEARCH ON US BIOFUELS, BIOPRODUCTS, HYBRID  
BIOMATERIALS COMPOSITES PRODUCTION, AND TRADITIONAL FOREST PRODUCTS***

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Item No. 188 of 602

**ACCESSION NO:** 0195032 **SUBFILE:** CRIS  
**PROJ NO:** IOW06627 **AGENCY:** CSREES IOW  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NE-1011  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Otto, D. M.

**PERFORMING INSTITUTION:**  
ECONOMICS  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***RURAL COMMUNITIES, RURAL LABOR MARKETS AND PUBLIC POLICY***

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Item No. 189 of 602

**ACCESSION NO:** 0195035 **SUBFILE:** CRIS  
**PROJ NO:** IOW06631 **AGENCY:** CSREES IOW  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2017 **FY:** 2006

**INVESTIGATOR:** Fales, S.

**PERFORMING INSTITUTION:**  
AGRONOMY  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

**BREEDING AND GENETICS OF FORAGE CROPS TO IMPROVE PRODUCTIVITY, QUALITY,  
AND INDUSTRIAL USES**

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Item No. 190 of 602

**ACCESSION NO:** 0197991 **SUBFILE:** CRIS  
**PROJ NO:** IOW06668 **AGENCY:** CSREES IOW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34149-13321 **PROPOSAL NO:** 2004-06249  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$479,697

**INVESTIGATOR:** Beghin, J. C.

**PERFORMING INSTITUTION:**  
CENTER FOR AGR & RURAL DEV  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***FOOD AND AGRICULTURE POLICY INSTITUTE***

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Item No. 191 of 602

**ACCESSION NO:** 0210316 **SUBFILE:** CRIS  
**PROJ NO:** IOWK-2007-00085 **AGENCY:** CSREES IOWK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18010 **PROPOSAL NO:** 2007-00085  
**START:** 01 JUN 2007 **TERM:** 01 FEB 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Reardon, J. P.

**PERFORMING INSTITUTION:**  
FRONTLINE BIOENERGY, LLC  
2521 S. ELWOOD DR. #125  
AMES, IOWA 50010

***DEVELOPING A PYROLYSIS PLATFORM BIOREFINERY (1) HIGH QUALITY BIO-OIL***

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Item No. 192 of 602

**ACCESSION NO:** 0200575 **SUBFILE:** CRIS  
**PROJ NO:** IOWR-2004-00961 **AGENCY:** CSREES IOWR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-15222 **PROPOSAL NO:** 2004-00961  
**START:** 01 DEC 2004 **TERM:** 30 NOV 2007 **GRANT YR:** 2005  
**GRANT AMT:** \$365,000

**INVESTIGATOR:** Gonzalez, R.

**PERFORMING INSTITUTION:**  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***DEVELOPMENT OF A NOVEL FERMENTATION PROCESS FOR THE ANAEROBIC  
CONVERSION OF GLYCEROL AND CO2 INTO SUCCINIC ACID USING E. COLI***

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Item No. 193 of 602

**ACCESSION NO:** 0195921 **SUBFILE:** CRIS  
**PROJ NO:** IOWW-2000-HONARY **AGENCY:** CSREES IOWW  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-38878-02087 **PROPOSAL NO:** 2006-06225  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$508,726

**INVESTIGATOR:** Honary, L.

**PERFORMING INSTITUTION:**  
UNIVERSITY OF NORTHERN IOWA  
400 TECHNOLOGY PLACE  
WAVERLY, IOWA 50677

***DEVELOPMENT AND MARKET ACCEPTANCE OF US GROWN AG-BASED INDUSTRIAL  
LUBRICANTS AND GREASES***

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Item No. 194 of 602

**ACCESSION NO:** 0199769 **SUBFILE:** CRIS  
**PROJ NO:** IOWW-2004-06253 **AGENCY:** CSREES IOWW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34188-15067 **PROPOSAL NO:** 2005-06284  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2007 **GRANT YR:** 2005  
**GRANT AMT:** \$1,656,591

**INVESTIGATOR:** Brown, R. C.

**PERFORMING INSTITUTION:**  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

***IOWA BIOTECHNOLOGY CONSORTIUM***

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Item No. 195 of 602

**ACCESSION NO:** 0206962 **SUBFILE:** CRIS  
**PROJ NO:** IOWW-2006-06129 **AGENCY:** CSREES IOWW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34188-17123 **PROPOSAL NO:** 2006-06129

**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$1,640,491

**INVESTIGATOR:** Brown, R. C.

**PERFORMING INSTITUTION:**  
IOWA STATE UNIVERSITY  
AMES, IOWA 50011

*IOWA BIOTECHNOLOGY CONSORTIUM*

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Item No. 196 of 602

**ACCESSION NO:** 0408488 **SUBFILE:** CRIS  
**PROJ NO:** 5430-44000-017-00D **AGENCY:** ARS 5430  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** BEAN S; WILSON J D; TILLEY M

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
1515 COLLEGE AVE  
MANHATTAN, KANSAS 66502

*ENHANCED END USE QUALITY AND UTILIZATION OF SORGHUM GRAIN*

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Item No. 197 of 602

**ACCESSION NO:** 0194612 **SUBFILE:** CRIS  
**PROJ NO:** KS1007 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Sun, X. S.; Wang, D.

**PERFORMING INSTITUTION:**  
GRAIN SCIENCE AND INDUSTRY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 198 of 602

**ACCESSION NO:** 0195151 **SUBFILE:** CRIS  
**PROJ NO:** KS1011 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2017 **FY:** 2005



**INVESTIGATOR:** St. Amand, P.

**PERFORMING INSTITUTION:**

AGRONOMY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***BREEDING AND GENETICS OF FORAGES CROPS TO IMPROVE PRODUCTIVITY, QUALITY,  
AND INDUSTRIAL USES***

Item No. 199 of 602

**ACCESSION NO:** 0205431 **SUBFILE:** CRIS  
**PROJ NO:** KS1016 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 SEP 2005 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Woolverton, M.

**PERFORMING INSTITUTION:**

AGRI ECONOMICS  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM  
THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED  
SECTOR***

Item No. 200 of 602

**ACCESSION NO:** 0192883 **SUBFILE:** CRIS  
**PROJ NO:** KS2452 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 JAN 2002 **TERM:** 31 DEC 2008 **FY:** 2006

**INVESTIGATOR:** Zhang, N.; Staggenborg, S.; Wolf, R.; Dhuyvetter, K.; Dille, A.; Kastens, T.; Kilgore, G.; Kluitenberg, G.; Lamond, R.; Maddux, L.; Schlegel, A.; Schrock, M.

**PERFORMING INSTITUTION:**

AGRI ENGINEERING  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***PRECISION AGRICULTURE TECHNOLOGIES***

Item No. 201 of 602

**ACCESSION NO:** 0201841 **SUBFILE:** CRIS  
**PROJ NO:** KS321 **AGENCY:** CSREES KAN

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Wang, D.; Seib, P.

**PERFORMING INSTITUTION:**

AGRI ENGINEERING  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***SORGHUM BIOCONVERSION RESEARCH***

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Item No. 202 of 602

**ACCESSION NO:** 0203106 **SUBFILE:** CRIS  
**PROJ NO:** KS324 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Walawender, W. P.; Fan, L. T.

**PERFORMING INSTITUTION:**

CHEMICAL ENGINEERING  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***VALUE-ADDED MANUFACTURE OF CARBON ADSORBENTS FOR NATURAL GAS AND HYDROGEN STORAGE FROM BIOMASS***

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Item No. 203 of 602

**ACCESSION NO:** 0212138 **SUBFILE:** CRIS  
**PROJ NO:** KS506 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-506  
**START:** 01 JUL 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Selfa, T.; Hargraove, W.

**PERFORMING INSTITUTION:**

SOCIOLOGY, SOC WORK & ANTHROP  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***SUSTAINABLE BIOREFINING SYSTEMS FOR CORN IN THE NORTH CENTRAL REGION***

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Item No. 204 of 602

**ACCESSION NO:** 0185522 **SUBFILE:** CRIS  
**PROJ NO:** KS575 **AGENCY:** CSREES KAN

**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2000 **TERM:** 30 JUN 2005 **FY:** 2005

**INVESTIGATOR:** Sun, X. S.

**PERFORMING INSTITUTION:**  
GRAIN SCIENCE AND INDUSTRY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*PLASTICS FROM STARCH AND POLY(LACTIC ACID)*

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Item No. 205 of 602

**ACCESSION NO:** 0207189 **SUBFILE:** CRIS  
**PROJ NO:** KS600212 **AGENCY:** CSREES KAN  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34370-17019 **PROPOSAL NO:** 2006-06107  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$680,226

**INVESTIGATOR:** Tuinstra, M.; Chumley, F.

**PERFORMING INSTITUTION:**  
AGRONOMY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*GREAT PLAINS SORGHUM IMPROVEMENT AND UTILIZATION CENTER*

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Item No. 206 of 602

**ACCESSION NO:** 0207583 **SUBFILE:** CRIS  
**PROJ NO:** KS600315 **AGENCY:** CSREES KAN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-35300-17219 **PROPOSAL NO:** 2007-04402  
**START:** 01 AUG 2006 **TERM:** 31 JUL 2009 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$300,000

**INVESTIGATOR:** Gill, B.; Li, W.

**PERFORMING INSTITUTION:**  
PLANT PATHOLOGY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*GENETIC DISSECTION OF THE LIGNOCELLULOSIC PATHWAY OF WHEAT TO IMPROVE  
BIOMASS QUALITY OF GRASSES AS A FEEDSTOCK FOR BIOFUELS*

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**ACCESSION NO:** 0188692 **SUBFILE:** CRIS  
**PROJ NO:** KS602 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Fan, L. T.; Seib, P. A.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*PROCESS SYNTHESIS FOR DOWNSTREAM PROCESSING IN PRODUCTION OF BUTANOL  
FROM CORN AND GRAIN SORGHUM*

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Item No. 208 of 602

**ACCESSION NO:** 0191124 **SUBFILE:** CRIS  
**PROJ NO:** KS617 **AGENCY:** CSREES KAN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 DEC 2001 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Willson, T. C.; Alam, M.; Dumler, T.; Frisebe, R.; Hale, R.; Hargrove, R.; Rice, C.;  
Schlegel, A.; Thompson, C.

**PERFORMING INSTITUTION:**  
KSU SW AGRICULTURE RESEARCH CENTER  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

*INVESTIGATING ENVIRONMENTAL ISSUES RELATED TO AGRICULTURE IN SOUTHWEST  
KANSAS*

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Item No. 209 of 602

**ACCESSION NO:** 0189033 **SUBFILE:** CRIS  
**PROJ NO:** KS9085 **AGENCY:** CSREES KAN  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-38700-11092 **PROPOSAL NO:** 2001-05597  
**START:** 01 SEP 2001 **TERM:** 31 AUG 2006 **FY:** 2006 **GRANT YR:** 2001  
**GRANT AMT:** \$14,259,000

**INVESTIGATOR:** Rice, C. W.

**PERFORMING INSTITUTION:**  
AGRONOMY  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

**CONSORTIUM FOR AGRICULTURAL SOILS MITIGATION OF GREENHOUSE GASES  
(CASMGs)**

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Item No. 210 of 602

**ACCESSION NO:** 0200360 **SUBFILE:** CRIS  
**PROJ NO:** KS9805 **AGENCY:** CSREES KAN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35504-14808 **PROPOSAL NO:** 2004-01056  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$450,000

**INVESTIGATOR:** Wang, D.; Seib, P.; Bean, S.; McLaren, J.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
KANSAS STATE UNIV  
MANHATTAN, KANSAS 66506

***SORGHUM AS A VIABLE RENEWABLE RESOURCE FOR BIOFUELS AND BIOBASED  
PRODUCTS-SHORT TITLE: SORGHUM BIOCONVERSION RESEARCH (SBR)***

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Item No. 211 of 602

**ACCESSION NO:** 0199884 **SUBFILE:** CRIS  
**PROJ NO:** KANE-2004-01781 **AGENCY:** CSREES KANE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-38414-14511 **PROPOSAL NO:** 2004-01781  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$24,992

**INVESTIGATOR:** Muff, K. M.; Strickler, D. S.; Damman, P. D.

**PERFORMING INSTITUTION:**  
Cloud County Community College  
Concordia, Kansas 66901

***WORKPLACE SKILLS FOR THE MIDWEST***

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Item No. 212 of 602

**ACCESSION NO:** 0203486 **SUBFILE:** CRIS  
**PROJ NO:** KANE-2005-02767 **AGENCY:** CSREES KANE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38414-15681 **PROPOSAL NO:** 2005-02767  
**START:** 15 SEP 2005 **TERM:** 14 SEP 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$32,833

**INVESTIGATOR:** REILLY, P. W.

**PERFORMING INSTITUTION:**  
ALLEN COUNTY COMMUNITY COLLEGE  
1801 N. COTTONWOOD  
IOLA, KANSAS 66749

***ENHANCING AGRICULTURE CAREER EDUCATION***

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Item No. 213 of 602

**ACCESSION NO:** 0186870 **SUBFILE:** CRIS  
**PROJ NO:** KY0-NOKES **AGENCY:** CSREES KY.  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10106 **PROPOSAL NO:** 2000-01898  
**START:** 01 DEC 2000 **TERM:** 30 NOV 2005 **FY:** 2006 **GRANT YR:** 2001  
**GRANT AMT:** \$195,000

**INVESTIGATOR:** Nokes, S. E.; Strobel, H. J.; Marchant, M. A.; Krishna, C.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS & AGRICULTURAL ENGINEERING  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

***SIMPLIFIED TECHNOLOGY FOR ENZYME PRODUCTION WITH THERMOPHILIC ANAEROBIC BACTERIA***

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Item No. 214 of 602

**ACCESSION NO:** 0194928 **SUBFILE:** CRIS  
**PROJ NO:** KY001662 **AGENCY:** CSREES KY.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2017 **FY:** 2006

**INVESTIGATOR:** Phillips, T. D.

**PERFORMING INSTITUTION:**  
PLANT AND SOIL SCIENCES  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

***BREEDING AND GENETICS OF FORAGE CROPS TO IMPROVE PRODUCTIVITY, QUALITY, AND INDUSTRIAL USES***

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Item No. 215 of 602

**ACCESSION NO:** 0196901 **SUBFILE:** CRIS  
**PROJ NO:** KY005018 **AGENCY:** CSREES KY.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 02 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Nokes, S. E.; Montross, M.; Crofcheck, C.; Strobel, H. J.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS & AGRICULTURAL ENGINEERING  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 216 of 602

**ACCESSION NO:** 0208796 **SUBFILE:** CRIS  
**PROJ NO:** KY007055 **AGENCY:** CSREES KY.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Strobel, H. J.

**PERFORMING INSTITUTION:**  
ANIMAL & FOOD SCIENCES  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

*POST-GENOMIC CHARACTERIZATION OF ANAEROBIC BACTERIAL METABOLISM*

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Item No. 217 of 602

**ACCESSION NO:** 0206657 **SUBFILE:** CRIS  
**PROJ NO:** KY0INGRAM1 **AGENCY:** CSREES KY.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34419-16877 **PROPOSAL NO:** 2006-06161  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$702,407

**INVESTIGATOR:** Ingram, D.; Van Sanford, D.; Dillon, C.

**PERFORMING INSTITUTION:**  
HORTICULTURE  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

*NEW CROP OPPORTUNITIES, KY, PHASE VII*

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Item No. 218 of 602

**ACCESSION NO:** 0207484 **SUBFILE:** CRIS  
**PROJ NO:** KY0YUAN **AGENCY:** CSREES KY.  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-35504-17413 **PROPOSAL NO:** 2006-02355

**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$100,000

**INVESTIGATOR:** Yuan, L.

**PERFORMING INSTITUTION:**  
PLANT AND SOIL SCIENCES  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

***DIRECTED EVOLUTION OF HEMICELLULOSIC HYDROLASES FOR CONVERSION OF BIOMASS FOR PRODUCTION ON BIOFUELS AND BIOPRODUCTS***

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Item No. 219 of 602

**ACCESSION NO:** 0200418 **SUBFILE:** CRIS  
**PROJ NO:** KYSTROBEL **AGENCY:** CSREES KY.  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35504-14678 **PROPOSAL NO:** 2004-01092  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$330,000

**INVESTIGATOR:** Strobel, H. J.; Lynn, B.

**PERFORMING INSTITUTION:**  
ANIMAL & FOOD SCIENCES  
UNIVERSITY OF KENTUCKY  
LEXINGTON, KENTUCKY 40546

***PROTEOMIC ANALYSIS OF ETHANOL SENSITIVITY AND TOLERANCE IN THERMOPHILIC AND ANAEROBIC BACTERIA***

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Item No. 220 of 602

**ACCESSION NO:** 0212113 **SUBFILE:** CRIS  
**PROJ NO:** KYX-10-07-42P **AGENCY:** CSREES KY.X  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Bomford, M. K.; Silvernail, A. S.

**PERFORMING INSTITUTION:**  
PLANT & SOIL SCIENCES  
KENTUCKY STATE UNIVERSITY  
FRANKFORT, KENTUCKY 40601

***SMALL ORGANIC FARMS GROWING FOOD AND BIOFUEL CROPS: EFFECTS OF SCALE ON SUSTAINABILITY***

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**ACCESSION NO:** 0408851 **SUBFILE:** CRIS  
**PROJ NO:** 6435-21000-012-00D **AGENCY:** ARS 6435  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 AUG 2004 **TERM:** 31 OCT 2008 **FY:** 2006

**INVESTIGATOR:** TEW T L; HALE A L; PAN Y; RICHARD JR E P; WHITE W H

**PERFORMING INSTITUTION:**  
SOUTHERN REGIONAL RES CENTER  
NEW ORLEANS, LOUISIANA 70179

***GENETIC IMPROVEMENT OF SUGARCANE BY CONVENTIONAL AND MOLECULAR APPROACHES***

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Item No. 222 of 602

**ACCESSION NO:** 0409330 **SUBFILE:** CRIS  
**PROJ NO:** 6435-21000-012-04T **AGENCY:** ARS 6435  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 MAR 2005 **TERM:** 28 FEB 2010 **FY:** 2006

**INVESTIGATOR:** RICHARD JR E P; JOHNSON R M; PAN Y; TEW T L; HALE A L; GRISHAM M P

**PERFORMING INSTITUTION:**  
SOUTHERN REGIONAL RES CENTER  
NEW ORLEANS, LOUISIANA 70179

***IMPROVING SUGARCANE PRODUCTION EFFICIENCY***

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Item No. 223 of 602

**ACCESSION NO:** 0408564 **SUBFILE:** CRIS  
**PROJ NO:** 6435-41000-096-00D **AGENCY:** ARS 6435  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** WAN P J; DOWD M K; KUK M S; DAILEY JR O D; KLASSON K T

**PERFORMING INSTITUTION:**  
SOUTHERN REGIONAL RES CENTER  
NEW ORLEANS, LOUISIANA 70179

***NEW AND EXPANDED USES OF OILSEED PRODUCTS AND BY-PRODUCTS***

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Item No. 224 of 602

**ACCESSION NO:** 0199958 **SUBFILE:** CRIS  
**PROJ NO:** LAB93700 **AGENCY:** CSREES LA.B  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JAN 2004 **TERM:** 31 DEC 2008 **FY:** 2006

**INVESTIGATOR:** Gaston, L.; Bollich, P.; Boquet, D.; Hotard, S.; Mascagni, H.; Stephens, M.; Wang, J.

**PERFORMING INSTITUTION:**  
AGRONOMY  
LOUISIANA STATE UNIVERSITY  
BATON ROUGE, LOUISIANA 70893

*SOIL PHOSPHORUS DYNAMICS IN THE LOWER MISSISSIPPI RIVER VALLEY*

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Item No. 225 of 602

**ACCESSION NO:** 0200789 **SUBFILE:** CRIS  
**PROJ NO:** LAB93708 **AGENCY:** CSREES LA.B  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Gauthier, W. M.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & AGRIBUSINESS  
LOUISIANA STATE UNIVERSITY  
BATON ROUGE, LOUISIANA 70893

*ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM  
THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED  
SECTOR*

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Item No. 226 of 602

**ACCESSION NO:** 0211600 **SUBFILE:** CRIS  
**PROJ NO:** LAB93863 **AGENCY:** CSREES LA.B  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012

**INVESTIGATOR:** Chen, J. Y.

**PERFORMING INSTITUTION:**  
SCHOOL OF HUMAN ECOLOGY  
LOUISIANA STATE UNIVERSITY  
BATON ROUGE, LOUISIANA 70893

*REGENERATED CELLULOSE POLYMERS AND NANOCOMPOSITES FROM AGRICULTURAL  
RESOURCES*

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**ACCESSION NO:** 0212868 **SUBFILE:** CRIS  
**PROJ NO:** LAB93884 **AGENCY:** CSREES LA.B  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Boldor, D.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGRICULTURAL ENGINEERING  
LOUISIANA STATE UNIVERSITY  
BATON ROUGE, LOUISIANA 70893

***MICROWAVE TECHNOLOGIES FOR POSTHARVEST PROCESSING OF BIODIESEL  
FEEDSTOCK***

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Item No. 228 of 602

**ACCESSION NO:** 0197770 **SUBFILE:** CRIS  
**PROJ NO:** ME02003-05147 **AGENCY:** CSREES ME.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34158-14006 **PROPOSAL NO:** 2003-05147  
**START:** 15 SEP 2003 **TERM:** 14 SEP 2006 **FY:** 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$807,486

**INVESTIGATOR:** Shaler, S. M.; Gardner, D. J.; Goodell, B.; Rice, R. W.; Jellison, J.; Erich, S.; Cole, B. J.; Fort, R.; Genco, J.

**PERFORMING INSTITUTION:**  
FOREST MANAGEMENT  
UNIVERSITY OF MAINE  
ORONO, MAINE 04469

***NEW ENGLAND WOOD UTILIZATION RESEARCH: 2003-2006***

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Item No. 229 of 602

**ACCESSION NO:** 0205262 **SUBFILE:** CRIS  
**PROJ NO:** ME02005-06308 **AGENCY:** CSREES ME.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34158-16545 **PROPOSAL NO:** 2005-06308  
**START:** 15 SEP 2005 **TERM:** 14 SEP 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$716,952

**INVESTIGATOR:** Shaler, S. M.; Cole, B. J.; Dagher, H. J.; Gardner, D. J.; Goodell, B.; Jellison, J.; Rice, R. W.

**PERFORMING INSTITUTION:**  
SCHOOL OF FOREST RESOURCES  
UNIVERSITY OF MAINE  
ORONO, MAINE 04469

**NEW ENGLAND WOOD UTILIZATION RESEARCH: 2005-2008**

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Item No. 230 of 602

**ACCESSION NO:** 0207110 **SUBFILE:** CRIS  
**PROJ NO:** ME02006-06328 **AGENCY:** CSREES ME.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34158-17570 **PROPOSAL NO:** 2006-06328  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$728,545

**INVESTIGATOR:** Goodell, B.; Cole, B. J.; Dagher, H. J.; Gardner, D. J.; Jellison, J.; Rice, R. W.; Shaler, S. M.

**PERFORMING INSTITUTION:**  
SCHOOL OF FOREST RESOURCES  
UNIVERSITY OF MAINE  
ORONO, MAINE 04469

**NEW ENGLAND WOOD UTILIZATION RESEARCH: 2006-2009**

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Item No. 231 of 602

**ACCESSION NO:** 0407194 **SUBFILE:** CRIS  
**PROJ NO:** 0210-22310-002-60T **AGENCY:** ARS 0210  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 04 SEP 2003 **TERM:** 11 JUN 2008 **FY:** 2006

**INVESTIGATOR:** WHUNG P

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BELTSVILLE, MARYLAND 20705

**EMBRAPA/USDA-ARS COOPERATION IN AGRICULTURAL RESEARCH AND SCIENTIFIC EXCHANGES**

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Item No. 232 of 602

**ACCESSION NO:** 0403503 **SUBFILE:** CRIS  
**PROJ NO:** 1265-12000-023-00D **AGENCY:** ARS 1265  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 03 APR 2000 **TERM:** 02 APR 2005 **FY:** 2005

**INVESTIGATOR:** MULBRY III W W; SMITH M C; DUNGAN R S

**PERFORMING INSTITUTION:**  
BELTSVILLE AGR RES CENTER  
BELTSVILLE, MARYLAND 20705

**MANURE TREATMENTS AND USES TO PROTECT SOIL-WATER-AIR QUALITY, FOOD SAFETY, AND IMPROVE MANURE VALUE**

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Item No. 233 of 602

**ACCESSION NO:** 0409609 **SUBFILE:** CRIS  
**PROJ NO:** 1265-12000-028-00D **AGENCY:** ARS 1265  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 03 APR 2005 **TERM:** 02 APR 2010 **FY:** 2006

**INVESTIGATOR:** SMITH M C; MULBRY III W W; RICE C; SCHMIDT W F

**PERFORMING INSTITUTION:**  
BELTSVILLE AGR RES CENTER  
BELTSVILLE, MARYLAND 20705

***BIOLOGICAL TREATMENT OF MANURE TO CAPTURE NUTRIENTS AND TRANSFORM CONTAMINANTS***

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Item No. 234 of 602

**ACCESSION NO:** 0212578 **SUBFILE:** CRIS  
**PROJ NO:** MD-ENTM-1016 **AGENCY:** CSREES MD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 NOV 2007 **TERM:** 31 OCT 2011

**INVESTIGATOR:** Lamp, W. O.

**PERFORMING INSTITUTION:**  
ENTOMOLOGY  
UNIV OF MARYLAND  
COLLEGE PARK, MARYLAND 20742

***TOLERANCE OF PERENNIAL FORAGE STANDS FOR MANAGING LEAFHOPPER INJURY***

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Item No. 235 of 602

**ACCESSION NO:** 0211149 **SUBFILE:** CRIS  
**PROJ NO:** MD-PSLA-0629 **AGENCY:** CSREES MD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-214  
**START:** 01 NOV 2006 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Grybauskas, A. P.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCE SCIENCES & LANDSCAPE ARCHITECTURE  
UNIV OF MARYLAND  
COLLEGE PARK, MARYLAND 20742

*MANAGEMENT OF CORN DISEASES*

Item No. 236 of 602

**ACCESSION NO:** 0204153 **SUBFILE:** CRIS  
**PROJ NO:** MD-SARE-0524 **AGENCY:** CSREES MD.  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38640-15931 **PROPOSAL NO:** 2005-04681  
**START:** 15 JUL 2005 **TERM:** 14 JUL 2010 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$565,899

**INVESTIGATOR:** Angle, J. S.; Kroll, K. S.

**PERFORMING INSTITUTION:**  
 ASSOCIATE DIRECTOR  
 UNIV OF MARYLAND  
 COLLEGE PARK, MARYLAND 20742

*COLLABORATION AND SUPPORT FOR SUSTAINABLE AGRICULTURE*

Item No. 237 of 602

**ACCESSION NO:** 0199919 **SUBFILE:** CRIS  
**PROJ NO:** MD-WREC-4274 **AGENCY:** CSREES MD.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34398-14471 **PROPOSAL NO:** 2004-06037  
**START:** 01 JUN 2004 **TERM:** 30 MAY 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$265,588

**INVESTIGATOR:** Brinsfield, R. B.; McConnell, V.; Hanlon, B.; Costa, J.

**PERFORMING INSTITUTION:**  
 WYE RES AND EDUCATION CENTER  
 UNIV OF MARYLAND  
 COLLEGE PARK, MARYLAND 20742

*CHEASAPEAKE BAY AGRO-ECOLOGY*

Item No. 238 of 602

**ACCESSION NO:** 0203651 **SUBFILE:** CRIS  
**PROJ NO:** MDE-2005-02321 **AGENCY:** CSREES MD.E  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38420-15761 **PROPOSAL NO:** 2005-02321  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$138,000

**INVESTIGATOR:** Chang, C.; Sze, H.

**PERFORMING INSTITUTION:**  
UNIVERSITY OF MARYLAND  
ROOM 2200 SYMONS HALL  
COLLEGE PARK, MARYLAND 20742

***GRADUATE TRAINING PROGRAM IN PLANT FUNCTIONAL GENOMICS***

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Item No. 239 of 602

**ACCESSION NO:** 0200835 **SUBFILE:** CRIS  
**PROJ NO:** MASK-2004-02656 **AGENCY:** CSREES MASK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-33610-14825 **PROPOSAL NO:** 2004-02656  
**START:** 01 SEP 2004 **TERM:** 31 OCT 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Bishop, B.

**PERFORMING INSTITUTION:**  
CERAMEM CORPORATION  
12 CLEMATIS AVENUE  
WALTHAM, MASSACHUSETTS 02154

***ABRASION-RESISTANT INORGANIC MEMBRANES FOR SUGAR PROCESSING***

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Item No. 240 of 602

**ACCESSION NO:** 0206537 **SUBFILE:** CRIS  
**PROJ NO:** MASK-2006-00439 **AGENCY:** CSREES MASK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16794 **PROPOSAL NO:** 2006-00439  
**START:** 01 MAY 2006 **TERM:** 31 DEC 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Bikson, B.

**PERFORMING INSTITUTION:**  
POROGEN CORPORATION  
200 BOSTON AVE., SUITE 4750  
MEDFORD, MASSACHUSETTS 02155

***BIOFUEL PRODUCTION BY CONTINUOUS ACETONE-BUTANOL-ETHANOL (ABE)  
FERMENTATION COUPLED WITH MEMBRANE SEPARATION***

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Item No. 241 of 602

**ACCESSION NO:** 0206599 **SUBFILE:** CRIS  
**PROJ NO:** MASK-2006-00489 **AGENCY:** CSREES MASK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16861 **PROPOSAL NO:** 2006-00489

**START:** 01 MAY 2006 **TERM:** 31 DEC 2006 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Foti, R.

**PERFORMING INSTITUTION:**  
CERAMEM CORPORATION  
12 CLEMATIS AVENUE  
WALTHAM, MASSACHUSETTS 02453

*AN INTEGRATED MEMBRANE-BASED PROCESS TRAIN FOR REDUCING COSTS OF  
ETHANOL PRODUCTION*

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Item No. 242 of 602

**ACCESSION NO:** 0211124 **SUBFILE:** CRIS  
**PROJ NO:** MASK-2007-03702 **AGENCY:** CSREES MASK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18558 **PROPOSAL NO:** 2007-03702  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$346,000

**INVESTIGATOR:** Bikson, B.

**PERFORMING INSTITUTION:**  
POROGEN CORPORATION  
16C GILL STREET  
WOBURN, MASSACHUSETTS 01801

*BIOFUEL PRODUCTION BY CONTINUOUS ACETONE-BUTANOL-ETHANOL (ABE)  
FERMENTATION PROCESS COUPLED WITH MEMBRANE SEPARATION*

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Item No. 243 of 602

**ACCESSION NO:** 0189281 **SUBFILE:** CRIS  
**PROJ NO:** MASR-2001-01464 **AGENCY:** CSREES MASR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10670 **PROPOSAL NO:** 2001-01464  
**START:** 15 AUG 2001 **TERM:** 31 AUG 2004 **FY:** 2003 **GRANT YR:** 2001  
**GRANT AMT:** \$194,000

**INVESTIGATOR:** Kashket, E. R.

**PERFORMING INSTITUTION:**  
MICROBIOLOGY  
BOSTON UNIV SCHOOL OF MEDICINE  
BOSTON, MASSACHUSETTS 02118

*BUTANOL TOLERANCE IN CLOSTRIDIA*

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**ACCESSION NO:** 0405512 **SUBFILE:** CRIS  
**PROJ NO:** 5447-41000-002-01S **AGENCY:** ARS 5447  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 01 MAY 2002 **TERM:** 30 APR 2007 **FY:** 2006

**INVESTIGATOR:** ROSENTRATER K A; MCCALLA D

**PERFORMING INSTITUTION:**

MBI INTERNATIONAL  
3900 COLLINS ROAD  
LANSING, MICHIGAN 48910

*IMPROVED USES AND VALUES FOR DRIED DISTILLERS GRAINS AND C4 GRASS  
FEEDSTOCKS*

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Item No. 245 of 602

**ACCESSION NO:** 0210067 **SUBFILE:** CRIS  
**PROJ NO:** MICE-2007-02102 **AGENCY:** CSREES MICE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-38424-17951 **PROPOSAL NO:** 2007-02102  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$137,620

**INVESTIGATOR:** Doyle, M.

**PERFORMING INSTITUTION:**

RESEARCH  
BAY MILLS COMMUNITY COLLEGE  
12214 W. LAKESHORE DR  
BRIMLEY, MICHIGAN 49715

*SMALL-SCALE PELLETIZATION OF SWITCH GRASS*

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Item No. 246 of 602

**ACCESSION NO:** 0204188 **SUBFILE:** CRIS  
**PROJ NO:** MICK-2005-03241 **AGENCY:** CSREES MICK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-16116 **PROPOSAL NO:** 2005-03241  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2007 **GRANT YR:** 2005  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Graiver, D.

**PERFORMING INSTITUTION:**

BIOPLASTIC POLYMERS & COMPOSITES, LLC  
MIDLAND, MICHIGAN 48640

*IMPROVED QUALITY SOY-OIL BASED BIODIESEL FUEL- PHASE II*

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Item No. 247 of 602

**ACCESSION NO:** 0009329 **SUBFILE:** CRIS  
**PROJ NO:** MICL00319 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 MAY 2007 **TERM:** 30 APR 2012 **FY:** 2006

**INVESTIGATOR:** Mokma, D.; Smucker, A.; Safferman, S.; Bughrara, S.; Thelen, K.; Leep, R.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*CLASSIFICATION, GENESIS AND EVALUATION OF MICHIGAN SOILS*

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Item No. 248 of 602

**ACCESSION NO:** 0172417 **SUBFILE:** CRIS  
**PROJ NO:** MICL01799 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Bickert, W.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS & AGRIC ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*INTEGRATING ALTERNATIVE MANURE TREATMENTS INTO CONVENTIONAL ANIMAL  
MANURE HANDLING AND STORAGE SYSTEMS*

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Item No. 249 of 602

**ACCESSION NO:** 0173185 **SUBFILE:** CRIS  
**PROJ NO:** MICL01815 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2006

**INVESTIGATOR:** Oehmke, J. F.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*THE POLITICAL ECONOMY OF AGRIBUSINESS STRUCTURE, AGRICULTURAL RESEARCH,  
AND THE BIOTECHNOLOGY INDUSTRY*

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Item No. 250 of 602

**ACCESSION NO:** 0176677 **SUBFILE:** CRIS  
**PROJ NO:** MICL01862 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 NOV 2003 **TERM:** 31 OCT 2008 **FY:** 2006

**INVESTIGATOR:** Surbrook, T.; Bickert, W.; Althouse, J.; Lloyd, J.; Dale, B.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS & AGRIC ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***BIO-ENERGY BASED ELECTRICAL SYSTEMS AND THEIR SAFE, EFFICIENT APPLICATIONS***

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Item No. 251 of 602

**ACCESSION NO:** 0191612 **SUBFILE:** CRIS  
**PROJ NO:** MICL02015 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 FEB 2007 **TERM:** 31 JAN 2012 **FY:** 2006

**INVESTIGATOR:** Warncke, D.; Gehl, R.; Dahl, J.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***DEVELOPMENT AND CORRELATION OF SOIL TEST PROCEDURES WITH CROP YIELDS AND PLANT NUTRIENT CONTENTS***

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**ACCESSION NO:** 0194307 **SUBFILE:** CRIS  
**PROJ NO:** MICL02047 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Lira, C.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 253 of 602

**ACCESSION NO:** 0195004 **SUBFILE:** CRIS  
**PROJ NO:** MICL02055 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JAN 2003 **TERM:** 31 DEC 2007 **FY:** 2006

**INVESTIGATOR:** Malmstrom, C. M.

**PERFORMING INSTITUTION:**  
PLANT BIOLOGY  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***THE EFFECTS OF THE BARLEY AND CEREAL YELLOW DWARF VIRUSES ON THE DYNAMICS OF NATURAL GRASSLANDS***

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Item No. 254 of 602

**ACCESSION NO:** 0202686 **SUBFILE:** CRIS  
**PROJ NO:** MICL02079 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JAN 2005 **TERM:** 31 DEC 2009 **FY:** 2006

**INVESTIGATOR:** Mohanty, A. K.; Harte, B.; Selke, S.; Singh, S. P.; Drzal, L. T.; Misra, M.; Joshi, S.

**PERFORMING INSTITUTION:**  
PACKAGING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***BIOBASED/GREEN MATERIALS AND NANOTECHNOLOGY FOR PACKAGING***

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Item No. 255 of 602

**ACCESSION NO:** 0207210 **SUBFILE:** CRIS  
**PROJ NO:** MICL02132 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2011 **FY:** 2006

**INVESTIGATOR:** Snapp, S.; Robertson, P.; Mutch, D.; Harrigan, T.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***MANAGING COARSE SOILS FOR NUTRIENT EFFICIENCY AND RESILIENCE THROUGH INTEGRATION OF MULTIFUNCTION COVER CROPS IN ROW CROP SYSTEMS***

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Item No. 256 of 602

**ACCESSION NO:** 0209047 **SUBFILE:** CRIS  
**PROJ NO:** MICL02137 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 NOV 2006 **TERM:** 31 OCT 2011 **FY:** 2006

**INVESTIGATOR:** Safferman, S. I.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS & AGRIC ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***RURAL SUSTAINABLE ENVIRONMENTAL MANAGEMENT***

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Item No. 257 of 602

**ACCESSION NO:** 0203508 **SUBFILE:** CRIS  
**PROJ NO:** MICL03414 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 MAY 2005 **TERM:** 30 APR 2010 **FY:** 2006

**INVESTIGATOR:** Dale, B. E.; Lira, C. T.; Worden, R. M.; Miller, D. J.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***ENABLING BIOREFINERIES***

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Item No. 258 of 602

**ACCESSION NO:** 0207213 **SUBFILE:** CRIS  
**PROJ NO:** MICL03418 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2011 **FY:** 2006

**INVESTIGATOR:** Gross, K. L.

**PERFORMING INSTITUTION:**  
KELLOGG BIOLOGICAL STATION  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***CONTROLS AND CONSEQUENCES OF PLANT DIVERSITY IN GRASSLANDS***

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**ACCESSION NO:** 0208768 **SUBFILE:** CRIS  
**PROJ NO:** MICL03431 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2006

**INVESTIGATOR:** Pueppke, S. G.; Dale, B. E.

**PERFORMING INSTITUTION:**  
MICHIGAN AGRICULTURAL EXPER. STATION  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*MSU BIOECONOMY INITIATIVE*

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Item No. 260 of 602

**ACCESSION NO:** 0210467 **SUBFILE:** CRIS  
**PROJ NO:** MICL03448 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 MAY 2007 **TERM:** 30 APR 2012

**INVESTIGATOR:** Joshi, S. V.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*ECONOMIC AND ENVIRONMENTAL ASESMENT OF BIOFUEL AND BIO-BASED MATERIALS*

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**ACCESSION NO:** 0212352 **SUBFILE:** CRIS  
**PROJ NO:** MICL03464 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2012

**INVESTIGATOR:** Miller, D. J.; Freed, R. D.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*A FIELD-TO-WHEELS ENERGY CROP PROGRAM FOR MICHIGAN: GROWING CANOLA FOR AGRIFUELS*

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**ACCESSION NO:** 0212782 **SUBFILE:** CRIS  
**PROJ NO:** MICL03472 **AGENCY:** SAES MICL  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 NOV 2007 **TERM:** 31 OCT 2012

**INVESTIGATOR:** Lira, C. T.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***PROPERTIES AND PROCESSING OF FUELS AND CHEMICALS FROM RENEWABLE RESOURCES***

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Item No. 263 of 602

**ACCESSION NO:** 0212045 **SUBFILE:** CRIS  
**PROJ NO:** MICL04026 **AGENCY:** CSREES MICL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-506  
**START:** 01 AUG 2007 **TERM:** 31 JUL 2009

**INVESTIGATOR:** Matuana, L. M.; Han, K. H.

**PERFORMING INSTITUTION:**  
FORESTRY  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***WOOD UTILIZATION RESEARCH ON US BIOFUELS, BIOPRODUCTS, HYBRID BIOMATERIALS COMPOSITES PRODUCTION, AND TRADITIONAL FOREST PRODUCTS***

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Item No. 264 of 602

**ACCESSION NO:** 0201046 **SUBFILE:** CRIS  
**PROJ NO:** MICL07695 **AGENCY:** CSREES MICL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34189-14557 **PROPOSAL NO:** 2005-06286  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2007 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$517,627

**INVESTIGATOR:** Dale, B. E.; Stowers, M. D.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***BIOPROCESSING FOR UTILIZATION OF AGRICULTURAL RESOURCES***

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Item No. 265 of 602

**ACCESSION NO:** 0206809 **SUBFILE:** CRIS  
**PROJ NO:** MICL07709 **AGENCY:** CSREES MICL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34189-17124 **PROPOSAL NO:** 2006-06143  
**START:** 15 JUL 2006 **TERM:** 14 JUL 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$512,942

**INVESTIGATOR:** Dale, B. E.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*BIOPROCESSING FOR UTILIZATION OF AGRICULTURAL RAW MATERIALS*

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Item No. 266 of 602

**ACCESSION NO:** 0189855 **SUBFILE:** CRIS  
**PROJ NO:** MICL08264 **AGENCY:** CSREES MICL  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10734 **PROPOSAL NO:** 2001-01463  
**START:** 15 SEP 2001 **TERM:** 30 SEP 2005 **FY:** 2006 **GRANT YR:** 2001  
**GRANT AMT:** \$232,500

**INVESTIGATOR:** Drzal, L. T.

**PERFORMING INSTITUTION:**  
COMPOSITE MATERIALS & STRUCTURES CENTER  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

*BIOCOMPOSITES FROM ENGINEERED BIO-FIBERS AND BIO-PLASTICS*

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Item No. 267 of 602

**ACCESSION NO:** 0204468 **SUBFILE:** CRIS  
**PROJ NO:** MICL08361 **AGENCY:** CSREES MICL  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-16195 **PROPOSAL NO:** 2005-02711  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$380,000

**INVESTIGATOR:** Pollard, M. R.

**PERFORMING INSTITUTION:**  
PLANT BIOLOGY



MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***PRODUCTION AND UTILIZATION OF ACETYL GLYCERIDE OILS IN TRANSGENIC OILSEEDS***

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Item No. 268 of 602

**ACCESSION NO:** 0207813 **SUBFILE:** CRIS  
**PROJ NO:** MICL08391 **AGENCY:** CSREES MICL  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-35504-17364 **PROPOSAL NO:** 2006-02231  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$427,548

**INVESTIGATOR:** Miller, D. J.; Lira, C. T.

**PERFORMING INSTITUTION:**  
CHEMICAL ENGINEERING  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***A NOVEL PROCESS FOR IMPROVED BIODIESEL PRODUCTION***

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Item No. 269 of 602

**ACCESSION NO:** 0209066 **SUBFILE:** CRIS  
**PROJ NO:** MICL10050 **AGENCY:** CSREES MICL  
**PROJ TYPE:** RREA **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Lovejoy, S.

**PERFORMING INSTITUTION:**  
EXTENSION  
MICHIGAN STATE UNIV  
EAST LANSING, MICHIGAN 48824

***RREA PROGRAM***

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Item No. 270 of 602

**ACCESSION NO:** 0192390 **SUBFILE:** CRIS  
**PROJ NO:** MICY-F004082 **AGENCY:** CSREES MICY  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35314-09998 **PROPOSAL NO:** 2000-03542  
**START:** 15 NOV 2000 **TERM:** 30 NOV 2003 **GRANT YR:** 2001  
**GRANT AMT:** \$90,000

**INVESTIGATOR:** Heller, M. C.

**PERFORMING INSTITUTION:**  
 RESOURCE ECOLOGY & MANAGEMENT  
 UNIVERSITY OF MICHIGAN  
 ANN ARBOR, MICHIGAN 48109

***LIFE CYCLE ASSESSMENT OF A WILLOW AGRICULTURE AND BIOMASS ENERGY  
 CONVERSION SYSTEM***

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Item No. 271 of 602

**ACCESSION NO:** 0402728 **SUBFILE:** CRIS  
**PROJ NO:** 3640-12000-006-01R **AGENCY:** ARS 3640  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 SEP 1999 **TERM:** 31 AUG 2004 **FY:** 2002

**INVESTIGATOR:** BAKER J M; CLAPP C E; VENTEREA R T

**PERFORMING INSTITUTION:**  
 AGRICULTURAL RESEARCH SERVICE  
 ST PAUL, MINNESOTA 55108

***IMPLICATIONS OF USING CORN STALKS AS A BIOFUEL SOURCE IN NORTHERN CLIMATE***

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Item No. 272 of 602

**ACCESSION NO:** 0410684 **SUBFILE:** CRIS  
**PROJ NO:** 3640-12000-007-00D **AGENCY:** ARS 3640  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 25 MAR 2006 **TERM:** 24 MAR 2011 **FY:** 2006

**INVESTIGATOR:** BAKER J M; VENTEREA R T; OCHSNER T E; CLAPP C E

**PERFORMING INSTITUTION:**  
 AGRICULTURAL RESEARCH SERVICE  
 ST PAUL, MINNESOTA 55108

***FARMING PRACTICES FOR THE NORTHERN CORN BELT TO PROTECT SOIL RESOURCES,  
 SUPPORT BIOFUEL PRODUCTION AND REDUCE GLOBAL WARMING POTENTIAL***

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Item No. 273 of 602

**ACCESSION NO:** 0404513 **SUBFILE:** CRIS  
**PROJ NO:** 3645-11000-002-00D **AGENCY:** ARS 3645  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 15 APR 2001 **TERM:** 14 APR 2006 **FY:** 2006

**INVESTIGATOR:** JOHNSON J M; REICOSKY D C; JARADAT A A; LACHNICHT WEYERS S L;  
 GESCH R W; ARCHER D W

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
MORRIS, MINNESOTA 56267

***SOIL CARBON CYCLING, TILLAGE AND CROP RESIDUE MANAGEMENT***

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Item No. 274 of 602

**ACCESSION NO:** 0402790 **SUBFILE:** CRIS  
**PROJ NO:** 3645-11000-002-01R **AGENCY:** ARS 3645  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 SEP 1999 **TERM:** 31 AUG 2004 **FY:** 2002

**INVESTIGATOR:** JOHNSON J M; REICOSKY D C; JARADAT A A; LACHNICHT WEYERS S L;  
PAPIERNIK S K

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
MORRIS, MINNESOTA 56267

***IMPLICATIONS OF USING CORN STALKS AS A BIOFUEL SOURCE***

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Item No. 275 of 602

**ACCESSION NO:** 0410741 **SUBFILE:** CRIS  
**PROJ NO:** 3645-11000-003-00D **AGENCY:** ARS 3645  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 15 APR 2006 **TERM:** 14 APR 2011 **FY:** 2006

**INVESTIGATOR:** JOHNSON J M; REICOSKY D C; JARADAT A A; LACHNICHT WEYERS S L;  
GESCH R W

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
MORRIS, MINNESOTA 56267

***SOIL CARBON CYCLING, TRACE GAS EMISSION, TILLAGE AND CROP RESIDUE  
MANAGEMENT***

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Item No. 276 of 602

**ACCESSION NO:** 0410760 **SUBFILE:** CRIS  
**PROJ NO:** 3645-12610-001-00D **AGENCY:** ARS 3645  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-174  
**START:** 15 APR 2006 **TERM:** 14 APR 2011 **FY:** 2006

**INVESTIGATOR:** PAPIERNIK S K; LACHNICHT WEYERS S L; REICOSKY D C; JOHNSON J M;  
JARADAT A A

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
MORRIS, MINNESOTA 56267

***SOIL AND CROP MANAGEMENT SYSTEMS TO SUSTAIN AGRICULTURAL PRODUCTION AND ENVIRONMENTAL QUALITY IN THE NORTHERN GREAT PLAINS***

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Item No. 277 of 602

**ACCESSION NO:** 0212593 **SUBFILE:** CRIS  
**PROJ NO:** MIN-12-063 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-506  
**START:** 01 AUG 2007 **TERM:** 30 JUN 2009

**INVESTIGATOR:** Ramaswamy, S.; Schilling, J.; Tze, W.; Bradshaw, B.

**PERFORMING INSTITUTION:**  
BIOPRODUCTS & BIOSYSTEMS ENGINEERING  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***WOOD UTILIZATION RESEARCH ON US BIOFUELS, BIOPRODUCTS, HYBRID BIOMATERIALS COMPOSITES PRODUCTION, AND TRADITIONAL FOREST PRODUCTS***

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Item No. 278 of 602

**ACCESSION NO:** 0211757 **SUBFILE:** CRIS  
**PROJ NO:** MIN-12-075 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2010

**INVESTIGATOR:** Wang, P.

**PERFORMING INSTITUTION:**  
BIOPRODUCTS & BIOSYSTEMS ENGINEERING  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***BIOSYNTHESIS OF METHANOL FROM BIOMASS DERIVED CARBON DIOXIDE***

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Item No. 279 of 602

**ACCESSION NO:** 0195325 **SUBFILE:** CRIS  
**PROJ NO:** MIN-12-093 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Ruan, R.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS AND AGRIC ENGINEERING  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 280 of 602

**ACCESSION NO:** 0023166 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-028 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Lamb, J. F.

**PERFORMING INSTITUTION:**  
AGRONOMY & PLANT GENETICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***GENETICS AND BREEDING OF ALFALFA FOR NEW USES AND FORAGE QUALITY***

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Item No. 281 of 602

**ACCESSION NO:** 0003057 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-035 **AGENCY:** SAES MIN  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012 **FY:** 2006

**INVESTIGATOR:** Ehlke, N. J.

**PERFORMING INSTITUTION:**  
AGRONOMY & PLANT GENETICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***ALTERNATIVE FORAGE AND TURF GRASS BREEDING, GENETICS AND SEED PRODUCTION***

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Item No. 282 of 602

**ACCESSION NO:** 0208585 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-039 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1036  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Porter, P. M.

**PERFORMING INSTITUTION:**  
AGRONOMY & PLANT GENETICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***RESEARCH AND EDUCATION SUPPORT FOR THE RENEWAL OF AN AGRICULTURE OF THE MIDDLE.***

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Item No. 283 of 602

**ACCESSION NO:** 0195843 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-043 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2017 **FY:** 2006

**INVESTIGATOR:** Ehlke, N. J.

**PERFORMING INSTITUTION:**  
AGRONOMY & PLANT GENETICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***BREEDING AND GENETICS OF FORAGE CROPS TO IMPROVE PRODUCTIVITY, QUALITY AND INDUSTRIAL USES***

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Item No. 284 of 602

**ACCESSION NO:** 0169786 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-052 **AGENCY:** SAES MIN  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2008 **FY:** 2006

**INVESTIGATOR:** Jordan, N. R.

**PERFORMING INSTITUTION:**  
AGRONOMY & PLANT GENETICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***MANAGING BIODIVERSE AGROECOSYSTEMS: ECOLOGICAL AND SOCIAL DIMENSIONS***

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Item No. 285 of 602

**ACCESSION NO:** 0091840 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-078 **AGENCY:** SAES MIN  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Gronwald, J. W.

**PERFORMING INSTITUTION:**  
 AGRONOMY & PLANT GENETICS  
 UNIV OF MINNESOTA  
 ST PAUL, MINNESOTA 55108

***MOLECULAR AND BIOCHEMICAL APPROACHES FOR DEVELOPING ALFALFA AS A  
 BIOFUEL FEEDSTOCK***

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Item No. 286 of 602

**ACCESSION NO:** 0210740 **SUBFILE:** CRIS  
**PROJ NO:** MIN-13-G17 **AGENCY:** CSREES MIN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35504-18250 **PROPOSAL NO:** 2007-04062  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$315,000

**INVESTIGATOR:** Bernardo, R. N.

**PERFORMING INSTITUTION:**  
 AGRONOMY & PLANT GENETICS  
 UNIV OF MINNESOTA  
 ST PAUL, MINNESOTA 55108

***STRATEGIES FOR USING MOLECULAR MARKERS TO SIMULTANEOUSLY IMPROVE CORN  
 GRAIN YIELD AND STOVER QUALITY FOR ETHANOL PRODUCTION***

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Item No. 287 of 602

**ACCESSION NO:** 0161830 **SUBFILE:** CRIS  
**PROJ NO:** MIN-14-040 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2005

**INVESTIGATOR:** Buhr, B. L.

**PERFORMING INSTITUTION:**  
 APPLIED ECONOMICS  
 UNIV OF MINNESOTA  
 ST PAUL, MINNESOTA 55108

***ECONOMIC ANALYSIS OF LIVESTOCK INDUSTRY MARKETING, PRICES, PRODUCTION AND  
 POLICY***

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Item No. 288 of 602

**ACCESSION NO:** 0182507 **SUBFILE:** CRIS  
**PROJ NO:** MIN-14-046 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NC-224  
**START:** 01 OCT 1998 **TERM:** 30 SEP 2003 **FY:** 2003

**INVESTIGATOR:** Fruin, J.

**PERFORMING INSTITUTION:**

APPLIED ECONOMICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***COMPETITIVENESS AND VALUE-ADDED MARKETS IN THE U.S. GRAIN AND OILSEED INDUSTRY***

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Item No. 289 of 602

**ACCESSION NO:** 0165964 **SUBFILE:** CRIS  
**PROJ NO:** MIN-14-052 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Fruin, J. E.; McCullough, G.

**PERFORMING INSTITUTION:**

APPLIED ECONOMICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***MODELING AND ANALYSIS OF TRANSPORTATION AND LOGISTICS SYSTEM REQUIREMENTS FOR AG COMMODITIES AND BIOMASS FOR FOOD, FUEL, AND RAW MATERIALS***

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Item No. 290 of 602

**ACCESSION NO:** 0200525 **SUBFILE:** CRIS  
**PROJ NO:** MIN-14-059 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Fruin, J.

**PERFORMING INSTITUTION:**

APPLIED ECONOMICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED SECTOR***

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**ACCESSION NO:** 0093725 **SUBFILE:** CRIS  
**PROJ NO:** MIN-14-064 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Runge, C. F.

**PERFORMING INSTITUTION:**  
APPLIED ECONOMICS  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

*TRADE, ENVIRONMENT AND AGRICULTURAL SCIENCE IN THE GLOBAL COMMONS*

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Item No. 292 of 602

**ACCESSION NO:** 0182514 **SUBFILE:** CRIS  
**PROJ NO:** MIN-21-049 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Gillman, J. H.

**PERFORMING INSTITUTION:**  
HORTICULTURAL SCIENCE  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

*INCREASING PRODUCTION EFFICIENCY AND LONG TERM HEALTH OF NURSERY GROWN CROPS*

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Item No. 293 of 602

**ACCESSION NO:** 0003068 **SUBFILE:** CRIS  
**PROJ NO:** MIN-25-076 **AGENCY:** SAES MIN  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012 **FY:** 2006

**INVESTIGATOR:** Graham, P. H.; Tlusty, B.; Sheaffer, C. C.; Vance, C. P.; Percich, J. A.; Kurle, J.;  
Graham, M. A.

**PERFORMING INSTITUTION:**  
SOIL, WATER, AND CLIMATE  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

*IMPROVING THE CAPACITY FOR NODULATION AND NITROGEN FIXATION OF CROP,  
PASTURE AND PRAIRIE LEGUMES*

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**ACCESSION NO:** 0087768 **SUBFILE:** CRIS  
**PROJ NO:** MIN-43-068 **AGENCY:** CSREES MIN  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Sarkanen, S.

**PERFORMING INSTITUTION:**  
WOOD AND PAPER SCIENCE  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***LIGNIN BIOSYNTHESIS, BIODEGRADATION AND DERIVATIVE PLASTICS***

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Item No. 295 of 602

**ACCESSION NO:** 0211172 **SUBFILE:** CRIS  
**PROJ NO:** MIN-71-038 **AGENCY:** SAES MIN  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2010

**INVESTIGATOR:** Weiblen, G. D.; Tschirner, U.

**PERFORMING INSTITUTION:**  
PLANT BIOLOGY  
UNIV OF MINNESOTA  
ST PAUL, MINNESOTA 55108

***HEMP BIOMASS AND QUANTITATIVE TRAIT LOCI MAPPING***

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Item No. 296 of 602

**ACCESSION NO:** 0195065 **SUBFILE:** CRIS  
**PROJ NO:** MINW-2003-06003 **AGENCY:** CSREES MINW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34291-13283 **PROPOSAL NO:** 2003-06003  
**START:** 15 SEP 2003 **TERM:** 14 SEP 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$464,361

**INVESTIGATOR:** Nagel, J. L.

**PERFORMING INSTITUTION:**  
UNIVERSITY OF MINNESOTA  
2900 UNIVERSITY AVENUE  
CROOKSTON, MINNESOTA 56716

***PRODUCER ALLIANCE INFRASTRUCTURE & AGRICULTURAL DIVERSITY IN THE  
NORTHERN GREAT PLAINS***

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Item No. 297 of 602

**ACCESSION NO:** 0191614 **SUBFILE:** CRIS  
**PROJ NO:** MINW-NAGEL **AGENCY:** CSREES MINW  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-34291-11882 **PROPOSAL NO:** 2002-06025  
**START:** 01 JUN 2002 **TERM:** 30 NOV 2003 **GRANT YR:** 2002  
**GRANT AMT:** \$374,145

**INVESTIGATOR:** Nagel, J. L.

**PERFORMING INSTITUTION:**  
NORTHERN GREAT PLAINS, INC  
CROOKSTON, MINNESOTA 56716

*PRODUCER ALLIANCE INFRASTRUCTURE & AGRICULTURAL DIVERSITY IN THE  
NORTHERN GREAT PLAINS*

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Item No. 298 of 602

**ACCESSION NO:** 0197343 **SUBFILE:** CRIS  
**PROJ NO:** NC-4158-1 **AGENCY:** FS NC  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 15 FEB 2001 **TERM:** 15 FEB 2006 **FY:** 2006

**INVESTIGATOR:** Riemenschneider, D. E.

**PERFORMING INSTITUTION:**  
FORESTRY SCIENCES LAB - RHINELANDER, WI  
NORTH CENTRAL RESEARCH STATION  
1992 FOLWELL AVENUE  
ST PAUL, MINNESOTA 55108

*CURRENT PRODUCTION POPULATIONS OF COTTONWOODS AND OTHER SPECIES ARE  
NOT SUFFICIENTLY DIVERSE*

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Item No. 299 of 602

**ACCESSION NO:** 0197344 **SUBFILE:** CRIS  
**PROJ NO:** NC-4158-2 **AGENCY:** FS NC  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 15 FEB 2001 **TERM:** 15 FEB 2006 **FY:** 2006

**INVESTIGATOR:** Riemenschneider, D. E.

**PERFORMING INSTITUTION:**  
FORESTRY SCIENCES LAB - RHINELANDER, WI  
NORTH CENTRAL RESEARCH STATION  
1992 FOLWELL AVENUE  
ST PAUL, MINNESOTA 55108

***BENEFITS AND SUSTAINABILITY OF INTENSIVE FORESTRY SYSTEMS ARE NOT WELL KNOWN***

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Item No. 300 of 602

**ACCESSION NO:** 0408547 **SUBFILE:** CRIS  
**PROJ NO:** 6402-41440-005-00D **AGENCY:** ARS 6402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 25 JUN 2004 **TERM:** 24 JUN 2009 **FY:** 2006

**INVESTIGATOR:** BYLER R K; RAY S J; BOYKIN JR J C; LE S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
STONEVILLE, MISSISSIPPI 38776

***DEVELOP, ENHANCE AND TRANSFER GIN TECHNOLOGY TO IMPROVE FIBER QUALITY AND PROFITS***

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Item No. 301 of 602

**ACCESSION NO:** 0410097 **SUBFILE:** CRIS  
**PROJ NO:** 6402-42000-003-00D **AGENCY:** ARS 6402  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1001  
**START:** 28 DEC 2005 **TERM:** 27 DEC 2010 **FY:** 2006

**INVESTIGATOR:** ABBAS H K; BRUNS H A; YOUNG L D

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
STONEVILLE, MISSISSIPPI 38776

***AGRICULTURAL PRACTICES, ECOLOGICAL AND VARIETAL EFFECTS ON AFLATOXINS AND OTHER MYCOTOXINS IN CORN***

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Item No. 302 of 602

**ACCESSION NO:** 0190359 **SUBFILE:** CRIS  
**PROJ NO:** MIS-162010 **AGENCY:** CSREES MIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 AUG 2001 **TERM:** 31 JUL 2006 **FY:** 2006

**INVESTIGATOR:** Baldwin, B. S.

**PERFORMING INSTITUTION:**  
PLANT & SOIL SCIENCE  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

*NEW CROPS FOR INDUSTRIAL USES*

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Item No. 303 of 602

**ACCESSION NO:** 0191441 **SUBFILE:** CRIS  
**PROJ NO:** MIS-162020 **AGENCY:** CSREES MIS  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-34447-10302-S **PROPOSAL NO:** 2001-03143-S  
**START:** 01 JUL 2001 **TERM:** 30 JUN 2003 **FY:** 2003

**INVESTIGATOR:** Gilbert, J. A.; Baldwin, B. S.; Meints, P. D.; Hudson, D. M.; Hite, D.; Thomasson, A.; Columbus, E.; Reichert, N. R.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

*BIOMASS-BASED ENERGY RESEARCH*

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Item No. 304 of 602

**ACCESSION NO:** 0198399 **SUBFILE:** CRIS  
**PROJ NO:** MIS-162030 **AGENCY:** CSREES MIS  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34447-13162-S **PROPOSAL NO:** 2003-06027-S  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2005 **FY:** 2005

**INVESTIGATOR:** Gilbert, J. A.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

*BIOMASS-BASED ENERGY RESEARCH 2003*

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Item No. 305 of 602

**ACCESSION NO:** 0202170 **SUBFILE:** CRIS  
**PROJ NO:** MIS-162050 **AGENCY:** SAES MIS  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2006 **FY:** 2006

**INVESTIGATOR:** Columbus, E. P.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING

MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***BIOMASS BASED ENERGY RESEARCH 2004***

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Item No. 306 of 602

**ACCESSION NO:** 0205539 **SUBFILE:** CRIS  
**PROJ NO:** MIS-162060 **AGENCY:** SAES MIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2007

**INVESTIGATOR:** Columbus, E. P.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***BIOMASS BASED ENERGY RESEARCH 2005***

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Item No. 307 of 602

**ACCESSION NO:** 0202244 **SUBFILE:** CRIS  
**PROJ NO:** MIS-189010 **AGENCY:** SAES MIS  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 SEP 2004 **TERM:** 29 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Columbus, E. P.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***BIODIESEL PRODUCTION PROJECT: DEVELOPMENT AND OPTIMIZATION OF NOVEL  
BIODIESEL PRODUCTION TECHNIQUES***

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Item No. 308 of 602

**ACCESSION NO:** 0202877 **SUBFILE:** CRIS  
**PROJ NO:** MIS-189020 **AGENCY:** CSREES MIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Allen, A. J.

**PERFORMING INSTITUTION:**  
AGRICULTURAL ECONOMICS

MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM  
THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED  
SECTOR***

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Item No. 309 of 602

**ACCESSION NO:** 0209437 **SUBFILE:** CRIS  
**PROJ NO:** MIS-189030 **AGENCY:** CSREES MIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Baldwin, B.

**PERFORMING INSTITUTION:**  
PLANT & SOIL SCIENCE  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***ALTERNATIVE CROPS FOR INDUSTRIAL USES***

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Item No. 310 of 602

**ACCESSION NO:** 0209746 **SUBFILE:** CRIS  
**PROJ NO:** MIS-241050 **AGENCY:** SAES MIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Batchelor, W.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***SUSTAINABLE ENERGY CENTER***

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Item No. 311 of 602

**ACCESSION NO:** 0202245 **SUBFILE:** CRIS  
**PROJ NO:** MIS-539010 **AGENCY:** SAES MIS  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 15 JUN 2004 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Columbus, E. P.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & BIOLOGICAL ENGINEERING  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***MICRO-CHP AND BIO-FUELS CENTER***

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Item No. 312 of 602

**ACCESSION NO:** 0207992 **SUBFILE:** CRIS  
**PROJ NO:** MIS-603110 **AGENCY:** CSREES MIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2011

**INVESTIGATOR:** Herndon, C. W.

**PERFORMING INSTITUTION:**  
AGRICULTURAL ECONOMICS  
MISSISSIPPI STATE UNIV  
MISSISSIPPI STATE, MISSISSIPPI 39762

***ECONOMIC AND POLICY ANALYSIS FOR RENEWABLE AND SUSTAINABLE ENERGY***

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Item No. 313 of 602

**ACCESSION NO:** 0200095 **SUBFILE:** CRIS  
**PROJ NO:** MISZ-065390 **AGENCY:** CSREES MISZ  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34158-14682 **PROPOSAL NO:** 2004-06324  
**START:** 15 AUG 2004 **TERM:** 14 AUG 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$736,009

**INVESTIGATOR:** Hopper, G. M.; Leightley, L. E.; Shepard, J. P.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS  
FOREST AND WILDLIFE RES CENTER  
MISSISSIPPI STATE, MISSISSIPPI 39762

***WOOD UTILIZATION RESEARCH PROGRAM 2004***

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Item No. 314 of 602

**ACCESSION NO:** 0203281 **SUBFILE:** CRIS  
**PROJ NO:** MISZ-065430 **AGENCY:** CSREES MISZ  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34158-16442 **PROPOSAL NO:** 2005-06304  
**START:** 15 SEP 2005 **TERM:** 14 SEP 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$716,952



**INVESTIGATOR:** Hopper, G. M.; Leightley, L. E.; Shepard, J. P.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS  
FOREST AND WILDLIFE RES CENTER  
MISSISSIPPI STATE, MISSISSIPPI 39762

*WOOD UTILIZATION RESEARCH PROGRAM 2005*

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Item No. 315 of 602

**ACCESSION NO:** 0174133 **SUBFILE:** CRIS  
**PROJ NO:** MISZ-069090 **AGENCY:** CSREES MISZ  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** REVISED  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2008 **FY:** 2006

**INVESTIGATOR:** Schultz, E. B.

**PERFORMING INSTITUTION:**  
DEPT OF FORESTRY  
FOREST AND WILDLIFE RES CENTER  
MISSISSIPPI STATE, MISSISSIPPI 39762

*COMPUTER APPLICATIONS IN FORESTRY AND TECHNOLOGY TRANSFER*

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Item No. 316 of 602

**ACCESSION NO:** 0156347 **SUBFILE:** CRIS  
**PROJ NO:** MO-FESL0281 **AGENCY:** CSREES MO.  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 1997 **TERM:** 30 SEP 2003 **FY:** 2003

**INVESTIGATOR:** Borgelt, S. C.

**PERFORMING INSTITUTION:**  
FOOD SCIENCE & ENGINEERING  
UNIVERSITY OF MISSOURI  
COLUMBIA, MISSOURI 65211

*TECHNOLOGY FOR EFFICIENT USE OF AGRI-RESOURCES*

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Item No. 317 of 602

**ACCESSION NO:** 0184985 **SUBFILE:** CRIS  
**PROJ NO:** MO-SSSG0078 **AGENCY:** CSREES MO.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-34212-8994 **PROPOSAL NO:** 2000-03997  
**START:** 01 JUL 2000 **TERM:** 30 JUN 2003 **FY:** 2003 **GRANT YR:** 2000  
**GRANT AMT:** \$142,196

**INVESTIGATOR:** Van Dyne, D. L.

**PERFORMING INSTITUTION:**  
SOCIAL SCIENCES  
UNIVERSITY OF MISSOURI  
COLUMBIA, MISSOURI 65211

*COMMERCIALIZING BIODIESEL AND OTHER PRODUCTS FROM OILSEEDS*

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Item No. 318 of 602

**ACCESSION NO:** 0207894 **SUBFILE:** CRIS  
**PROJ NO:** MOE-2006-02762 **AGENCY:** CSREES MO.E  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38820-17589 **PROPOSAL NO:** 2006-02762  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$299,639

**INVESTIGATOR:** Eivazi, F.; Nkongolo, N.; Yang, J.; Motavalli, P.; Nam, P.

**PERFORMING INSTITUTION:**  
AGRICULTURE, BIOLOGY, CHEMISTRY & PHYSICS  
LINCOLN UNIVERSITY  
JEFFERSON CITY, MISSOURI 65101

*CENTER FOR AGRICULTURAL/ENVIRONMENTAL EXPERIENTIAL LEARNING*

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Item No. 319 of 602

**ACCESSION NO:** 0200830 **SUBFILE:** CRIS  
**PROJ NO:** MOR-2004-00953 **AGENCY:** CSREES MO.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35504-14896 **PROPOSAL NO:** 2004-00953  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2008 **FY:** 2005 **GRANT YR:** 2004  
**GRANT AMT:** \$312,205

**INVESTIGATOR:** Angenent, L. T.; Shen, A.; Floss, C.

**PERFORMING INSTITUTION:**  
WASHINGTON UNIV  
#1 NORTH BROOKINGS DRIVE, CAMPUS BOX 1137  
ST LOUIS, MISSOURI 63130

*IMPROVING STABILITY IN ANAEROBIC DIGESTION FOR ANIMAL WASTE TREATMENT BY UNDERSTANDING THE MICROBIAL ECOLOGY*

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Item No. 320 of 602

**ACCESSION NO:** 0190838 **SUBFILE:** CRIS  
**PROJ NO:** MONB00082 **AGENCY:** CSREES MONB  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NC-1003  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Smith, V.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*IMPACT ANALYSIS AND DECISION STRATEGIES FOR AGRICULTURAL RESEARCH*

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Item No. 321 of 602

**ACCESSION NO:** 0090165 **SUBFILE:** CRIS  
**PROJ NO:** MONB00089 **AGENCY:** CSREES MONB  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Antle, J. M.; Capalbo, S. M.; Hewitt, J. A.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*CLIMATE CHANGE AND GREENHOUSE GAS MITIGATION IN MONTANA AND U.S.  
AGRICULTURE*

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Item No. 322 of 602

**ACCESSION NO:** 0189403 **SUBFILE:** CRIS  
**PROJ NO:** MONB00093 **AGENCY:** CSREES MONB  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011 **FY:** 2006

**INVESTIGATOR:** Smith, V. H.; Buschena, D. E.; Rucker, R. R.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*AGRICULTURAL POLICY*

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Item No. 323 of 602

**ACCESSION NO:** 0196652 **SUBFILE:** CRIS  
**PROJ NO:** MONB00505 **AGENCY:** SAES MONB  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 MAR 2006 **TERM:** 01 MAR 2011 **FY:** 2006

**INVESTIGATOR:** Chen, C.

**PERFORMING INSTITUTION:**  
CENTRAL AGRICULTURAL RESEARCH CENTER  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*CROPPING SYSTEMS FOR PROFITABILITY AND CONSERVATION.*

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Item No. 324 of 602

**ACCESSION NO:** 0186171 **SUBFILE:** CRIS  
**PROJ NO:** MONB00656 **AGENCY:** SAES MONB  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Kephart, K. D.

**PERFORMING INSTITUTION:**  
SOUTHERN AGRI RES CENTER  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*FIELD CROP PRODUCTION FOR SOUTH CENTRAL MONTANA*

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Item No. 325 of 602

**ACCESSION NO:** 0194467 **SUBFILE:** CRIS  
**PROJ NO:** MONB00760 **AGENCY:** CSREES MONB  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Johnson, D.

**PERFORMING INSTITUTION:**  
NORTHWESTERN AGRI RES CENTER  
MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA 59717

*SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 326 of 602

**ACCESSION NO:** 0210723 **SUBFILE:** CRIS  
**PROJ NO:** MONE-2007-02666 **AGENCY:** CSREES MONE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-47002-03839 **PROPOSAL NO:** 2007-02666  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$85,000

**INVESTIGATOR:** vinger, B. L.

**PERFORMING INSTITUTION:**  
FORT PECK COMMUNITY COLLEGE  
P. O. BOX 398  
POPLAR, MONTANA 59255

***FORT PECK COMMUNITY COLLEGE TRIBAL COLLEGE EXTENSION SERVICES PROGRAM***

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Item No. 327 of 602

**ACCESSION NO:** 0192708 **SUBFILE:** CRIS  
**PROJ NO:** MONK-2002-00424 **AGENCY:** CSREES MONK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-33610-11881 **PROPOSAL NO:** 2002-00424  
**START:** 15 MAY 2002 **TERM:** 14 NOV 2002 **GRANT YR:** 2002  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Mcgrath, S.

**PERFORMING INSTITUTION:**  
MONTEC RESEARCH  
1901 SOUTH FRANKLIN STREET2  
BUTTE, MONTANA 59702

***INNOVATIVE ENZYMATIC REACTOR FOR PRODUCTION OF ALTERNATIVE FUELS***

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Item No. 328 of 602

**ACCESSION NO:** 0197311 **SUBFILE:** CRIS  
**PROJ NO:** MONK-2003-04090 **AGENCY:** CSREES MONK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-33610-14000 **PROPOSAL NO:** 2003-04090  
**START:** 01 SEP 2003 **TERM:** 31 DEC 2006 **FY:** 2004 **GRANT YR:** 2003  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Yang, F.

**PERFORMING INSTITUTION:**  
MONTEC RESEARCH  
1901 SOUTH FRANKLIN STREET2  
BUTTE, MONTANA 59702

***INNOVATIVE ENZYMATIC REACTOR FOR PRODUCTION OF ALTERNATIVE FUELS***

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Item No. 329 of 602

**ACCESSION NO:** 0403044 **SUBFILE:** CRIS  
**PROJ NO:** 5440-12130-002-01R **AGENCY:** ARS 5440  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 SEP 1999 **TERM:** 30 AUG 2004 **FY:** 2003

**INVESTIGATOR:** SCHEPERS J S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
LINCOLN, NEBRASKA 68583

***NITROGEN MANAGEMENT ASSOCIATED WITH USING CORN STALKS AS A BIOFUEL SOURCE***

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Item No. 330 of 602

**ACCESSION NO:** 0404962 **SUBFILE:** CRIS  
**PROJ NO:** 5440-12210-008-00D **AGENCY:** ARS 5440  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 30 SEP 2001 **TERM:** 29 SEP 2006 **FY:** 2006

**INVESTIGATOR:** WIENHOLD B J; VARVEL G E; SHANAHAN J F; SCHEPERS J S; WILHELM W W

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
LINCOLN, NEBRASKA 68583

***SOIL HEALTH AS AN INDICATOR OF SUSTAINABLE MANAGEMENT***

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Item No. 331 of 602

**ACCESSION NO:** 0410721 **SUBFILE:** CRIS  
**PROJ NO:** 5440-12210-050-00D **AGENCY:** ARS 5440  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** WIENHOLD B J; VARVEL G E; WILHELM W W; SHANAHAN J F; SCHEPERS J S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
LINCOLN, NEBRASKA 68583

***SOIL MANAGEMENT SYSTEMS FOR DRYLAND AND IRRIGATED CROPPING SYSTEMS***

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**ACCESSION NO:** 0406507 **SUBFILE:** CRIS  
**PROJ NO:** 5440-21000-021-00D **AGENCY:** ARS 5440  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 06 NOV 2002 **TERM:** 05 NOV 2007 **FY:** 2006

**INVESTIGATOR:** VOGEL K P; SARATH G; MITCHELL R

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
LINCOLN, NEBRASKA 68583

*IMPROVED PLANTS AND PRODUCTION PRACTICES FOR GRASSLANDS AND BIOMASS  
CROPS IN THE MID-CONTINENTAL USA*

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Item No. 333 of 602

**ACCESSION NO:** 0405988 **SUBFILE:** CRIS  
**PROJ NO:** 5440-21220-024-08S **AGENCY:** ARS 5440  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 01 SEP 2002 **TERM:** 31 AUG 2007 **FY:** 2002

**INVESTIGATOR:** VOGEL K P; GRAYBOSCH R A; PEDERSEN J F

**PERFORMING INSTITUTION:**  
AGRONOMY & HORTICULTURE  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

*ENHANCING SORGHUM, WHEAT, AND FORAGE GERMLASM DEVELOPMENT WITH  
IRRIGATION*

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Item No. 334 of 602

**ACCESSION NO:** 0201316 **SUBFILE:** CRIS  
**PROJ NO:** NEB-10-154 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Conley, D. M.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

*ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM  
THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED  
SECTOR*

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Item No. 335 of 602

**ACCESSION NO:** 0204354 **SUBFILE:** CRIS  
**PROJ NO:** NEB-12-309 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2005 **TERM:** 31 JUL 2010 **FY:** 2006

**INVESTIGATOR:** Russell, W. K.

**PERFORMING INSTITUTION:**  
AGRONOMY & HORTICULTURE  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

***IMPROVING EFFICIENCY OF CORN BREEDING AND DEVELOPING ALTERNATIVE  
BREEDING METHODS***

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Item No. 336 of 602

**ACCESSION NO:** 0210783 **SUBFILE:** CRIS  
**PROJ NO:** NEB-22-324 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-506  
**START:** 01 JAN 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Cassman, K. G.; Perrin, R.

**PERFORMING INSTITUTION:**  
AGRONOMY & HORTICULTURE  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

***SUSTAINABLE BIOREFINING SYSTEMS FOR CORN IN THE NORTH CENTRAL REGION***

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Item No. 337 of 602

**ACCESSION NO:** 0211154 **SUBFILE:** CRIS  
**PROJ NO:** NEB-22-325 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2012

**INVESTIGATOR:** Wortmann, C. S.

**PERFORMING INSTITUTION:**  
AGRONOMY & HORTICULTURE  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

***NUTRIENT AND WATER MANAGEMENT FOR GRAIN AND BIOFUEL PRODUCTION SYSTEMS  
OF NEBRASKA***



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Item No. 338 of 602

**ACCESSION NO:** 0209550 **SUBFILE:** CRIS  
**PROJ NO:** NEB-24-158 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-1034  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Perrin, R. K.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

*IMPACT ANALYSES AND DECISION STRATEGIES FOR AGRICULTURAL RESEARCH*

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Item No. 339 of 602

**ACCESSION NO:** 0188612 **SUBFILE:** CRIS  
**PROJ NO:** NEB-29-011 **AGENCY:** CSREES NEB  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-34233-10499 **PROPOSAL NO:** 2002-06133  
**START:** 01 SEP 2001 **TERM:** 31 AUG 2004 **FY:** 2004 **GRANT YR:** 2002  
**GRANT AMT:** \$59,863

**INVESTIGATOR:** Hanna, M. A.

**PERFORMING INSTITUTION:**  
INDUSTRIAL AGRICULTURAL PRODUCTS CENTER  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

*INDUSTRIAL AGRICULTURAL PRODUCTS CENTER*

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Item No. 340 of 602

**ACCESSION NO:** 0201421 **SUBFILE:** CRIS  
**PROJ NO:** NEB-29-013 **AGENCY:** CSREES NEB  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-38859-02234 **PROPOSAL NO:** 2004-05024  
**START:** 15 SEP 2004 **TERM:** 14 SEP 2005 **FY:** 2005 **GRANT YR:** 2004  
**GRANT AMT:** \$25,000

**INVESTIGATOR:** Hanna, M. A.; Isom, L. D.

**PERFORMING INSTITUTION:**  
INDUSTRIAL AGRICULTURAL PRODUCTS CENTER  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

**POST AWARD MANAGEMENT OF BIOMASS R&D INITIATIVE PROJECTS**

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Item No. 341 of 602

**ACCESSION NO:** 0192057 **SUBFILE:** CRIS  
**PROJ NO:** NEB-37-035 **AGENCY:** CSREES NEB  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 APR 2007 **TERM:** 31 MAR 2012 **FY:** 2006

**INVESTIGATOR:** Yang, Y.

**PERFORMING INSTITUTION:**  
TEXTILES, CLOTHING & DESIGN  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

***PROCESS AND PROPERTY INVESTIGATIONS OF FIBERS FROM NEBRASKA'S  
AGRICULTURAL PRODUCTS AND BY-PRODUCTS***

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Item No. 342 of 602

**ACCESSION NO:** 0211958 **SUBFILE:** CRIS  
**PROJ NO:** NEV00342 **AGENCY:** CSREES NEV  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2010

**INVESTIGATOR:** Harper, J.; Cushman, J.

**PERFORMING INSTITUTION:**  
BIOCHEMISTRY  
UNIVERSITY OF NEVADA  
RENO, NEVADA 89557

***BIOFUELS FROM SALT BASIN ALGAE: AN ENERGY CROP FOR NEVADA***

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Item No. 343 of 602

**ACCESSION NO:** 0212419 **SUBFILE:** CRIS  
**PROJ NO:** NEV003GN **AGENCY:** SAES NEV  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 15 JUL 2007 **TERM:** 31 JAN 2008

**INVESTIGATOR:** Cushman, J.; Shintani, D.; Harper, J.

**PERFORMING INSTITUTION:**  
BIOCHEMISTRY  
UNIVERSITY OF NEVADA  
RENO, NEVADA 89557

**BIOFUELS FROM SALT BASIN ALGAE: A RENEWABLE ENERGY CROP FOR CARBON SEQUESTRATION**

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Item No. 344 of 602

**ACCESSION NO:** 0203348 **SUBFILE:** CRIS  
**PROJ NO:** NEV052PD **AGENCY:** SAES NEV  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 21 JAN 2005 **TERM:** 30 JUN 2007 **FY:** 2006

**INVESTIGATOR:** Tsukamoto, T.; Miller, G.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCES & ENVIRONMENTAL SCIENCES  
UNIVERSITY OF NEVADA  
RENO, NEVADA 89557

***OPERATION, MONITORING AND MAINTANENCE OF BIOREACTORS AT THE LEVIATHAN MINE***

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Item No. 345 of 602

**ACCESSION NO:** 0186027 **SUBFILE:** CRIS  
**PROJ NO:** NHR-2000-01888 **AGENCY:** CSREES NH.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10041 **PROPOSAL NO:** 2000-01888  
**START:** 15 DEC 2000 **TERM:** 30 JUN 2003 **FY:** 2003 **GRANT YR:** 2001  
**GRANT AMT:** \$103,000

**INVESTIGATOR:** Wyman, C. E.

**PERFORMING INSTITUTION:**  
THAYER SCHOOL OF ENGINEERING  
DARTMOUTH COLLEGE  
8000 CUMMINGS HALL  
HANOVER N H, NEW HAMPSHIRE 03755

***FUNDAMENTALS OF WATER-ONLY HYDROLYSIS FOR ADVANCED BIOMASS PRETREATMENT***

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Item No. 346 of 602

**ACCESSION NO:** 0200573 **SUBFILE:** CRIS  
**PROJ NO:** NHR-2004-00952 **AGENCY:** CSREES NH.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35504-14668 **PROPOSAL NO:** 2004-00952  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$401,000

**INVESTIGATOR:** Wyman, C.

**PERFORMING INSTITUTION:**

Thayer School of Engineering  
Hanover, NEW HAMPSHIRE 03755

***LIGNIN BLOCKERS FOR LOWER COST ENZYMATIC HYDROLYSIS OF PRETREATED CELLULOSE***

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Item No. 347 of 602

**ACCESSION NO:** 0186451 **SUBFILE:** CRIS  
**PROJ NO:** NHW-2000-04726 **AGENCY:** CSREES NH.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-52104-9663 **PROPOSAL NO:** 2000-04726  
**START:** 15 SEP 2000 **TERM:** 30 SEP 2004 **FY:** 2003 **GRANT YR:** 2000  
**GRANT AMT:** \$1,200,000

**INVESTIGATOR:** Wyman, C. E.

**PERFORMING INSTITUTION:**

THAYER SCHOOL OF ENGINEERING  
DARTMOUTH COLLEGE  
8000 CUMMINGS HALL  
HANOVER N H, NEW HAMPSHIRE 03755

***COORDINATED DEVELOPMENT OF LEADING BIOMASS PRETREATMENT TECHNOLOGIES***

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Item No. 348 of 602

**ACCESSION NO:** 0408682 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-121-01S **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** TERMINATED  
**START:** 08 JUL 2004 **TERM:** 31 OCT 2006 **FY:** 2005

**INVESTIGATOR:** HUGHES S R; FARRELLY P

**PERFORMING INSTITUTION:**

HUDSON CONTROL GROUP, INC.  
10 STERN AVENUE  
SPRINGFIELD, NEW JERSEY 07081

***CONSTRUCTION OF A HIGH THROUGHPUT MOLECULAR BIOLOGY SCREENING PLATFORM TO IDENTIFY SUPERIOR BIOCATALYSTS FOR AGRICULTURAL PRODUCTS***

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Item No. 349 of 602

**ACCESSION NO:** 0408961 **SUBFILE:** CRIS  
**PROJ NO:** 6235-41000-006-00D **AGENCY:** ARS 6235  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 27 AUG 2004 **TERM:** 26 AUG 2009 **FY:** 2006

**INVESTIGATOR:** HUGHS S E; ARMIJO C B; FUNK P A; WHITELOCK D P; BAKER K D

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
LAS CRUCES, NEW MEXICO 88001

***GINNING AND PROCESSING RESEARCH TO ENHANCE QUALITY, PROFITABILITY, AND  
TEXTILE UTILITY OF WESTERN COTTONS***

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Item No. 350 of 602

**ACCESSION NO:** 0201774 **SUBFILE:** CRIS  
**PROJ NO:** NM-1-5-27024 **AGENCY:** CSREES NM.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** W-1128  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** O'Neill, M.

**PERFORMING INSTITUTION:**  
AG SCI CENTER AT FARMINGTON  
NEW MEXICO STATE UNIV  
LAS CRUCES, NEW MEXICO 88003

***REDUCING BARRIERS TO ADOPTION OF MICROIRRIGATION***

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Item No. 351 of 602

**ACCESSION NO:** 0201787 **SUBFILE:** CRIS  
**PROJ NO:** NM-1-5-27548 **AGENCY:** CSREES NM.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Lauriault, L.

**PERFORMING INSTITUTION:**  
AG SCI CENTER AT TUCUMCARI  
NEW MEXICO STATE UNIV  
LAS CRUCES, NEW MEXICO 88003

***DEVELOPING FORAGE MANAGEMENT STRATEGIES TO MEET CHANGES IN NEW MEXICO  
AGRICULTURE***

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Item No. 352 of 602

**ACCESSION NO:** 0211946 **SUBFILE:** CRIS  
**PROJ NO:** NM-112139 **AGENCY:** CSREES NM.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Cabrera, V. E.

**PERFORMING INSTITUTION:**  
PLANT AND ENVIRONMENTAL SCIENCES  
NEW MEXICO STATE UNIV  
LAS CRUCES, NEW MEXICO 88003

***PARTICIPATORY DEVELOPMENT OF A DECISION SUPPORT SYSTEM TO REDUCE ENVIRONMENTAL IMPACTS FROM DAIRY FARMING IN NEW MEXICO***

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Item No. 353 of 602

**ACCESSION NO:** 0186903 **SUBFILE:** CRIS  
**PROJ NO:** NMR-2000-01229 **AGENCY:** CSREES NM.R  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35501-10100 **PROPOSAL NO:** 2000-01229  
**START:** 15 NOV 2000 **TERM:** 30 SEP 2004 **GRANT YR:** 2001  
**GRANT AMT:** \$75,000

**INVESTIGATOR:** Samani, Z.; Hanson, A.; Smith, G.

**PERFORMING INSTITUTION:**  
CIVIL AND AGRIC ENGINEERING  
NEW MEXICO STATE UNIV  
LAS CRUCES, NEW MEXICO 88003

***PRODUCING ENERGY FROM FEEDLOT MANURE WASTE USING A BI-PHASIC FERMENTATION SYSTEM***

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Item No. 354 of 602

**ACCESSION NO:** 0209893 **SUBFILE:** CRIS  
**PROJ NO:** NYC-102398 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JAN 2007 **TERM:** 31 DEC 2011

**INVESTIGATOR:** Walker, L. P.; Hoffmann, M. P.

**PERFORMING INSTITUTION:**  
STATION ADMINISTRATION  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***BIOBASED TRANSPORTATION RESEARCH PROGRAM***

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Item No. 355 of 602

**ACCESSION NO:** 0201655 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123310 **AGENCY:** SAES NY.C

**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2009 **FY:** 2006

**INVESTIGATOR:** Scott, N. R.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*FEASIBILITY STUDY TO ANALYZE THE ECONOMIC VALUE PROPOSITION AND RELATED  
MARKETING ATRATEGY FOR A MODULAR, PRESSURIZED ANAEROBIC DIGESTION*

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Item No. 356 of 602

**ACCESSION NO:** 0188785 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123344 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 APR 2001 **TERM:** 31 DEC 2008 **FY:** 2006

**INVESTIGATOR:** Gooch, C. A.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*MANURE TREATMENT SYSTEMS EVALUATION AND TECHNOLOGY TRANSFER*

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Item No. 357 of 602

**ACCESSION NO:** 0094603 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123347 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 1993 **TERM:** 30 SEP 2003 **FY:** 2003

**INVESTIGATOR:** Aneshansley, D.; Pellerin, R. A.; Sobel, A. T.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*ENERGY USE ON FARMS*

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Item No. 358 of 602

**ACCESSION NO:** 0202776 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123384 **AGENCY:** SAES NY.C

**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 JAN 2006 **TERM:** 31 DEC 2010 **FY:** 2006

**INVESTIGATOR:** Walker, L. P.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*SUSTAINABLE PRODUCTION OF BIOFUELS, BIOPOWER AND BIOPRODUCTS*

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Item No. 359 of 602

**ACCESSION NO:** 0191069 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123400 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2004 **FY:** 2006

**INVESTIGATOR:** Scott, N. R.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*INNOVATIVE SYSTEMS OF ENERGY CONVERSION ON FARMS AND SUSTAINABLE COMMUNITIES*

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Item No. 360 of 602

**ACCESSION NO:** 0205082 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123417 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Gebremedhin, K. G.; Gooch, C.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*DEVELOPMENT, VALIDATION, AND COSTS OF NET ENERGY AND GAS PRODUCTION MODEL OF ANAEROBIC DIGESTERS*

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Item No. 361 of 602



**ACCESSION NO:** 0205655 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123420 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 01 OCT 2007 **FY:** 2006

**INVESTIGATOR:** Aneshansley, D. J.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***DEVELOPMENT AND EVALUATION OF EQUIPMENT FOR THE PRODUCTION AND HARVESTING OF BIOMASS***

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Item No. 362 of 602

**ACCESSION NO:** 0208604 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123428 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Gebremedhin, K. G.; Gooch, C.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***DEVELOPMENT, VALIDATION, AND COSTS OF NET ENERGY AND GAS PRODUCTION MODEL OF ANAEROBIC DIGESTERS***

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Item No. 363 of 602

**ACCESSION NO:** 0192400 **SUBFILE:** CRIS  
**PROJ NO:** NYC-123593 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-34474-11937-S **PROPOSAL NO:** 2003-06059-S  
**START:** 01 MAY 2002 **TERM:** 31 DEC 2004 **FY:** 2006

**INVESTIGATOR:** Walker, L. P.; Scott, N. R.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ENVIRONMENTAL ENGINEERING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***PLANNING THE SUN GRANT INITIATIVE***

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**ACCESSION NO:** 0212500 **SUBFILE:** CRIS  
**PROJ NO:** NYC-125320 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2009

**INVESTIGATOR:** Woodbury, P. B.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*SUSTAINABLE BIOMASS ENERGY*

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Item No. 365 of 602

**ACCESSION NO:** 0205574 **SUBFILE:** CRIS  
**PROJ NO:** NYC-125515 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Lehmann, C. J.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*BIO-CHAR SEQUESTRATION, SOIL FERTILITY IMPROVEMENT AND ENERGY PRODUCTION*

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Item No. 366 of 602

**ACCESSION NO:** 0195575 **SUBFILE:** CRIS  
**PROJ NO:** NYC-125583 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34244-13837 **PROPOSAL NO:** 2004-06061  
**START:** 15 AUG 2003 **TERM:** 14 AUG 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$327,806

**INVESTIGATOR:** Duxbury, J. M.; Wolfe, D. W.; DeGloria, S. D.; McBride, M. B.; Thies, J. E.; Mohler, C.; van Es, H. M.; DiTommaso, T.; Cherney, J.; Goodale, C.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*AGRICULTURAL ECOSYSTEMS PROGRAM*

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Item No. 367 of 602

**ACCESSION NO:** 0193616 **SUBFILE:** CRIS  
**PROJ NO:** NYC-143346 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Brady, J. W.

**PERFORMING INSTITUTION:**  
FOOD SCIENCE  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*USE OF COMPUTER MODELING AND MD SIMULATIONS*

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Item No. 368 of 602

**ACCESSION NO:** 0193857 **SUBFILE:** CRIS; HNRIMS  
**PROJ NO:** NYC-145312 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 AUG 2002 **TERM:** 31 JUL 2007 **FY:** 2006

**INVESTIGATOR:** Gan, S.

**PERFORMING INSTITUTION:**  
HORTICULTURE  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*MOLECULAR, GENETIC AND GENOMIC ANALYSES AND IMPROVEMENT OF PLANT  
GROWTH AND DEVELOPMENT*

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Item No. 369 of 602

**ACCESSION NO:** 0196691 **SUBFILE:** CRIS  
**PROJ NO:** NYC-147325 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 11 JUN 2003 **TERM:** 30 JUN 2011 **FY:** 2006

**INVESTIGATOR:** Lassoie, J. P.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCES  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*ASSESSING THE SUCCESS OF CONSERVATION INTERVENTIONS FOR THE PROTECTION  
OF NATURE, COMMUNITIES, AND CULTURES IN NW YUNNAN, PRC*

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Item No. 370 of 602

**ACCESSION NO:** 0209877 **SUBFILE:** CRIS  
**PROJ NO:** NYC-149368 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 MAR 2007 **TERM:** 28 FEB 2012

**INVESTIGATOR:** Viands, D. R.; Hansen, J. L.; Bergstrom, G.; Schmit, T.; Watkins, C.; Taylor, A.

**PERFORMING INSTITUTION:**  
PLANT BREEDING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*BREEDING AND GENETICS OF PERENNIAL FORAGE CROPS*

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Item No. 371 of 602

**ACCESSION NO:** 0193618 **SUBFILE:** CRIS  
**PROJ NO:** NYC-149820 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2017 **FY:** 2006

**INVESTIGATOR:** Viands, D. R.; Hansen, J. L.; Shields, E. J.; Pell, A. N.

**PERFORMING INSTITUTION:**  
PLANT BREEDING  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

*BREEDING AND GENETICS OF FORAGE CROPS TO IMPROVE PRODUCTIVITY, QUALITY,  
AND INDUSTRIAL USES*

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Item No. 372 of 602

**ACCESSION NO:** 0190516 **SUBFILE:** CRIS  
**PROJ NO:** NYC-175574 **AGENCY:** CSREES NY.C  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-52104-11484 **PROPOSAL NO:** 2001-04193  
**START:** 15 SEP 2001 **TERM:** 30 SEP 2006 **FY:** 2006 **GRANT YR:** 2001  
**GRANT AMT:** \$2,065,908

**INVESTIGATOR:** Walker, L. P.; Craighead, H.; Loria, R.; Rose, J.

**PERFORMING INSTITUTION:**  
BIOTECHNOLOGY  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

**EDUCATING YOUNG RESEARCHERS FOR SUSTAINABLE AGRICULTURALLY-BASED  
BIOINDUSTRIES**

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Item No. 373 of 602

**ACCESSION NO:** 0212199 **SUBFILE:** CRIS  
**PROJ NO:** NYC-183323 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 SEP 2007 **TERM:** 30 SEP 2010

**INVESTIGATOR:** Howarth, R. W.

**PERFORMING INSTITUTION:**  
ECOLOGY & EVOLUTIONARY BIOLOGY  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***BIOFUELS: ENVIRONMENTAL BENEFITS AND COSTS***

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Item No. 374 of 602

**ACCESSION NO:** 0174982 **SUBFILE:** CRIS  
**PROJ NO:** NYC-184303 **AGENCY:** SAES NY.C  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 MAY 1997 **TERM:** 30 APR 2007 **FY:** 2006

**INVESTIGATOR:** Doyle, J. J.

**PERFORMING INSTITUTION:**  
PLANT BIOLOGY  
CORNELL UNIVERSITY  
ITHACA, NEW YORK 14853

***MOLECULAR SYSTEMATICS OF PLANTS***

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Item No. 375 of 602

**ACCESSION NO:** 0211662 **SUBFILE:** CRIS  
**PROJ NO:** NYG-632425 **AGENCY:** CSREES NY.G  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Harman, G. E.

**PERFORMING INSTITUTION:**  
GENEVA - HORTICULTURAL SCIENCES  
N Y AGRICULTURAL EXPT STATION  
GENEVA, NEW YORK 14456

**USE OF AGRICULTURAL WASTE PRODUCTS AND PLANT-MICROBE INTERACTIONS TO ALLEVIATE ENVIRONMENTAL POLLUTION AND PRODUCE CARBON-NEUTRAL BIOENERGY**

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Item No. 376 of 602

**ACCESSION NO:** 0203255 **SUBFILE:** CRIS  
**PROJ NO:** NYK-2005-00046 **AGENCY:** CSREES NY.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-15557 **PROPOSAL NO:** 2005-00046  
**START:** 01 MAY 2005 **TERM:** 30 JUN 2006 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$79,309

**INVESTIGATOR:** Langhans, R. W.

**PERFORMING INSTITUTION:**  
CEA Systems  
Ithaca, NEW YORK 14850

***BIOMOLECULAR FARMING SYSTEM FOR INDUSTRIAL, PHARMACEUTICAL AND OTHER NON-FOOD PLANT PRODUCTS***

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Item No. 377 of 602

**ACCESSION NO:** 0207536 **SUBFILE:** CRIS  
**PROJ NO:** NYK-2006-03094 **AGENCY:** CSREES NY.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-17173 **PROPOSAL NO:** 2006-03094  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Zhang, P.

**PERFORMING INSTITUTION:**  
UNITED ENVIRONMENT & ENERGY, LLC  
701 CHEMUNG STREET  
HORSEHEADS, NEW YORK 14845

***A NEW PROCESS FOR BIODIESEL PRODUCTION BASED ON WASTE COOKING OILS AND HETEROGENEOUS CATALYSTS***

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Item No. 378 of 602

**ACCESSION NO:** 0211017 **SUBFILE:** CRIS  
**PROJ NO:** NYZ-2340-02-005 **AGENCY:** CSREES NY.Z  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35504-18341 **PROPOSAL NO:** 2007-02176  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2010 **GRANT YR:** 2007  
**GRANT AMT:** \$499,299

**INVESTIGATOR:** Stipanovic, A. J.; Winter, W. T.; Driscoll, M. S.

**PERFORMING INSTITUTION:**  
CHEMISTRY  
STATE UNIV OF NEW YORK  
SYRACUSE, NEW YORK 13210

***ELECTRON BEAM & X-RAY IRRADIATION OF LIGNOCELLULOSIC BIOMASS - SYNERGIES  
W/ BIODELIGNIFICATION & HEMICELLULOSE REMOVAL IN REDUCING RECALCI.***

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Item No. 379 of 602

**ACCESSION NO:** 0203857 **SUBFILE:** CRIS  
**PROJ NO:** NYZ-2370-02-022 **AGENCY:** OCI NY.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2008 **FY:** 2006

**INVESTIGATOR:** Stipanovic, A. J.

**PERFORMING INSTITUTION:**  
CHEMISTRY  
STATE UNIV OF NEW YORK  
SYRACUSE, NEW YORK 13210

***MOLECULAR CHARACTERIZATIONS OF FOREST PRODUCTS***

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Item No. 380 of 602

**ACCESSION NO:** 0204449 **SUBFILE:** CRIS  
**PROJ NO:** NYZ-2622-01-015 **AGENCY:** OCI NY.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2008 **FY:** 2006

**INVESTIGATOR:** Smart, L. B.

**PERFORMING INSTITUTION:**  
ENVIRONMENTAL & FOREST BIOLOGY  
STATE UNIV OF NEW YORK  
SYRACUSE, NEW YORK 13210

***WILLOW BIOMASS GENETICS***

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Item No. 381 of 602

**ACCESSION NO:** 0203772 **SUBFILE:** CRIS  
**PROJ NO:** NYZ-2622-02-016 **AGENCY:** CSREES NY.Z  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 31 OCT 2005 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Stipanovic, A. J.; Smart, L. B.; Cameron, K. D.

**PERFORMING INSTITUTION:**  
CHEMISTRY  
STATE UNIV OF NEW YORK  
SYRACUSE, NEW YORK 13210

***NMR AND TGA METHODS FOR RAPID SELECTION OF WILLOW VARIETIES WITH OPTIMUM WOOD PROPERTIES***

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Item No. 382 of 602

**ACCESSION NO:** 0203850 **SUBFILE:** CRIS  
**PROJ NO:** NYZ-2622-20-017 **AGENCY:** CSREES NY.Z  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-45039-03237 **PROPOSAL NO:** 2006-06315  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$178,675

**INVESTIGATOR:** Abrahamson, L. P.; Volk, T. A.

**PERFORMING INSTITUTION:**  
ENVIRONMENTAL & FOREST BIOLOGY  
STATE UNIV OF NEW YORK  
SYRACUSE, NEW YORK 13210

***WOODY BIOMASS/ALTERNATIVE FARM PRODUCT***

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Item No. 383 of 602

**ACCESSION NO:** 0194557 **SUBFILE:** CRIS  
**PROJ NO:** NC01007 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Cheng, J.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 384 of 602

**ACCESSION NO:** 0187105 **SUBFILE:** CRIS  
**PROJ NO:** NC03984 **AGENCY:** CSREES NC.



**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Shih, J. C.; Cheng, J.; Williams, C. M.; Zering, K. D.

**PERFORMING INSTITUTION:**  
POULTRY SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***THERMOPHILIC ANAEROBIC DIGESTION OF ANIMAL WASTE***

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Item No. 385 of 602

**ACCESSION NO:** 0181652 **SUBFILE:** CRIS  
**PROJ NO:** NC05885 **AGENCY:** SAES NC.  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JAN 1999 **TERM:** 31 DEC 2003 **FY:** 2003

**INVESTIGATOR:** Willits, D. H.; Peet, M. M.; Cheng, J.; Sobsey, M.; Keener, K.; Zering, K. D.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***USING A GREENHOUSE TOMATO CROP TO RECOVER BIO-RESOURCES FROM SWINE WASTE: A SYSTEMS APPROACH***

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Item No. 386 of 602

**ACCESSION NO:** 0193536 **SUBFILE:** CRIS  
**PROJ NO:** NC06691 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** QU, R.

**PERFORMING INSTITUTION:**  
CROP SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***TURFGRASS BIOTECHNOLOGY***

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Item No. 387 of 602

**ACCESSION NO:** 0194649 **SUBFILE:** CRIS  
**PROJ NO:** NC06708 **AGENCY:** CSREES NC.

**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Sosinski, B. R.; Yench, G. C.; Kelly, R. M.; Allen, G. C.

**PERFORMING INSTITUTION:**  
HORTICULTURAL SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***MOLECULAR GENETIC AND GENOMIC APPROACHES FOR SWEETPOTATO IMPROVEMENT***

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Item No. 388 of 602

**ACCESSION NO:** 0198031 **SUBFILE:** CRIS  
**PROJ NO:** NC06712 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 MAY 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Sharma, R. R.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***BIOETHANOL PRODUCTION FROM AGRICULTURAL RESIDUE***

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Item No. 389 of 602

**ACCESSION NO:** 0199187 **SUBFILE:** CRIS  
**PROJ NO:** NC06742 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Haigler, C.; Beers, E.; Dhugga, K.; Holaday, A. S.; Grimson, M.; Sederoff, R.; Wilkerson, C.

**PERFORMING INSTITUTION:**  
CROP SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***MECHANISTIC UNDERSTANDING OF CELLULOSE SYNTHESIS, COTTON FIBER DEVELOPMENT, AND XYLEM DIFFERENTIATION IN RELATION TO CROP IMPROVEMENT***

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Item No. 390 of 602

**ACCESSION NO:** 0198981 **SUBFILE:** CRIS  
**PROJ NO:** NC06753 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 04 AUG 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Chinn, M. S.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***PRODUCTION OF VALUE ADDED PRODUCTS USING PLANT & CROP BASED RENEWABLE RESOURCES***

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Item No. 391 of 602

**ACCESSION NO:** 0200309 **SUBFILE:** CRIS  
**PROJ NO:** NC06783 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Cheng, J. J.; Chinn, M.; de los Reyes, F.; Peet, M. M.; Sharma, R.; Shih, J. C.; Stomp, A. M.; Willits, D. H.; Zering, K. D.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***BIOCONVERSION OF ANIMAL MANURE AND AGRICULTURAL RESIDUES INTO RENEWABLE ENERGY SOURCES***

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Item No. 392 of 602

**ACCESSION NO:** 0204630 **SUBFILE:** CRIS  
**PROJ NO:** NC06827 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 01 OCT 2010 **FY:** 2006

**INVESTIGATOR:** Stikeleather, L. F.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***ENGINEERING FOR BIOPROCESSES INCLUDING HUMAN/ANIMAL HEALTH AND SAFETY***

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**ACCESSION NO:** 0209455 **SUBFILE:** CRIS  
**PROJ NO:** NC06862 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Schroeder, M. S.; Ruffy, T.; Fernandez, G.; Creamer, N. G.; Hu, S.; Mueller, J. P.;  
Louws, F.; Greaver, T.

**PERFORMING INSTITUTION:**  
CROP SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***ARBUSCULAR MYCORRHIZAL FUNGI AND SUSTAINABLE AGROECOSYSTEM RESEARCH IN  
NORTH CAROLINA***

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Item No. 394 of 602

**ACCESSION NO:** 0210420 **SUBFILE:** CRIS  
**PROJ NO:** NC06865 **AGENCY:** CSREES NC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Sheppard, J. D.

**PERFORMING INSTITUTION:**  
FOOD SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***DEVELOPMENT OF BIOPROCESSES FOR THE PRODUCTION OF FOOD AND FUELS FROM  
RENEWABLE RESOURCES.***

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Item No. 395 of 602

**ACCESSION NO:** 0192192 **SUBFILE:** CRIS  
**PROJ NO:** NC09125 **AGENCY:** CSREES NC.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-34376-11896 **PROPOSAL NO:** 2002-06200  
**START:** 01 JUL 2002 **TERM:** 30 JUN 2005 **FY:** 2004 **GRANT YR:** 2002  
**GRANT AMT:** \$457,392

**INVESTIGATOR:** Bull, L. S.; Williams, C. M.; Humenik, F.

**PERFORMING INSTITUTION:**  
ANIMAL SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***MANAGEMENT OF CLOSURE OR REMEDIATION OF SWINE WASTE TREATMENT LAGOONS***

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Item No. 396 of 602

**ACCESSION NO:** 0205343 **SUBFILE:** CRIS  
**PROJ NO:** NCX-207-5-06-130-1 **AGENCY:** CSREES NC.X  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** SHAHBAZI, A.; LI, Y.; IBRAHIM, S.; SHIRLEY, V.; NIEDZIELA, C.

**PERFORMING INSTITUTION:**  
NATURAL RESOURCES & ENVIRONMENTAL DESIGN  
NORTH CAROLINA A&T STATE UNIV  
1601 EAST MARKET STREET  
GREENSBORO, NORTH CAROLINA 27411

***BIOLOGICAL CONVERSION OF CROP RESIDUES TO FUELS AND CHEMICALS***

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Item No. 397 of 602

**ACCESSION NO:** 0201987 **SUBFILE:** CRIS  
**PROJ NO:** NCZ04200 **AGENCY:** CSREES NC.Z  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 01 OCT 2009 **FY:** 2006

**INVESTIGATOR:** Chiang, V. L.; Sederoff, R. R.

**PERFORMING INSTITUTION:**  
FORESTRY  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***METABOLIC ENGINEERING OF LIGNIN BIOSYNTHESIS IN WOOD TO FACILITATE WOOD PULPING AND BLEACHING***

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Item No. 398 of 602

**ACCESSION NO:** 0200371 **SUBFILE:** CRIS  
**PROJ NO:** NCZ09452 **AGENCY:** CSREES NC.Z  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-35504-14652 **PROPOSAL NO:** 2004-01005  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$451,000

**INVESTIGATOR:** Chiang, V.; Li, L.; Chang, H.

**PERFORMING INSTITUTION:**  
FORESTRY  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***BEYOND THE BARRIER: ETHANOL FROM LIGNOCELLULOSIC BIOMASS USING METABOLIC ENGINEERING***

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Item No. 399 of 602

**ACCESSION NO:** 0204687 **SUBFILE:** CRIS  
**PROJ NO:** NCZ09457 **AGENCY:** CSREES NC.Z  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-16264 **PROPOSAL NO:** 2005-02893  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$418,061

**INVESTIGATOR:** Venditti, R. A.; Pawlak, J. J.

**PERFORMING INSTITUTION:**  
WOOD AND PAPER SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***NOVEL UTILIZATION OF STARCH MICROCELLULAR FOAM MATERIALS AS OPACIFYING AGENTS IN PAPER, PAINT AND COATING APPLICATIONS***

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Item No. 400 of 602

**ACCESSION NO:** 0207121 **SUBFILE:** CRIS  
**PROJ NO:** NCZ09459 **AGENCY:** CSREES NC.Z  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38411-17035 **PROPOSAL NO:** 2006-03116  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$489,929

**INVESTIGATOR:** Lucia, L. A.; Schimmel, K.; Rials, T. G.; Kelley, S. S.; Hubbe, M. A.; Tiller, K.

**PERFORMING INSTITUTION:**  
WOOD AND PAPER SCIENCE  
NORTH CAROLINA STATE UNIV  
RALEIGH, NORTH CAROLINA 27695

***BIOSUCCEED: BIOPRODUCTS SUSTAINABILITY, A UNIVERSITY COOPERATIVE CENTER FOR EXCELLENCE IN EDUCATION***

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Item No. 401 of 602

**ACCESSION NO:** 0197611 **SUBFILE:** CRIS  
**PROJ NO:** SRS-4103-1 **AGENCY:** FS SRS  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** REVISED  
**START:** 04 AUG 2003 **TERM:** 30 SEP 2008 **FY:** 2005

**INVESTIGATOR:** Trettin, C. C.; Burke, M. K.; Coleman, M. D.; Kilgo, J. C.; Amatya, D. M.; Li, H.

**PERFORMING INSTITUTION:**

SRS CENTER FOR FORESTED WETLANDS RESEARCH, CHARLESTON, SC  
USDA FOREST SERVICE  
200 WEAVER BLVD., PO BOX 2680  
ASHEVILLE, NORTH CAROLINA 28802

***THE SUSTAINABILITY OF MANAGED FORESTED WETLAND LANDSCAPES REQUIRES A DETAILED UNDERSTANDING OF BIOTIC AND ABIOTIC ECOSYSTEM PROCESSES.***

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Item No. 402 of 602

**ACCESSION NO:** 0406585 **SUBFILE:** CRIS**PROJ NO:** 5445-21000-008-04R **AGENCY:** ARS 5445**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED**START:** 01 AUG 2002 **TERM:** 31 AUG 2005 **FY:** 2004**INVESTIGATOR:** HANSON J D; BERDAHL J D; KRUPINSKY J M; LIEBIG M A; FRANK A B**PERFORMING INSTITUTION:**

AGRICULTURAL RESEARCH SERVICE  
MANDAN, NORTH DAKOTA 58554

***BIOFUEL FEEDSTOCK DEVELOPMENT***

Item No. 403 of 602

**ACCESSION NO:** 0410217 **SUBFILE:** CRIS**PROJ NO:** 5445-21000-008-07R **AGENCY:** ARS 5445**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW**START:** 01 NOV 2005 **TERM:** 31 OCT 2010 **FY:** 2006**INVESTIGATOR:** NICHOLS K A; KRUSE A D; LIEBIG M A**PERFORMING INSTITUTION:**

AGRICULTURAL RESEARCH SERVICE  
MANDAN, NORTH DAKOTA 58554

***EVALUATION OF PERENNIAL HERBACEOUS BIOMASS CROPS IN NORTH DAKOTA***

Item No. 404 of 602

**ACCESSION NO:** 0195107 **SUBFILE:** CRIS**PROJ NO:** ND01458 **AGENCY:** CSREES ND.**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007**START:** 02 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006**INVESTIGATOR:** Panigrahi, S.

**PERFORMING INSTITUTION:**  
AGRICULTURAL AND BIOSYSTEMS ENGINEERING  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 405 of 602

**ACCESSION NO:** 0211174 **SUBFILE:** CRIS  
**PROJ NO:** ND01463 **AGENCY:** CSREES ND.  
**PROJ TYPE:** HATCH **PROJ STATUS:** PENDING NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Pryor, S. W.

**PERFORMING INSTITUTION:**  
AGRICULTURAL AND BIOSYSTEMS ENGINEERING  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***USE OF NORTHERN GREAT PLAINS AGRICULTURAL RESOURCES FOR BIOENERGY AND BIOPRODUCT DEVELOPMENT***

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Item No. 406 of 602

**ACCESSION NO:** 0201226 **SUBFILE:** CRIS  
**PROJ NO:** ND03363 **AGENCY:** SAES ND.  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Gustafson, C.

**PERFORMING INSTITUTION:**  
AGRIBUSINESS AND APPLIED ECONOMICS  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***RURAL BUSINESS FINANCE***

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Item No. 407 of 602

**ACCESSION NO:** 0212143 **SUBFILE:** CRIS  
**PROJ NO:** ND05046 **AGENCY:** CSREES ND.  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2008-35504-18667 **PROPOSAL NO:** 2007-02158  
**START:** 01 DEC 2007 **TERM:** 30 NOV 2009 **GRANT YR:** 2008  
**GRANT AMT:** \$99,562



**INVESTIGATOR:** Pryor, S. W.; Chang, K. C.

**PERFORMING INSTITUTION:**  
AGRICULTURAL AND BIOSYSTEMS ENGINEERING  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***BIODIESEL CO-PRODUCT DEVELOPMENT: UTILIZATION OF CANOLA MEAL AND CANOLA PROTEINS FOR INDUSTRIAL BIOPRODUCTS***

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Item No. 408 of 602

**ACCESSION NO:** 0209717 **SUBFILE:** CRIS  
**PROJ NO:** ND06348 **AGENCY:** SAES ND.  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Halvorson, M. A.

**PERFORMING INSTITUTION:**  
NORTH CENTRAL RESEARCH EXTENSION CENTER  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***DRYLAND CROP PRODUCTION RESEARCH IN NORTH CENTRAL NORTH DAKOTA***

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Item No. 409 of 602

**ACCESSION NO:** 0190851 **SUBFILE:** CRIS  
**PROJ NO:** ND06428 **AGENCY:** SAES ND.  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Schatz, B. G.

**PERFORMING INSTITUTION:**  
CARRINGTON RESEARCH EXTENSION CENTER  
NORTH DAKOTA STATE UNIV  
FARGO, NORTH DAKOTA 58105

***INCREASING CROP PRODUCTIVITY IN CENTRAL NORTH DAKOTA***

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Item No. 410 of 602

**ACCESSION NO:** 0187998 **SUBFILE:** CRIS  
**PROJ NO:** NDW-20010045 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-38819-8989-R **PROPOSAL NO:** 2001-03154

**START:** 01 JUN 2000 **TERM:** 31 MAY 2002 **FY:** 2003 **GRANT YR:** 2001  
**GRANT AMT:** \$241,891

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY PHASE 11*

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Item No. 411 of 602

**ACCESSION NO:** 0191656 **SUBFILE:** CRIS  
**PROJ NO:** NDW-2002-06205 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-38819-01906 **PROPOSAL NO:** 2002-06205  
**START:** 01 JUL 2002 **TERM:** 31 DEC 2003 **FY:** 2003 **GRANT YR:** 2002  
**GRANT AMT:** \$275,184

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 12*

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Item No. 412 of 602

**ACCESSION NO:** 0195206 **SUBFILE:** CRIS  
**PROJ NO:** NDW-2003-06204 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-38819-02014 **PROPOSAL NO:** 2003-06204  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2004 **FY:** 2004 **GRANT YR:** 2003  
**GRANT AMT:** \$280,835

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 13*

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Item No. 413 of 602

**ACCESSION NO:** 0199475 **SUBFILE:** CRIS  
**PROJ NO:** NDW-2004-06202 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-38819-02182 **PROPOSAL NO:** 2004-06202  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2005 **FY:** 2005 **GRANT YR:** 2004  
**GRANT AMT:** \$251,229

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 14*

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**ACCESSION NO:** 0202931 **SUBFILE:** CRIS  
**PROJ NO:** NDW-2005-06198 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38819-02311 **PROPOSAL NO:** 2005-06198  
**START:** 01 JUN 2005 **TERM:** 31 MAY 2006 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$263,698

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 15*

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Item No. 415 of 602

**ACCESSION NO:** 0206950 **SUBFILE:** CRIS  
**PROJ NO:** NDW-2006-06229 **AGENCY:** CSREES ND.W  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38819-03470 **PROPOSAL NO:** 2006-06229  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2007 **GRANT YR:** 2006  
**GRANT AMT:** \$261,313

**INVESTIGATOR:** Aulich, T. R.

**PERFORMING INSTITUTION:**  
ENERGY & ENVIRONMENTAL RES CTR  
UNIV OF NORTH DAKOTA  
GRAND FORKS, NORTH DAKOTA 58201

*NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 16*

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Item No. 416 of 602

**ACCESSION NO:** 0407641 **SUBFILE:** CRIS  
**PROJ NO:** 3605-11610-001-00D **AGENCY:** ARS 3605  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 APR 2007 **FY:** 2006

**INVESTIGATOR:** BONTA J V; SHIPITALO M J; OWENS L B

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
COSHOCKTON, OHIO 43812

***EFFECTIVENESS OF WATERSHED LAND-MANAGEMENT PRACTICES TO IMPROVE WATER QUALITY***

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Item No. 417 of 602

**ACCESSION NO:** 0199702 **SUBFILE:** CRIS  
**PROJ NO:** OHO01082 **AGENCY:** CSREES OHO  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2005 **FY:** 2005

**INVESTIGATOR:** Larson, D. W.

**PERFORMING INSTITUTION:**  
AGRICULTURE, ENVIRONMENT AND DEVELOPMENT ECONOMICS  
OHIO STATE UNIVERSITY  
1680 MADISON AVENUE  
WOOSTER, OHIO 44691

***ECONOMIC ASSESSMENT OF TRADE ARRANGEMENTS, BIO-TERRORISM THREATS AND RENEWABLE FUELS ON U.S. GRAINS AND OILSEEDS***

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Item No. 418 of 602

**ACCESSION NO:** 0200353 **SUBFILE:** CRIS  
**PROJ NO:** OHO01094-MRF **AGENCY:** CSREES OHO  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NC-1016  
**START:** 01 OCT 2004 **TERM:** 31 DEC 2006 **FY:** 2006

**INVESTIGATOR:** Larson, D. W.

**PERFORMING INSTITUTION:**  
AGRICULTURE, ENVIRONMENT AND DEVELOPMENT ECONOMICS  
OHIO STATE UNIVERSITY  
1680 MADISON AVENUE  
WOOSTER, OHIO 44691

***ECONOMIC ASSESSMENT OF CHANGES IN TRADE ARRANGEMENTS, BIO-TERRORISM  
THREATS AND RENEWABLE FUELS REQUIREMENTS ON THE U.S. GRAIN AND OILSEED  
SECTOR***

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Item No. 419 of 602

**ACCESSION NO:** 0203763 **SUBFILE:** CRIS  
**PROJ NO:** OHOE-2005-02337 **AGENCY:** CSREES OHOE  
**PROJ TYPE:** SERD GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38420-15792 **PROPOSAL NO:** 2005-02337  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$207,000

**INVESTIGATOR:** Dick, W. A.; Dick, R. P.; Tuovinen, O. H.

**PERFORMING INSTITUTION:**  
 SCHOOL OF NATURAL RESOURCES  
 OHIO STATE UNIVERSITY  
 1680 MADISON AVENUE  
 WOOSTER, OHIO 44691

***GRADUATE FELLOWSHIPS IN SOIL MICROBIAL ECOLOGY AND ENVIRONMENTAL  
SCIENCE: FOCUS ON BIOREMEDIATION, BIOSECURITY CYCLING***

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Item No. 420 of 602

**ACCESSION NO:** 0206497 **SUBFILE:** CRIS  
**PROJ NO:** OHOK-2006-00576 **AGENCY:** CSREES OHOK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-16839 **PROPOSAL NO:** 2006-00576  
**START:** 01 MAY 2006 **TERM:** 28 FEB 2007 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Milliken, C. E.

**PERFORMING INSTITUTION:**  
 TECHNOLOGY MANAGEMENT, INC.  
 9718 LAKESHORE BLVD  
 CLEVELAND, OHIO 44108

***TMI SOLID OXIDE FUEL CELL OPERATION ON ANIMAL-WASTE DERIVED AMMONIA FUEL***

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Item No. 421 of 602

**ACCESSION NO:** 0210295 **SUBFILE:** CRIS  
**PROJ NO:** OHOK-2007-00050 **AGENCY:** CSREES OHOK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18009 **PROPOSAL NO:** 2007-00050  
**START:** 01 JUN 2007 **TERM:** 31 JAN 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Swartz, S. L.

**PERFORMING INSTITUTION:**

NexTech Materials, Ltd.  
Lewis Center, OHIO 43035

***BIO-ETHANOL FUELED SOFC SYSTEM***

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Item No. 422 of 602

**ACCESSION NO:** 0191012 **SUBFILE:** CRIS  
**PROJ NO:** OHOW-2001-04097 **AGENCY:** CSREES OHOW  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-52104-11476 **PROPOSAL NO:** 2001-04097  
**START:** 15 SEP 2001 **TERM:** 30 SEP 2006 **FY:** 2005 **GRANT YR:** 2001  
**GRANT AMT:** \$911,000

**INVESTIGATOR:** Ju, L. K.; Lee, P.; Tanner, R.

**PERFORMING INSTITUTION:**

CHEMICAL ENGINEERING  
UNIVERSITY OF AKRON  
AKRON, OHIO 44325

***COUPLING CELLULASE FERMENTATION WITH IN SITU FOAM FRACTIONATION***

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Item No. 423 of 602

**ACCESSION NO:** 0012066 **SUBFILE:** CRIS  
**PROJ NO:** OKL01361 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 1997 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Wu, Y.

**PERFORMING INSTITUTION:**

PLANT & SOIL SCIENCES  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***PASTURE, RANGE AND TURF GRASS BREEDING***

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Item No. 424 of 602

**ACCESSION NO:** 0071714 **SUBFILE:** CRIS  
**PROJ NO:** OKL01644 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Peeper, T.; Krenzer, E.; Solie, J.; Epplin, F. M.

**PERFORMING INSTITUTION:**

PLANT & SOIL SCIENCES  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***INTEGRATED WEED CONTROL PROGRAMS FOR SMALL GRAINS***

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Item No. 425 of 602

**ACCESSION NO:** 0186541 **SUBFILE:** CRIS

**PROJ NO:** OKL02449 **AGENCY:** CSREES OKL

**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** TERMINATED

**CONTRACT/GRANT/AGREEMENT NO:** 00-52104-9662 **PROPOSAL NO:** 2000-04642

**START:** 15 SEP 2000 **TERM:** 30 SEP 2005 **FY:** 2005 **GRANT YR:** 2000

**GRANT AMT:** \$848,000

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Lewis, R. S.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**

AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***CONVERSION OF LOW-COST BIOMASS TO ETHANOL***

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Item No. 426 of 602

**ACCESSION NO:** 0188159 **SUBFILE:** CRIS

**PROJ NO:** OKL02461 **AGENCY:** CSREES OKL

**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED

**CONTRACT/GRANT/AGREEMENT NO:** 2001-34447-10302 **PROPOSAL NO:** 2001-03143

**START:** 01 JUL 2001 **TERM:** 30 JUN 2003 **FY:** 2003 **GRANT YR:** 2001

**GRANT AMT:** \$841,883

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Lalman, J. A.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**

AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***BIOMASS-BASED ENERGY RESEARCH***

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Item No. 427 of 602

**ACCESSION NO:** 0189888 **SUBFILE:** CRIS  
**PROJ NO:** OKL02469 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2005 **FY:** 2005

**INVESTIGATOR:** Lalman, J. A.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***DETERMINATION OF OPERATIONAL PARAMETERS FOR A FULL-SCALE ANAEROBIC SEQUENCING BATCH REACTOR (ASBR) USED TO TREAT SWINE WASTE***

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Item No. 428 of 602

**ACCESSION NO:** 0192633 **SUBFILE:** CRIS  
**PROJ NO:** OKL02491 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Kenkel, P. L.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***PROVIDING INFORMATION AND DECISION SUPPORT TOOLS TO INCREASE THE EFFECTIVENESS OF TRADITIONAL AND NON-TRADITIONAL COOPERATIVES***

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Item No. 429 of 602

**ACCESSION NO:** 0192552 **SUBFILE:** CRIS  
**PROJ NO:** OKL02492 **AGENCY:** CSREES OKL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2002-34447-11908 **PROPOSAL NO:** 2002-06048  
**START:** 01 JUL 2002 **TERM:** 30 JUN 2004 **FY:** 2004 **GRANT YR:** 2002  
**GRANT AMT:** \$897,947

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Johannes, A. H.; Lalman, J. A.; Lewis, R. S.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***BIOMASS-BASED ENERGY RESEARCH***

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**ACCESSION NO:** 0195537 **SUBFILE:** CRIS  
**PROJ NO:** OKL02504 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 JAN 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Kelsey, K. D.

**PERFORMING INSTITUTION:**  
AGRI EDUCATION  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

*EVALUATION RESEARCH TO INCREASE THE EFFECTIVENESS AND ACCOUNTABILITY OF  
TEACHING, RESEARCH, AND EXTENSION PROGRAMS OFFERED BY THE DASNR*

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Item No. 431 of 602

**ACCESSION NO:** 0195347 **SUBFILE:** CRIS  
**PROJ NO:** OKL02505 **AGENCY:** CSREES OKL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34447-13162 **PROPOSAL NO:** 2003-06027  
**START:** 01 JUL 2003 **TERM:** 30 JUN 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$1,068,026

**INVESTIGATOR:** Huhnke, R. L.; Barfield, B. J.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Johannes, A. H.; Lewis, R. S.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

*BIOMASS-BASED ENERGY RESEARCH*

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Item No. 432 of 602

**ACCESSION NO:** 0199724 **SUBFILE:** CRIS  
**PROJ NO:** OKL02544 **AGENCY:** CSREES OKL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34447-14487 **PROPOSAL NO:** 2004-06030  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2006 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$955,563

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Johannes, A. H.; Lewis, R. S.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

**BIOMASS-BASED ENERGY RESEARCH**

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Item No. 433 of 602

**ACCESSION NO:** 0203092 **SUBFILE:** CRIS  
**PROJ NO:** OKL02563 **AGENCY:** CSREES OKL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34447-15711 **PROPOSAL NO:** 2005-06030  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$947,285

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Epplin, F. M.; Johannes, A. H.; Lewis, R. S.;  
Taliaferro, C. M.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

**BIOMASS-BASED ENERGY RESEARCH**

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Item No. 434 of 602

**ACCESSION NO:** 0207008 **SUBFILE:** CRIS  
**PROJ NO:** OKL02592 **AGENCY:** CSREES OKL  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34447-16939 **PROPOSAL NO:** 2006-06041  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$1,109,064

**INVESTIGATOR:** Huhnke, R. L.; Bellmer, D. D.; Epplin, F. M.; Johannes, A. H.; Taliaferro, C. M.;  
Wilkins, M. R.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

**BIOMASS-BASED ENERGY RESEARCH**

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Item No. 435 of 602

**ACCESSION NO:** 0207135 **SUBFILE:** CRIS  
**PROJ NO:** OKL02593 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Wilkins, M. R.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***RENEWABLE FUELS FROM OKLAHOMA BIOMASS***

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Item No. 436 of 602

**ACCESSION NO:** 0210697 **SUBFILE:** CRIS  
**PROJ NO:** OKL02638 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Bellmer, D.; Huhnke, R.; Godsey, C.; Whiteley, R.; Holcomb, R.; Kenkel, P.; Gilliland, S.

**PERFORMING INSTITUTION:**  
FOOD AND AGRICULTURE PRODUCTS CENTER  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***USE OF SWEET SORGHUM AS A BIOENERGY CROP FOR OKLAHOMA***

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Item No. 437 of 602

**ACCESSION NO:** 0210698 **SUBFILE:** CRIS  
**PROJ NO:** OKL02639 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Dunford, N. T.

**PERFORMING INSTITUTION:**  
FOOD AND AGRICULTURE PRODUCTS CENTER  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***ADVANCED PROCESSING TECHNIQUES FOR BIOBASED PRODUCT DEVELOPMENT***

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Item No. 438 of 602

**ACCESSION NO:** 0210699 **SUBFILE:** CRIS  
**PROJ NO:** OKL02640 **AGENCY:** CSREES OKL  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Holcomb, R. B.

**PERFORMING INSTITUTION:**  
FOOD AND AGRICULTURE PRODUCTS CENTER  
OKLAHOMA STATE UNIVERSITY  
STILLWATER, OKLAHOMA 74078

***ECONOMIC ASSESSMENTS OF VALUE-ADDED AGRIBUSINESS AND BIOFUEL VENTURES  
IN OKLAHOMA***

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Item No. 439 of 602

**ACCESSION NO:** 0402894 **SUBFILE:** CRIS  
**PROJ NO:** 5358-21410-001-00D **AGENCY:** ARS 5358  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 25 MAR 1999 **TERM:** 12 MAR 2004 **FY:** 2004

**INVESTIGATOR:** STEINER J J; GRIFFITH S M; MUELLER WARRANT G W; WHITTAKER G W;  
BANOWETZ G M; PFENDER W F

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
CORVALLIS, OREGON 97331

***INTEGRATED APPROACHES TO SUSTAINABLE GRASS SEED CROPPING SYSTEMS***

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Item No. 440 of 602

**ACCESSION NO:** 0408069 **SUBFILE:** CRIS  
**PROJ NO:** 5358-21410-002-00D **AGENCY:** ARS 5358  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 13 MAR 2004 **TERM:** 28 FEB 2008 **FY:** 2006

**INVESTIGATOR:** GRIFFITH S M; MUELLER WARRANT G W; WHITTAKER G W; PFENDER W  
F; BANOWETZ G M

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
CORVALLIS, OREGON 97331

***INTEGRATING PRODUCTION AND CONSERVATION PRACTICES TO MAINTAIN GRASS SEED  
FARM PROFITS***

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Item No. 441 of 602

**ACCESSION NO:** 0193195 **SUBFILE:** CRIS  
**PROJ NO:** ORE00109 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Machado, S.

**PERFORMING INSTITUTION:**  
COLUMBIA BASIN AGRICULTURAL RES CENTER  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***DEVELOPING SUSTAINABLE FIELD CROPPING SYSTEMS IN SEMI-ARID EASTERN OREGON***

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Item No. 442 of 602

**ACCESSION NO:** 0198144 **SUBFILE:** CRIS  
**PROJ NO:** ORE00183A **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Wysocki, D. J.

**PERFORMING INSTITUTION:**  
COLUMBIA BASIN AGRICULTURAL RES CENTER  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***SUSTAINABLE SOIL, WATER AND CROP MANAGEMENT STRATEGIES FOR SEMIARID OREGON***

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Item No. 443 of 602

**ACCESSION NO:** 0201264 **SUBFILE:** CRIS  
**PROJ NO:** ORE00412 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 MAY 2004 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Ely, R. L.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ECOLOGICAL ENGINEERING  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***SYSTEMS FOR BIOLOGICAL PRODUCTION OF HYDROGEN GAS***

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Item No. 444 of 602

**ACCESSION NO:** 0177883 **SUBFILE:** CRIS  
**PROJ NO:** ORE00430 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 JAN 2003 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Chastain, T. G.

**PERFORMING INSTITUTION:**  
CROP AND SOIL SCIENCE  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***PHYSIOLOGICAL ECOLOGY OF GRASS SEED PRODUCTION SYSTEMS***

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Item No. 445 of 602

**ACCESSION NO:** 0195403 **SUBFILE:** CRIS  
**PROJ NO:** ORE00460C **AGENCY:** CSREES ORE  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-34213-13137 **PROPOSAL NO:** 2003-06279  
**START:** 01 AUG 2003 **TERM:** 31 JUL 2005 **FY:** 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$705,827

**INVESTIGATOR:** Hayes, P. M.

**PERFORMING INSTITUTION:**  
CROP AND SOIL SCIENCE  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***REGIONAL BARLEY GENOME MAPPING PROJECT***

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Item No. 446 of 602

**ACCESSION NO:** 0207150 **SUBFILE:** CRIS  
**PROJ NO:** ORE00460E **AGENCY:** CSREES ORE  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34213-17026 **PROPOSAL NO:** 2006-06181  
**START:** 01 AUG 2006 **TERM:** 31 JUL 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$630,319

**INVESTIGATOR:** Hayes, P. M.

**PERFORMING INSTITUTION:**  
CROP AND SOIL SCIENCE  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***REGIONAL BARLEY GENE MAPPING PROJECT***

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Item No. 447 of 602

**ACCESSION NO:** 0197314 **SUBFILE:** CRIS  
**PROJ NO:** ORE00470 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Penner, M. H.

**PERFORMING INSTITUTION:**  
FOOD SCIENCE AND TECHNOLOGY  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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Item No. 448 of 602

**ACCESSION NO:** 0194112 **SUBFILE:** CRIS  
**PROJ NO:** ORE00489 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Roseberg, R. J.

**PERFORMING INSTITUTION:**  
KLAMATH EXPERIMENT STATION  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

*ALTERNATIVE CROPS FOR THE SEMI-ARID CLIMATE AND SOILS OF SOUTHERN OREGON*

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Item No. 449 of 602

**ACCESSION NO:** 0211308 **SUBFILE:** CRIS  
**PROJ NO:** ORE00860 **AGENCY:** CSREES ORE  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 APR 2007 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Chaplen, F. W.; Ely, R.; Liu, H.; Murthy, G.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & ECOLOGICAL ENGINEERING  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

*BIOLOGICAL ENGINEERING INCLUDING ALTERNATIVE ENERGY SYSTEMS AND BIOPRODUCTS*

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Item No. 450 of 602

**ACCESSION NO:** 0206744 **SUBFILE:** CRIS  
**PROJ NO:** OREZ-FP-400-U-06 **AGENCY:** CSREES OREZ  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34158-17189 **PROPOSAL NO:** 2006-06327

**START:** 01 AUG 2006 **TERM:** 31 JUL 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$728,545

**INVESTIGATOR:** McLain, T. E.; Tesch, S. D.

**PERFORMING INSTITUTION:**  
WOOD SCIENCE AND ENGINEERING  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***WOOD UTILIZATION RESEARCH CENTER***

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Item No. 451 of 602

**ACCESSION NO:** 0196550 **SUBFILE:** CRIS  
**PROJ NO:** OREZ-FP-802-U **AGENCY:** CSREES OREZ  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35103-13711 **PROPOSAL NO:** 2003-02267  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2006 **FY:** 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$125,000

**INVESTIGATOR:** Simonsen, J.

**PERFORMING INSTITUTION:**  
WOOD SCIENCE AND ENGINEERING  
OREGON STATE UNIVERSITY  
CORVALLIS, OREGON 97331

***CELLULOSE NANNOCRYSTAL COMPOSITES***

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Item No. 452 of 602

**ACCESSION NO:** 0405294 **SUBFILE:** CRIS  
**PROJ NO:** 1902-21000-005-00D **AGENCY:** ARS 1902  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NE-132  
**START:** 29 JUL 2001 **TERM:** 16 DEC 2002 **FY:** 2003

**INVESTIGATOR:** SANDERSON M A; VACANT; ADLER P R; GUSTINE D L; SKINNER R H;  
DELL C J

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
UNIVERSITY PARK, PENNSYLVANIA 16802

***BIODIVERSITY MANAGEMENT IN GRAZING LANDS***

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Item No. 453 of 602



**ACCESSION NO:** 0402627 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-040-00D **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 03 MAY 1999 **TERM:** 02 MAY 2004 **FY:** 2004

**INVESTIGATOR:** MOREAU R A; DICKEY L C; PARRIS N; HICKS K B

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*NEW BIOBASED PRODUCTS TO INCREASE DEMAND FOR GRAINS*

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Item No. 454 of 602

**ACCESSION NO:** 0405084 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-061-00D **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 MAR 2002 **TERM:** 01 JUL 2004 **FY:** 2004

**INVESTIGATOR:** SOLAIMAN D; ASHBY R D; ZERKOWSKI J A; FOGLIA T A; MARMER W N

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*BIOCONVERSION OF AGRICULTURAL FATS, OILS AND THEIR DERIVATIVES INTO VALUE-ADDED BIOBASED PRODUCTS*

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Item No. 455 of 602

**ACCESSION NO:** 0408630 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-067-00D **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 02 JUL 2004 **TERM:** 01 JUL 2009 **FY:** 2006

**INVESTIGATOR:** SOLAIMAN D; ZERKOWSKI J A; ASHBY R D; MARMER W N

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*INTEGRATIVE PROCESSES FOR THE BIOCONVERSION OF FATS, OILS AND THEIR DERIVATIVES INTO BIOBASED MATERIALS AND PRODUCTS*

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Item No. 456 of 602

**ACCESSION NO:** 0408906 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-070-00D **AGENCY:** ARS 1935

**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** JOHNSTON D; YADAV M P; PARRIS N; HICKS K B; GOLDBERG N M

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*ENZYME-BASED TECHNOLOGIES FOR MILLING GRAINS AND PRODUCING BIOBASED PRODUCTS AND FUELS*

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Item No. 457 of 602

**ACCESSION NO:** 0403582 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-070-02T **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 30 SEP 2000 **TERM:** 30 SEP 2005 **FY:** 2004

**INVESTIGATOR:** JOHNSTON D

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*USE OF ENZYMES TO REDUCE STEEP TIME, REDUCE SO<sub>2</sub>, IMPROVE PRODUCT YIELD DURING CORN WET MILLING*

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Item No. 458 of 602

**ACCESSION NO:** 0409037 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-072-00D **AGENCY:** ARS 1935  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 29 OCT 2004 **TERM:** 28 OCT 2009 **FY:** 2006

**INVESTIGATOR:** HICKS K B; TAYLOR F; BOATENG A A; MOREAU R A; MCALOON A J;  
FISHMAN M L

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

*ECONOMIC COMPETITIVENESS OF RENEWABLE FUELS DERIVED FROM GRAINS AND RELATED BIOMASS*

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Item No. 459 of 602

**ACCESSION NO:** 0407996 **SUBFILE:** CRIS  
**PROJ NO:** 1935-41000-072-02T **AGENCY:** ARS 1935

**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 MAY 2004 **TERM:** 30 APR 2007

**INVESTIGATOR:** TAYLOR F

**PERFORMING INSTITUTION:**  
EASTERN REGIONAL RES CENTER  
WYNDMOOR, PENNSYLVANIA 19118

***BIOMASS RESEARCH AND DEVELOPMENT FOR THE PRODUCTION OF FUELS,  
CHEMICALS, AND IMPROVED CATTLE FEED***

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Item No. 460 of 602

**ACCESSION NO:** 0197205 **SUBFILE:** CRIS  
**PROJ NO:** NE-4352-1 **AGENCY:** FS NE  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 16 NOV 1996 **TERM:** 16 NOV 2001 **FY:** 2006

**INVESTIGATOR:** Eagar, C.; Bailey, S. W.; Rustad, L. E.; Pardo, L. R.; Campbell, J. L.

**PERFORMING INSTITUTION:**  
LOUIS C. WYMAN FOR SCI LAB - DURHAM, NH  
NORTHEASTERN RESEARCH STATION  
11 CAMPUS DRIVE  
NEWTOWN SQUARE, PENNSYLVANIA 19073

***HOW DO THE CUMULATIVE EFFECTS OF DISTURBANCE & ACIDIC DEPOSITION AFFECT  
BIOGEOCHEMISTRY OF NUTRIENT BASE CATIONS & ECOSYSTEM FUNCTION?***

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Item No. 461 of 602

**ACCESSION NO:** 0188092 **SUBFILE:** CRIS  
**PROJ NO:** PEN03824 **AGENCY:** CSREES PEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NE-1001  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2005 **FY:** 2005

**INVESTIGATOR:** Elliott, H. A.; Stehouwer, R. C.

**PERFORMING INSTITUTION:**  
AGRI & BIOLOGICAL ENGINEERING  
PENNSYLVANIA STATE UNIVERSITY  
208 MUELLER LABORATORY  
UNIVERSITY PARK, PENNSYLVANIA 16802

***APPLICATION OF SEWAGE BIOSOLIDS TO AGRICULTURAL SOILS IN THE NORTHEAST:  
LONG-TERM IMPACTS AND BENEFIT USES***

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Item No. 462 of 602

**ACCESSION NO:** 0203753 **SUBFILE:** CRIS  
**PROJ NO:** PEN04083 **AGENCY:** CSREES PEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2005 **TERM:** 30 JUN 2010 **FY:** 2006

**INVESTIGATOR:** Demirci, A.; Puri, V. M.; Walker, P. N.; Knabel, S. J.; Richard, T. L.

**PERFORMING INSTITUTION:**  
AGRI & BIOLOGICAL ENGINEERING  
PENNSYLVANIA STATE UNIVERSITY  
208 MUELLER LABORATORY  
UNIVERSITY PARK, PENNSYLVANIA 16802

***NOVEL PROCESSES FOR FOOD SAFETY AND FOR PRODUCTION AND BIOPROCESSING OF  
BIOBASED VALUE-ADDED PRODUCTS***

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Item No. 463 of 602

**ACCESSION NO:** 0207999 **SUBFILE:** CRIS  
**PROJ NO:** PEN04148 **AGENCY:** CSREES PEN  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34437-17166 **PROPOSAL NO:** 2006-06063  
**START:** 01 AUG 2006 **TERM:** 31 JUL 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$462,110

**INVESTIGATOR:** Hyde, J.; Shortle, J.; Richard, T.; Graves, R.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
PENNSYLVANIA STATE UNIVERSITY  
208 MUELLER LABORATORY  
UNIVERSITY PARK, PENNSYLVANIA 16802

***IMPROVING PROFITABILITY AND PERFORMANCE OF DAIRY MANURE DIGESTERS***

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Item No. 464 of 602

**ACCESSION NO:** 0208576 **SUBFILE:** CRIS  
**PROJ NO:** PEN04158 **AGENCY:** CSREES PEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Abler, D. G.; Blandford, D.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
PENNSYLVANIA STATE UNIVERSITY  
208 MUELLER LABORATORY  
UNIVERSITY PARK, PENNSYLVANIA 16802

***GLOBALIZATION AND THE REINSTRUMENTATION OF DOMESTIC AGRICULTURAL  
POLICIES***

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Item No. 465 of 602

**ACCESSION NO:** 0211191 **SUBFILE:** CRIS  
**PROJ NO:** PEN04200 **AGENCY:** CSREES PEN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35504-18339 **PROPOSAL NO:** 2007-02145  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2010 **GRANT YR:** 2007  
**GRANT AMT:** \$499,156

**INVESTIGATOR:** Catchmark, J. M.; Brown, N. R.; Tien, M.; Kubicki, J.; Komarneni, S.

**PERFORMING INSTITUTION:**  
AGRI & BIOLOGICAL ENGINEERING  
PENNSYLVANIA STATE UNIVERSITY  
208 MUELLER LABORATORY  
UNIVERSITY PARK, PENNSYLVANIA 16802

*IMPROVED SUSTAINABLE CELLULOSIC MATERIALS ASSEMBLED USING ENGINEERED MOLECULAR LINKERS*

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Item No. 466 of 602

**ACCESSION NO:** 0404819 **SUBFILE:** CRIS  
**PROJ NO:** 3620-41000-084-01S **AGENCY:** ARS 3620  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 10 JUL 2001 **TERM:** 30 SEP 2004 **FY:** 2003

**INVESTIGATOR:** COTTA M A; GOVIND N S

**PERFORMING INSTITUTION:**  
MARINE SCIENCE AND ENGINEERING  
UNIVERSITY OF PUERTO RICO  
MAYAGUEZ, PUERTO RICO 00708

*PRODUCTION OF TRICHODERMA REESEI MUTANTS THAT CANNOT UTILIZE GLUCOSE*

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Item No. 467 of 602

**ACCESSION NO:** 0409671 **SUBFILE:** CRIS  
**PROJ NO:** 6657-13630-003-00D **AGENCY:** ARS 6657  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1000  
**START:** 03 APR 2005 **TERM:** 02 APR 2010 **FY:** 2006

**INVESTIGATOR:** HUNT P G; VANOTTI M B; CANTRELL K B; SZOGI A A; RO K S

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
FLORENCE, SOUTH CAROLINA 29503

***INNOVATIVE ANIMAL MANURE TREATMENT TECHNOLOGIES FOR ENHANCED ENVIRONMENTAL QUALITY***

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Item No. 468 of 602

**ACCESSION NO:** 0191165 **SUBFILE:** CRIS  
**PROJ NO:** SC-1700186 **AGENCY:** CSREES SC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED **MULTISTATE PROJ NO:** S-1000  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Brune, D. E.; Eversole, A. G.; Collier, J. A.; Schwedler, T. E.

**PERFORMING INSTITUTION:**  
AGRI & BIOLOGICAL ENGINEERING  
CLEMSON UNIVERSITY  
CLEMSON, SOUTH CAROLINA 29634

***ANIMAL MANURE AND WASTE UTILIZATION, TREATMENT AND NUISANCE AVOIDANCE FOR A SUSTAINABLE AGRICULTURE***

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Item No. 469 of 602

**ACCESSION NO:** 0194559 **SUBFILE:** CRIS  
**PROJ NO:** SC-1700223 **AGENCY:** CSREES SC.  
**PROJ TYPE:** HATCH **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2008 **FY:** 2005

**INVESTIGATOR:** Brune, D. E.; Chastain, J. P.; Dodd, R. B.

**PERFORMING INSTITUTION:**  
AGRI & BIOLOGICAL ENGINEERING  
CLEMSON UNIVERSITY  
CLEMSON, SOUTH CAROLINA 29634

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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Item No. 470 of 602

**ACCESSION NO:** 0411196 **SUBFILE:** CRIS  
**PROJ NO:** 5447-41000-002-00D **AGENCY:** ARS 5447  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 31 MAR 2010

**INVESTIGATOR:** ROSENTRATER K A; DASHIELL K E

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BROOKINGS, SOUTH DAKOTA 57006

**FIBER EXTRUSION TO IMPROVE USE AND PRODUCTION OF ETHANOL BYPRODUCTS**

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Item No. 471 of 602

**ACCESSION NO:** 0206830 **SUBFILE:** CRIS  
**PROJ NO:** SD00036-G **AGENCY:** CSREES SD.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34474-17038 **PROPOSAL NO:** 2006-06079  
**START:** 01 AUG 2006 **TERM:** 31 JUL 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$623,849

**INVESTIGATOR:** Kephart, K. D.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*PLANNING THE SUN GRANT INITIATIVE- 2006*

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Item No. 472 of 602

**ACCESSION NO:** 0204372 **SUBFILE:** CRIS  
**PROJ NO:** SD00065-G **AGENCY:** CSREES SD.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34474-16038 **PROPOSAL NO:** 2005-06068  
**START:** 01 AUG 2005 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$623,189

**INVESTIGATOR:** Kephart, K. D.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*PLANNING THE SUN GRANT INITIATIVE*

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Item No. 473 of 602

**ACCESSION NO:** 0200354 **SUBFILE:** CRIS  
**PROJ NO:** SD00134-G **AGENCY:** CSREES SD.  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34474-15053 **PROPOSAL NO:** 2004-06070  
**START:** 01 SEP 2004 **TERM:** 30 APR 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$626,826

**INVESTIGATOR:** Kephart, K. D.

**PERFORMING INSTITUTION:**  
UNIVERSITY ADMINISTRATION  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***PLANNING THE SUN GRANT INITIATIVE***

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Item No. 474 of 602

**ACCESSION NO:** 0186389 **SUBFILE:** CRIS  
**PROJ NO:** SD00160-H **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2004 **FY:** 2005

**INVESTIGATOR:** Taylor, G.; Klein, N.

**PERFORMING INSTITUTION:**  
ECONOMICS  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***VALUE ADDED AGRICULTURE IN SOUTH DAKOTA: ITS IMPACT ON STRUCTURE,  
EFFICIENCY, PRICES, AND AGRICULTURAL POLICY***

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Item No. 475 of 602

**ACCESSION NO:** 0211071 **SUBFILE:** CRIS  
**PROJ NO:** SD00198H-07 **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** West, T. P.

**PERFORMING INSTITUTION:**  
BIOLOGY & MICROBIOLOGY  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***BIOCONVERSION OF AGRICULTURAL BIOMASS AND PROCESSING COPRODUCTS INTO  
INDUSTRIALLY VALUABLE CHEMICALS***

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Item No. 476 of 602

**ACCESSION NO:** 0205738 **SUBFILE:** CRIS  
**PROJ NO:** SD00205-H **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006



**INVESTIGATOR:** Berg, R. K.

**PERFORMING INSTITUTION:**  
AGRI RES & EXTENSION CENTER  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***ALTERNATIVE CROP, ROTATION, AND TILLAGE PRACTICES***

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Item No. 477 of 602

**ACCESSION NO:** 0205739 **SUBFILE:** CRIS  
**PROJ NO:** SD00215-H **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Cheesbrough, T. M.

**PERFORMING INSTITUTION:**  
BIOLOGY & MICROBIOLOGY  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***GENETIC ANALYSIS AND MODIFICATION OF CROP PLANTS***

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Item No. 478 of 602

**ACCESSION NO:** 0201400 **SUBFILE:** CRIS  
**PROJ NO:** SD00234-H **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Taylor, G. L.; Klein, N.

**PERFORMING INSTITUTION:**  
ECONOMICS  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***VALUE ADDED AGRICULTURE IN SOUTH DAKOTA: OPPORTUNITIES TO CAPTURE  
ADDITIONAL VALUE FOR SOUTH DAKOTA PRODUCERS***

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Item No. 479 of 602

**ACCESSION NO:** 0194031 **SUBFILE:** CRIS  
**PROJ NO:** SD00262-H **AGENCY:** CSREES SD.

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Humburg, D. S.; Long, D.; Robert, P. C.; Kvien, C. K.; Clay, D. E.; Carlson, C. G.; O'Neill, M.; Schumacher, T. E.; Schumacher, L. G.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*ENGINEERING TECHNOLOGY APPLIED TO QUALITY AND PRODUCTION ISSUES IN  
AGRICULTURE OF THE NORTHERN PLAINS*

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Item No. 480 of 602

**ACCESSION NO:** 0194380 **SUBFILE:** CRIS  
**PROJ NO:** SD00332-R **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1010  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Boe, A.

**PERFORMING INSTITUTION:**  
PLANT SCIENCE  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*BREEDING AND GENETICS OF FORAGE CROPS TO IMPROVE PRODUCTIVITY, QUALITY,  
AND INDUSTRIAL USES*

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**ACCESSION NO:** 0194763 **SUBFILE:** CRIS  
**PROJ NO:** SD00392-R **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007

**INVESTIGATOR:** Gibbons, W. R.; Julson, J. L.

**PERFORMING INSTITUTION:**  
BIOLOGY & MICROBIOLOGY  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY*

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**ACCESSION NO:** 0208297 **SUBFILE:** CRIS  
**PROJ NO:** SD00H156-06 **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Julson, J. L.; Raynie, D.; Twedt, M.; Gelderman, R.; Muthukumarappan, M.; Klein, N.; Gibbons, W.; Brown, R.; Hanna, M.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*VALUE ENHANCEMENT OF SOUTH DAKOTA AGRICULTURAL RENEWABLE RESOURCES*

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Item No. 483 of 602

**ACCESSION NO:** 0209120 **SUBFILE:** CRIS  
**PROJ NO:** SD00H168-06IHG **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Anderson, G. A.; Halaweish, F.; Browning, L.; Kommareddy, A.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

*EXTINCTION COEFFICIENTS FOR A PBR WITH DIFFERENT AIR ENTRAINMENT RATIOS,  
ALGAL CONCENTRATIONS, AND LIGHT SOURCES FOR TWO SPECIES OF ALGAE.*

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Item No. 484 of 602

**ACCESSION NO:** 0209123 **SUBFILE:** CRIS  
**PROJ NO:** SD00H173-06IHG **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Jeranyama, P.; Smart, A. J.; Nleya, T. M.

**PERFORMING INSTITUTION:**  
PLANT SCIENCE  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***BOTANICAL COMPOSITION AND LIGNOCELLULOSIC FEEDSTOCK BIOFUEL QUALITY  
IN SELECT CONSERVATION RESERVE PROGRAM LANDS***

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Item No. 485 of 602

**ACCESSION NO:** 0211493 **SUBFILE:** CRIS  
**PROJ NO:** SD00H208-07 **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 01 OCT 2012

**INVESTIGATOR:** Van der Sluis, E.

**PERFORMING INSTITUTION:**  
ECONOMICS  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***VALUE-ADDED AGRICULTURE ACTIVITIES IN A CHANGING FOOD AND FIBER SYSTEM.***

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Item No. 486 of 602

**ACCESSION NO:** 0211861 **SUBFILE:** CRIS  
**PROJ NO:** SD00H214-07 **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Muthukumarappan, K.; Julson, J. L.; Gibbons, W.

**PERFORMING INSTITUTION:**  
AGRI ENGINEERING  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***DEVELOPING NOVEL PRETREATMENT TECHNOLOGIES FOR BIOFUELS PRODUCTION***

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Item No. 487 of 602

**ACCESSION NO:** 0212764 **SUBFILE:** CRIS  
**PROJ NO:** SD00H229-07IHG **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2009

**INVESTIGATOR:** West, T. P.

**PERFORMING INSTITUTION:**  
BIOLOGY & MICROBIOLOGY  
SOUTH DAKOTA STATE UNIVERSITY

PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***PRODUCTION OF A PRECURSOR CHEMICAL FOR PLASTIC SYNTHESIS FROM RAW GLYCEROL***

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Item No. 488 of 602

**ACCESSION NO:** 0212915 **SUBFILE:** CRIS  
**PROJ NO:** SD00H238-07IHG **AGENCY:** CSREES SD.  
**PROJ TYPE:** HATCH **PROJ STATUS:** PENDING NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Rupp, S. P.; Jensen, K. C.; Boe, A.; VanDerSluis, E.

**PERFORMING INSTITUTION:**  
WILDLIFE & FISHERIES SCIENCES  
SOUTH DAKOTA STATE UNIVERSITY  
PO BOX 2275A  
BROOKINGS, SOUTH DAKOTA 57007

***DEVELOPING SUSTAINABLE HARVEST STRATEGIES FOR CELLULOSE-BASED BIOFUELS: THE EFFECT OF INTENSITY AND SEASON OF HARVEST ON WILDLIFE AND BIOMA***

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Item No. 489 of 602

**ACCESSION NO:** 0209072 **SUBFILE:** CRIS  
**PROJ NO:** TEN001-RREA **AGENCY:** CSREES TEN  
**PROJ TYPE:** RREA **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Clatterbuck, W. K.

**PERFORMING INSTITUTION:**  
FORESTRY FISHERIES & WILDLIFE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***RREA PROGRAM***

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Item No. 490 of 602

**ACCESSION NO:** 0180430 **SUBFILE:** CRIS  
**PROJ NO:** TEN00193 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 1998 **TERM:** 30 SEP 2003 **FY:** 2003

**INVESTIGATOR:** Ray, D. E.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE  
KNOXVILLE, TENNESSEE 37996

***EVALUATING A NEW FARM POLICY ENVIRONMENT: APPLYING THE POLYSYS  
ANALYTICAL FRAMEWORK***

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Item No. 491 of 602

**ACCESSION NO:** 0192816 **SUBFILE:** CRIS  
**PROJ NO:** TEN002002-01486 **AGENCY:** CSREES TEN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35400-12908 **PROPOSAL NO:** 2002-01486  
**START:** 15 NOV 2002 **TERM:** 14 NOV 2003 **FY:** 2004 **GRANT YR:** 2003  
**GRANT AMT:** \$40,000

**INVESTIGATOR:** Jensen, K. L.; English, B. C.; Jakus, P. M.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***RESIDENTIAL ENERGY CONSUMERS` PREFERENCES FOR GREEN POWER FROM  
BIOENERGY***

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Item No. 492 of 602

**ACCESSION NO:** 0187741 **SUBFILE:** CRIS  
**PROJ NO:** TEN00238 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2005 **FY:** 2005

**INVESTIGATOR:** West, D. R.

**PERFORMING INSTITUTION:**  
PLANT SCIENCES & LANDSCAPE SYSTEMS  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***CEREAL BREEDING***

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Item No. 493 of 602

**ACCESSION NO:** 0198763 **SUBFILE:** CRIS  
**PROJ NO:** TEN00300 **AGENCY:** CSREES TEN

**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2008 **FY:** 2006

**INVESTIGATOR:** Tyler, D. D.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS ENGINEERING & ENVIRONMENTAL SCIENCE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***LANDSCAPE PROCESSES AND SOIL MANAGEMENT STRATEGIES FOR ENHANCED  
AGRICULTURAL AND ENVIRONMENTAL SUSTAINABILITY.***

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Item No. 494 of 602

**ACCESSION NO:** 0199120 **SUBFILE:** CRIS  
**PROJ NO:** TEN00301 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2003 **TERM:** 31 JUL 2008 **FY:** 2006

**INVESTIGATOR:** English, B. C.; Jensen, K. L.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***ANALYSIS OF ECONOMIC IMPACTS OF AND OPPORTUNITIES FOR TENNESSEE AGRI-  
INDUSTRY DEVELOPMENT***

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Item No. 495 of 602

**ACCESSION NO:** 0202359 **SUBFILE:** CRIS  
**PROJ NO:** TEN00309 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Hayes, D. G.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS ENGINEERING & ENVIRONMENTAL SCIENCE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***VALUE-ADDED PRODUCTS FROM AGRICULTURALLY-DERIVED LIPID AND PROTEIN  
FEEDSTOCKS: INNOVATIONS IN SEPARATIONS AND BIOREACTOR DESIGN.***

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**ACCESSION NO:** 0203594 **SUBFILE:** CRIS  
**PROJ NO:** TEN00312 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JAN 2005 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** De La Torre Ugarte, D. G.; English, B. C.; Ray, D. E.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***ECONOMIC IMPACTS AND EXPANSION POSSIBILITIES OF DEVELOPING A BIOENERGY  
AND BIOPRODUCTS INDUSTRY BASED ON AGRICULTURAL FEEDSTOCK***

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Item No. 497 of 602

**ACCESSION NO:** 0205613 **SUBFILE:** CRIS  
**PROJ NO:** TEN00325 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Ye, X.

**PERFORMING INSTITUTION:**  
BIOSYSTEMS ENGINEERING & ENVIRONMENTAL SCIENCE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***INVESTIGATION OF PHYSICOCHEMICAL PROPERTIES OF BIOLOGICAL MATERIALS IN  
BIOPROCESS ENGINEERING.***

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Item No. 498 of 602

**ACCESSION NO:** 0205614 **SUBFILE:** CRIS  
**PROJ NO:** TEN00330 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** West, D. R.

**PERFORMING INSTITUTION:**  
PLANT SCIENCES & LANDSCAPE SYSTEMS  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***CEREAL BREEDING***



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Item No. 499 of 602

**ACCESSION NO:** 0210747 **SUBFILE:** CRIS  
**PROJ NO:** TEN00350 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2010

**INVESTIGATOR:** Keyser, P.

**PERFORMING INSTITUTION:**  
FORESTRY FISHERIES & WILDLIFE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

*CENTER FOR NATIVE GRASSLANDS MANAGEMENT: CHANGES ECOLOGICAL HEALTH IN  
MANAGED ECOSYSTEMS.*

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Item No. 500 of 602

**ACCESSION NO:** 0212903 **SUBFILE:** CRIS  
**PROJ NO:** TEN00364 **AGENCY:** CSREES TEN  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1029  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Lambert, D. M.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE  
569 DABNEY HALL  
KNOXVILLE, TENNESSEE 37996

*RURAL CHANGE: MARKETS, GOVERNANCE AND QUALITY OF LIFE*

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Item No. 501 of 602

**ACCESSION NO:** 0197017 **SUBFILE:** CRIS  
**PROJ NO:** TEN02003-02985 **AGENCY:** CSREES TEN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35400-13860 **PROPOSAL NO:** 2003-02985  
**START:** 15 AUG 2003 **TERM:** 31 AUG 2006 **FY:** 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$136,000

**INVESTIGATOR:** English, B. C.; De La Torre Ugarte, D. G.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS & RURAL SOCIOL  
UNIVERSITY OF TENNESSEE

569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***ECONOMIC IMPACTS FROM INCREASED COMPETING DEMANDS FOR AGRICULTURAL  
FEEDSTOCKS TO PRODUCE BIOENERGY & BIOPRODUCTS***

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Item No. 502 of 602

**ACCESSION NO:** 0206964 **SUBFILE:** CRIS  
**PROJ NO:** TEN02006-06324 **AGENCY:** CSREES TEN  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-34158-17585 **PROPOSAL NO:** 2006-06324  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2009 **GRANT YR:** 2006  
**GRANT AMT:** \$428,286

**INVESTIGATOR:** Rials, T.

**PERFORMING INSTITUTION:**  
FORESTRY FISHERIES & WILDLIFE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***WOOD UTILIZATION THROUGH INNOVATIVE RESEARCH***

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Item No. 503 of 602

**ACCESSION NO:** 0210902 **SUBFILE:** CRIS  
**PROJ NO:** TEN02007-35101 **AGENCY:** CSREES TEN  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35101-18258 **PROPOSAL NO:** 2007-01455  
**START:** 15 SEP 2007 **TERM:** 14 SEP 2011 **GRANT YR:** 2007  
**GRANT AMT:** \$398,725

**INVESTIGATOR:** Keyser, P.

**PERFORMING INSTITUTION:**  
FORESTRY FISHERIES & WILDLIFE  
UNIVERSITY OF TENNESSEE  
569 DABNE HALL  
KNOXVILLE, TENNESSEE 37996

***DEVELOPMENT OF AN INTEGRATED FORAGE/BIOFUELS MANAGEMENT SYSTEM FOR  
THE MID-SOUTH***

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Item No. 504 of 602

**ACCESSION NO:** 0407435 **SUBFILE:** CRIS  
**PROJ NO:** 5430-21000-005-15S **AGENCY:** ARS 5430

**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 02 SEP 2003 **TERM:** 31 JUL 2008

**INVESTIGATOR:** BOWDEN R L; MORGAN G D

**PERFORMING INSTITUTION:**  
SOIL & CROP SCIENCES  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

*ALTERNATIVE CROPS AND CROPPING SYSTEMS TO MITIGATE KARNAL BUNT IN WHEAT*

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Item No. 505 of 602

**ACCESSION NO:** 0405270 **SUBFILE:** CRIS  
**PROJ NO:** 6206-13610-005-00D **AGENCY:** ARS 6206  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 08 FEB 2002 **TERM:** 07 FEB 2007 **FY:** 2006

**INVESTIGATOR:** ARNOLD J G; HARMEL R D; KINIRY J R; GREEN C H

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
TEMPLE, TEXAS 76502

*DEVELOPMENT OF MODELS AND CONSERVATION PRACTICES FOR WATER QUALITY  
MANAGEMENT AND RESOURCE ASSESSMENTS*

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Item No. 506 of 602

**ACCESSION NO:** 0403768 **SUBFILE:** CRIS  
**PROJ NO:** 6209-13610-005-00D **AGENCY:** ARS 6209  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2000 **TERM:** 31 AUG 2004 **FY:** 2004

**INVESTIGATOR:** CLARK R N

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BUSHLAND, TEXAS 79012

*RENEWABLE ENERGY SYSTEMS FOR WATER PUMPING AND REMOTE ELECTRIC POWER  
GENERATION*

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Item No. 507 of 602

**ACCESSION NO:** 0402333 **SUBFILE:** CRIS  
**PROJ NO:** 6209-13610-005-09R **AGENCY:** ARS 6209

**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 15 JUL 1998 **TERM:** 14 JUL 2003 **FY:** 2003

**INVESTIGATOR:** CLARK R N

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BUSHLAND, TEXAS 79012

*WIND/HYBRID CONTROL PROTOTYPE DEVELOPMENT*

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Item No. 508 of 602

**ACCESSION NO:** 0408952 **SUBFILE:** CRIS  
**PROJ NO:** 6209-13610-006-00D **AGENCY:** ARS 6209  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2009 **FY:** 2006

**INVESTIGATOR:** CLARK R N; VICK B D

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BUSHLAND, TEXAS 79012

*REMOTE WATER PUMPING AND ELECTRIC POWER GENERATION WITH RENEWABLE ENERGY*

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Item No. 509 of 602

**ACCESSION NO:** 0407084 **SUBFILE:** CRIS  
**PROJ NO:** 6209-13610-006-12R **AGENCY:** ARS 6209  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 APR 2003 **TERM:** 31 MAR 2008 **FY:** 2006

**INVESTIGATOR:** CLARK R N

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
BUSHLAND, TEXAS 79012

*WIND-BIODIESEL HYBRID ELECTRIC POWER GENERATION*

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Item No. 510 of 602

**ACCESSION NO:** 0409055 **SUBFILE:** CRIS  
**PROJ NO:** 6209-13610-006-13S **AGENCY:** ARS 6209  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** CLARK R N; HOLMAN A; STARCHER K

**PERFORMING INSTITUTION:**  
WEST TEXAS A&M UNIVERSITY  
CANYON, TEXAS 79016

*WATER PUMPING AND ELECTRIC GENERATION USING SMALL WIND SYSTEMS*

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Item No. 511 of 602

**ACCESSION NO:** 0190419 **SUBFILE:** CRIS  
**PROJ NO:** TEX03004 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED **MULTISTATE PROJ NO:** NC-1003  
**START:** 01 OCT 2001 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** McCarl, B. A.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

*IMPACT ANALYSIS AND DECISION STRATEGIES FOR AGRICULTURAL RESEARCH*

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Item No. 512 of 602

**ACCESSION NO:** 0165974 **SUBFILE:** CRIS  
**PROJ NO:** TEX08310 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 20 AUG 2004 **TERM:** 19 AUG 2009 **FY:** 2006

**INVESTIGATOR:** Ansley, R. J.

**PERFORMING INSTITUTION:**  
CHILLICOTHE-VERNON TAMU AG RES CNTR  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

*ECOLOGY, MANAGEMENT AND UTILIZATION OF WOODY PLANTS IN RANGELAND ECOSYSTEMS*

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Item No. 513 of 602

**ACCESSION NO:** 0168063 **SUBFILE:** CRIS  
**PROJ NO:** TEX08363 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 15 NOV 2007 **TERM:** 14 NOV 2012 **FY:** 2006

**INVESTIGATOR:** Mirkov, T. E.

**PERFORMING INSTITUTION:**  
WESLACO-TAMU AGR RES CNTR  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***CONTROL OF PLANT VIRUSES AND THEIR VECTORS USING TRANSGENIC PLANT TECHNOLOGIES***

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Item No. 514 of 602

**ACCESSION NO:** 0178464 **SUBFILE:** CRIS  
**PROJ NO:** TEX08548 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 DEC 2005 **TERM:** 30 NOV 2010 **FY:** 2006

**INVESTIGATOR:** Sweeten, J. M.

**PERFORMING INSTITUTION:**  
AMARILLO-TAMU AGR RES CENTER  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***FEEDLOT MANURE AND AIR QUALITY MANAGEMENT FOR MOISTURE-DEFICIT CLIMATES***

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Item No. 515 of 602

**ACCESSION NO:** 0192008 **SUBFILE:** CRIS  
**PROJ NO:** TEX08835 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 18 MAY 2007 **TERM:** 17 MAY 2012 **FY:** 2006

**INVESTIGATOR:** Burow, M. D.; Simpson, C.; Baring, M.; Burke, J.; Payton, P.; Puppala, N.; Isleib, T.;  
Chenault, K.; Paterson, A.; Schubert, A.; Wheeler, T.

**PERFORMING INSTITUTION:**  
LUBBOCK-TAMU AGR RES CNTR  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***PEANUT BREEDING AND GENETICS***

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Item No. 516 of 602

**ACCESSION NO:** 0190245 **SUBFILE:** CRIS  
**PROJ NO:** TEX08836 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012 **FY:** 2006

**INVESTIGATOR:** Tarpley, L.

**PERFORMING INSTITUTION:**  
BEAUMONT-TAMU AGR RES CNTR  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***PHYSIOLOGICAL PRINCIPLES OF U.S. SUB-TROPICAL CROP PRODUCTION***

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Item No. 517 of 602

**ACCESSION NO:** 0192197 **SUBFILE:** CRIS  
**PROJ NO:** TEX08879 **AGENCY:** CSREES TEX  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 12 APR 2002 **TERM:** 11 APR 2008 **FY:** 2006

**INVESTIGATOR:** GAN, J.

**PERFORMING INSTITUTION:**  
DEPT OF ECOSYSTEM SCIENCE & MANAGEMENT  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***EFFECTS OF TARIFF REDUCTIONS AND NON-TARIFF BARRIERS ON U.S. FOREST PRODUCTS INDUSTRIES***

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Item No. 518 of 602

**ACCESSION NO:** 0196945 **SUBFILE:** CRIS  
**PROJ NO:** TEX09007 **AGENCY:** CSREES TEX  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35400-13833 **PROPOSAL NO:** 2003-03045  
**START:** 15 AUG 2003 **TERM:** 14 AUG 2008 **FY:** 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$175,000

**INVESTIGATOR:** Gan, J.; McCarl, B. A.; Mjelde, J. W.

**PERFORMING INSTITUTION:**  
DEPT OF ECOSYSTEM SCIENCE & MANAGEMENT  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***EFFECTS OF CLIMATE CHANGE, FOREST CERTIFICATION, BIOTECHNOLOGY, AND INDUSTRIAL CONCENTRATION ON THE U.S. FOREST PRODUCTS INDUSTRY AND TRADE***

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Item No. 519 of 602

**ACCESSION NO:** 0211192 **SUBFILE:** CRIS  
**PROJ NO:** TEX09131 **AGENCY:** CSREES TEX  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 25 JUN 2007 **TERM:** 24 MAY 2012

**INVESTIGATOR:** Capareda, S. C.

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGRICULTURAL ENGINEERING  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***ADVANCED BIO-ENERGY AND ENVIRONMENTAL QUALITY RESEARCH FOR SUSTAINABLE AGRICULTURE***

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Item No. 520 of 602

**ACCESSION NO:** 0212430 **SUBFILE:** CRIS  
**PROJ NO:** TEX09271 **AGENCY:** CSREES TEX  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2008-35400-18690 **PROPOSAL NO:** 2007-04480  
**START:** 01 DEC 2007 **TERM:** 30 NOV 2009 **GRANT YR:** 2008  
**GRANT AMT:** \$180,000

**INVESTIGATOR:** Bryant, H. L.

**PERFORMING INSTITUTION:**  
AGRI ECONOMICS  
TEXAS A&M UNIV  
COLLEGE STATION, TEXAS 77843

***EFFECTS OF BIOFUELS TECHNOLOGY DEVELOPMENT AND FOSSIL ENERGY EXTRACTION CONDITIONS***

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Item No. 521 of 602

**ACCESSION NO:** 0202953 **SUBFILE:** CRIS  
**PROJ NO:** TEXK-2005-00435 **AGENCY:** CSREES TEXK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-15504 **PROPOSAL NO:** 2005-00435  
**START:** 01 MAY 2005 **TERM:** 21 OCT 2005 **GRANT YR:** 2005  
**GRANT AMT:** \$79,966

**INVESTIGATOR:** Massingill, J. L.

**PERFORMING INSTITUTION:**  
Advanced Materials and Processes  
San Marcos, TEXAS 78666

***HIGH YIELD, HIGH EFFICIENCY BIO-REFINING***

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Item No. 522 of 602



**ACCESSION NO:** 0207447 **SUBFILE:** CRIS  
**PROJ NO:** TEXK-2006-03095 **AGENCY:** CSREES TEXK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-17174 **PROPOSAL NO:** 2006-03095  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Massingill, J. L.

**PERFORMING INSTITUTION:**  
Advanced Materials and Processes  
San Marcos, TEXAS 78666

***HIGH YIELD, HIGH EFFICIENCY BIO-REFINING***

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**ACCESSION NO:** 0210102 **SUBFILE:** CRIS  
**PROJ NO:** TEXK-2007-00084 **AGENCY:** CSREES TEXK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-17966 **PROPOSAL NO:** 2007-00084  
**START:** 15 MAY 2007 **TERM:** 14 JAN 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Hennings, B.

**PERFORMING INSTITUTION:**  
LYNNTECH, INC  
7610 EASTMARK DRIVE SUITE 105  
COLLEGE STATION, TEXAS 77840

***REDUCED WASTE PROCESS TO PRODUCE BIOFUELS WITH ENHANCED PROPERTIES***

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Item No. 524 of 602

**ACCESSION NO:** 0211871 **SUBFILE:** CRIS  
**PROJ NO:** TEXN-0024 **AGENCY:** CSREES TEXN  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-38624-18576 **PROPOSAL NO:** 2007-04141  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2009 **GRANT YR:** 2007  
**GRANT AMT:** \$173,327

**INVESTIGATOR:** Trostle, C. L.; Angadi, S.; Auld, D. L.; Bean, B. W.; Nansen, C.; Baughman, T. A.;  
Flynn, R. P.; O'Neill, M.; Baltensperger, D. L.; Libbin, J. D.; Smith, J. G.

**PERFORMING INSTITUTION:**  
COOPERATIVE EXTENSION  
TEXAS COOPERATIVE EXTENSION  
COLLEGE STATION, TEXAS 77843

***CANOLA ADAPTATION AND PRODUCTION IN THE SOUTHERN HIGH PLAINS***

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Item No. 525 of 602

**ACCESSION NO:** 0196374 **SUBFILE:** CRIS  
**PROJ NO:** TEXR-2003-01039 **AGENCY:** CSREES TEXR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35504-13687 **PROPOSAL NO:** 2003-01039  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2003  
**GRANT AMT:** \$178,500

**INVESTIGATOR:** Kinney, K. A.; Katz, L. E.; Seibert, A. F.

**PERFORMING INSTITUTION:**  
UNIVERSITY OF TEXAS  
AUSTIN, TEXAS 78712

*VAPOR PHASE BIOREACTORS TO TREAT AIR POLLUTANTS EMITTED FROM CORN-BASED ETHANOL PRODUCTION FACILITIES*

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Item No. 526 of 602

**ACCESSION NO:** 0204715 **SUBFILE:** CRIS  
**PROJ NO:** TEXR-2005-02627 **AGENCY:** CSREES TEXR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-35504-16335 **PROPOSAL NO:** 2005-02627  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **GRANT YR:** 2005  
**GRANT AMT:** \$373,178

**INVESTIGATOR:** van Walsum, G. P.; Chambliss, C. K.

**PERFORMING INSTITUTION:**  
BAYLOR UNIV  
WACO, TEXAS 76703

*CHARACTERIZATION OF ACCUMULATION TRENDS FOR CARBOHYDRATE, LIGNIN AND EXTRACTIVE DEGRADATION PRODUCTS IN LIGNOCELLULOSE PRETREATMENT*

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Item No. 527 of 602

**ACCESSION NO:** 0196299 **SUBFILE:** CRIS  
**PROJ NO:** TEXR-LCMS **AGENCY:** CSREES TEXR  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35504-13686 **PROPOSAL NO:** 2003-01096  
**START:** 01 SEP 2003 **TERM:** 31 AUG 2006 **FY:** 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$175,000

**INVESTIGATOR:** van Walsum, G. P.; Chambliss, C. K.

**PERFORMING INSTITUTION:**  
BAYLOR UNIV  
WACO, TEXAS 76703

***QUANTITATIVE ASSESSMENT OF CARBOHYDRATE, LIGNIN AND EXTRACTIVE  
DEGRADATION PRODUCTS IN PRETREATED LIGNOCELLULOSE***

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Item No. 528 of 602

**ACCESSION NO:** 0210812 **SUBFILE:** CRIS  
**PROJ NO:** UTA00572 **AGENCY:** CSREES UTA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 30 JUN 2009

**INVESTIGATOR:** Barney, B. M.; Israelson, C. E.; Pace, M. G.; Seefeldt, L. C.

**PERFORMING INSTITUTION:**  
CHEMISTRY & BIOCHEMISTRY  
UTAH STATE UNIVERSITY  
LOGAN, UTAH 84322

***BIODIESEL PRODUCTION FROM UTAH SAFFLOWER***

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Item No. 529 of 602

**ACCESSION NO:** 0184227 **SUBFILE:** CRIS  
**PROJ NO:** UTA00942 **AGENCY:** SAES UTA  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 1999 **TERM:** 30 JUN 2004 **FY:** 2004

**INVESTIGATOR:** Harrison, J. D.

**PERFORMING INSTITUTION:**  
AGRI SYSTEMS TECHNOLOGY EDU  
UTAH STATE UNIVERSITY  
LOGAN, UTAH 84322

***INTEGRATED FACULTATIVE PONDS (IFP) FOR AGRICULTURAL WASTEWATER  
TREATMENT***

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Item No. 530 of 602

**ACCESSION NO:** 0210191 **SUBFILE:** CRIS  
**PROJ NO:** UTAK-2007-00496 **AGENCY:** CSREES UTAK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18012 **PROPOSAL NO:** 2007-00496  
**START:** 15 JUN 2007 **TERM:** 14 FEB 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$79,994

**INVESTIGATOR:** Hansen, C. S.; Hansen, C. L.; Greenwood, M.

**PERFORMING INSTITUTION:**  
Hansen Energy and Environmental

15600 N 4005 W  
East Garland, UTAH 84312

***PRODUCTION OF HYDROGEN FROM AGRICULTURAL WASTE***

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**ACCESSION NO:** 0193522 **SUBFILE:** CRIS  
**PROJ NO:** VA-135681 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Chen, J. S.

**PERFORMING INSTITUTION:**  
BIOCHEMISTRY  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***A BIOCHEMICAL AND GENETIC STUDY OF ANAEROBIC BACTERIA FOR THE PRODUCTION OF USEFUL CHEMICALS***

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Item No. 532 of 602

**ACCESSION NO:** 0205429 **SUBFILE:** CRIS  
**PROJ NO:** VA-135747 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Agblevor, F. A.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***BIOFUELS PRODUCTION FROM COTTON GIN WASTE AND RECYCLED PAPER SLUDGE***

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Item No. 533 of 602

**ACCESSION NO:** 0207970 **SUBFILE:** CRIS  
**PROJ NO:** VA-135769 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JUL 2006 **TERM:** 30 JUN 2011 **FY:** 2006

**INVESTIGATOR:** Ogejo, J. A.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***ENERGY AND PHOSPHORUS RECOVERY FROM DAIRY MANURE***

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**ACCESSION NO:** 0208720 **SUBFILE:** CRIS  
**PROJ NO:** VA-135779 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Zhang, Y. P.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***IMPROVEMENT IN BACTERIAL CELLULASES APPLICABLE TO PRETREATED  
LIGNOCELLULOSE FOR PRODUCTION OF BIOETHANOL AND BIOBASED PRODUCTS***

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Item No. 535 of 602

**ACCESSION NO:** 0209558 **SUBFILE:** CRIS  
**PROJ NO:** VA-135794 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 JAN 2007 **TERM:** 30 SEP 2007

**INVESTIGATOR:** Fan, Z.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***DEVELOPMENT OF NEW CATALYST AND CATALYTIC STRATEGY FOR RENEWABLE  
RESOURCE UTILIZATION***

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Item No. 536 of 602

**ACCESSION NO:** 0195030 **SUBFILE:** CRIS  
**PROJ NO:** VA-136185 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Zhang, C.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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**ACCESSION NO:** 0194479 **SUBFILE:** CRIS  
**PROJ NO:** VA-136190 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-1011  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Alwang, J. R.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & APPLIED ECONOMICS  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***RURAL COMMUNITIES, RURAL LABOR MARKETS AND PUBLIC POLICY***

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Item No. 538 of 602

**ACCESSION NO:** 0212874 **SUBFILE:** CRIS  
**PROJ NO:** VA-136217 **AGENCY:** CSREES VA.  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NE-506  
**START:** 01 AUG 2007 **TERM:** 01 JUL 2009

**INVESTIGATOR:** Winistorfer, P. M.

**PERFORMING INSTITUTION:**  
WOOD SCIENCE & FORESTS PRODUCTS  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***WOOD UTILIZATION RESEARCH ON US BIOFUELS, BIOPRODUCTS, HYBRID  
BIOMATERIALS COMPOSITES PRODUCTION, AND TRADITIONAL FOREST PRODUCTS***

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Item No. 539 of 602

**ACCESSION NO:** 0202161 **SUBFILE:** CRIS  
**PROJ NO:** VA-136602 **AGENCY:** CSREES VA.  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 JAN 2005 **TERM:** 31 DEC 2009 **FY:** 2006

**INVESTIGATOR:** Radtke, P. J.

**PERFORMING INSTITUTION:**  
FORESTRY  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***MODELING FOREST GROWTH AND YIELD IN A CHANGING ENVIRONMENT***

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Item No. 540 of 602

**ACCESSION NO:** 0207010 **SUBFILE:** CRIS  
**PROJ NO:** VA-428273 **AGENCY:** CSREES VA.  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-38909-03484 **PROPOSAL NO:** 2006-06234  
**START:** 01 JUN 2006 **TERM:** 31 MAY 2009 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$880,308

**INVESTIGATOR:** Mostaghimi, S.; Quisenberry, S.

**PERFORMING INSTITUTION:**  
CAL S ADMINISTRATION  
VIRGINIA POLYTECHNIC INSTITUTE  
BLACKSBURG, VIRGINIA 24061

***ESTABLISH A BIODESIGN AND BIOPROCESSING RESEARCH CENTER AT VIRGINIA TECH***

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Item No. 541 of 602

**ACCESSION NO:** 0198445 **SUBFILE:** CRIS  
**PROJ NO:** VAK-2003-04081 **AGENCY:** CSREES VA.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-33610-13967 **PROPOSAL NO:** 2003-04081  
**START:** 15 SEP 2003 **TERM:** 14 MAR 2006 **FY:** 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Blaylock, M. J.

**PERFORMING INSTITUTION:**  
EDENSPACE SYSTEMS CORPORATION  
15100 ENTERPRISE COURT STE 100  
CHANTILLY, VIRGINIA 20151

***PHYTOREMEDIATION USING UNDEREMPLOYED AGRICULTURAL ASSETS***

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Item No. 542 of 602

**ACCESSION NO:** 0210227 **SUBFILE:** CRIS  
**PROJ NO:** VAK-2007-00181 **AGENCY:** CSREES VA.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-18017 **PROPOSAL NO:** 2007-00181

**START:** 01 JUN 2007 **TERM:** 31 JAN 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Blaylock, M. J.

**PERFORMING INSTITUTION:**  
EDENSPACE SYSTEMS CORPORATION  
15100 ENTERPRISE COURT STE 100  
CHANTILLY, VIRGINIA 20151

***PLANT EXPRESSION OF CELLULASE FOR BIOMASS ETHANOL PRODUCTION***

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**ACCESSION NO:** 0406925 **SUBFILE:** CRIS  
**PROJ NO:** 5348-22000-011-00D **AGENCY:** ARS 5348  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 25 FEB 2003 **TERM:** 13 JUN 2005 **FY:** 2005

**INVESTIGATOR:** YOUNG F L; KENNEDY A C; MCCOOL D K; HUGGINS D R

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PULLMAN, WASHINGTON 99164

***BIOLOGY, ECOLOGY, AND MANAGEMENT OF PROBLEM WEEDS IN PACIFIC NORTHWEST  
AGRO-ECOSYSTEMS***

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Item No. 544 of 602

**ACCESSION NO:** 0407397 **SUBFILE:** CRIS  
**PROJ NO:** 5348-22000-012-00D **AGENCY:** ARS 5348  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 01 JUL 2003 **TERM:** 30 APR 2008 **FY:** 2006

**INVESTIGATOR:** WELLER D M; THOMASHOW L S; OKUBARA P A; PAULITZ T C

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PULLMAN, WASHINGTON 99164

***BIOLOGY, BIOLOGICAL CONTROL AND MOLECULAR GENETICS OF ROOT DISEASES OF  
WHEAT AND BARLEY***

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Item No. 545 of 602

**ACCESSION NO:** 0409362 **SUBFILE:** CRIS  
**PROJ NO:** 5348-22610-001-00D **AGENCY:** ARS 5348



**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 15 JUN 2005 **TERM:** 28 FEB 2009 **FY:** 2006

**INVESTIGATOR:** YOUNG F L; HUGGINS D R; LONG D S; WILLIAMS J D; SIEMENS M C;  
GOLLANY H T

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PULLMAN, WASHINGTON 99164

*IMPROVED AND INTEGRATED MANAGEMENT SYSTEMS IN PACIFIC NORTHWEST AGRO-  
ECOSYSTEMS*

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Item No. 546 of 602

**ACCESSION NO:** 0407883 **SUBFILE:** CRIS  
**PROJ NO:** 5354-21660-001-00D **AGENCY:** ARS 5354  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 14 DEC 2003 **TERM:** 13 DEC 2008 **FY:** 2006

**INVESTIGATOR:** COLLINS H P; BOYDSTON R A; ALVA A K

**PERFORMING INSTITUTION:**  
AGRICULTURAL RESEARCH SERVICE  
PROSSER, WASHINGTON 99350

*SUSTAINABLE POTATO CROPPING SYSTEMS FOR IRRIGATED AGRICULTURE IN THE  
PACIFIC NORTHWEST*

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Item No. 547 of 602

**ACCESSION NO:** 0204403 **SUBFILE:** CRIS  
**PROJ NO:** WNK-2005-03231 **AGENCY:** CSREES WN.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-33610-16176 **PROPOSAL NO:** 2005-03231  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2007 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Durfey, T. R.

**PERFORMING INSTITUTION:**  
EMERALD RANCHES  
6880 EMERALD RD.  
SUNNYSIDE, WASHINGTON 98944

*BIOSOLIDS FOR BIODIESEL*

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Item No. 548 of 602

**ACCESSION NO:** 0207574 **SUBFILE:** CRIS  
**PROJ NO:** WNK-2006-03055 **AGENCY:** CSREES WN.K  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-33610-17595 **PROPOSAL NO:** 2006-03055  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$296,000

**INVESTIGATOR:** Dooley, J. H.

**PERFORMING INSTITUTION:**  
FOREST CONCEPTS, LLC  
1911 SW CAMPUS DRIVE #655  
FEDERAL WAY, WASHINGTON 98023

***APPROPRIATE TECHNOLOGY WOODY-BIOMASS COLLECTION SYSTEMS FOR BIOENERGY AND BIOBASED PRODUCTS***

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Item No. 549 of 602

**ACCESSION NO:** 0195184 **SUBFILE:** CRIS  
**PROJ NO:** WNP00450 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** S-1007  
**START:** 01 OCT 2002 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Chen, S.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY***

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**ACCESSION NO:** 0198301 **SUBFILE:** CRIS  
**PROJ NO:** WNP00562 **AGENCY:** SAES WN.P  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Chen, S.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***RESEARCH AND DEVELOPMENT FOR BIOMASS PROCESSING AND BIOPRODUCT PRODUCTION***

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**ACCESSION NO:** 0201321 **SUBFILE:** CRIS  
**PROJ NO:** WNP00591 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-34261-15183 **PROPOSAL NO:** 2004-06268  
**START:** 15 SEP 2004 **TERM:** 14 SEP 2007 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$556,250

**INVESTIGATOR:** Koenig, R. T.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***STEEP: WATER QUALITY IN THE PACIFIC NORTHWEST***

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**ACCESSION NO:** 0204126 **SUBFILE:** CRIS  
**PROJ NO:** WNP00614 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** SPECIAL GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-34261-16444 **PROPOSAL NO:** 2005-06291  
**START:** 15 SEP 2005 **TERM:** 14 SEP 2008 **FY:** 2006 **GRANT YR:** 2005  
**GRANT AMT:** \$597,262

**INVESTIGATOR:** Koenig, R. T.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***STEEP: WATER QUALITY IN THE PACIFIC NORTHWEST***

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Item No. 553 of 602

**ACCESSION NO:** 0212483 **SUBFILE:** CRIS  
**PROJ NO:** WNP00686 **AGENCY:** SAES WN.P  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 JUL 2007 **TERM:** 01 JUL 2012

**INVESTIGATOR:** Pan, W. L.; Kruger, C. E.; Hulbert, S.; Koenig, R. T.; Stevens, R. G.; Fransen, S. C.;  
Hang, A.; Miller, T. W.; Cogger, C. G.; Schillinger, W. H.; Yenish, J. P.; Burke, I.

**PERFORMING INSTITUTION:**  
CROP & SOIL SCIENCES  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***BIOFUEL/BIOPRODUCT FEEDSTOCK CROPPING SYSTEMS***

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Item No. 554 of 602

**ACCESSION NO:** 0093398 **SUBFILE:** CRIS  
**PROJ NO:** WNP00689 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** HATCH **PROJ STATUS:** REVISED  
**START:** 01 SEP 2005 **TERM:** 31 AUG 2008 **FY:** 2006

**INVESTIGATOR:** Fransen, S. C.; Collins, H. P.; Hudson, T.; Vandemark, G.

**PERFORMING INSTITUTION:**  
PROSSER IRRIGATED AG RES & EXT CENTER  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***FORAGE MANAGEMENT AND QUALITY OF PERENNIAL GRASSES AS STORED FORAGE OR BIOFUEL***

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Item No. 555 of 602

**ACCESSION NO:** 0156204 **SUBFILE:** CRIS  
**PROJ NO:** WNP00947 **AGENCY:** SAES WN.P  
**PROJ TYPE:** STATE **PROJ STATUS:** REVISED  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Weller, D. W.; Thomashow, L. S.; Paulitz, T. C.; Okubara, P. A.

**PERFORMING INSTITUTION:**  
PLANT PATHOLOGY  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***METABOLITES AND GENES OF BIOCONTROL AGENTS INVOLVED IN SUPPRESSION OF ROOT PATHOGENS OF WHEAT AND BARLEY***

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Item No. 556 of 602

**ACCESSION NO:** 0211665 **SUBFILE:** CRIS  
**PROJ NO:** WNP06689 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-51130-03893 **PROPOSAL NO:** 2007-03846  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2011 **GRANT YR:** 2007  
**GRANT AMT:** \$395,000

**INVESTIGATOR:** Fransen, S. C.; Ottman, M. J.; Peters, R. T.

**PERFORMING INSTITUTION:**  
PROSSER IRRIGATED AG RES & EXT CENTER  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***WATER REQUIREMENTS AND ECONOMICS FOR GROWING PERENNIAL WARM-SEASON GRASSES FOR ETHANOL UNDER IRRIGATION IN THE ARID-WEST***

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**ACCESSION NO:** 0210833 **SUBFILE:** CRIS  
**PROJ NO:** WNP07551 **AGENCY:** CSREES WN.P  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-35107-18279 **PROPOSAL NO:** 2007-03159  
**START:** 15 AUG 2007 **TERM:** 14 AUG 2010 **GRANT YR:** 2007  
**GRANT AMT:** \$395,000

**INVESTIGATOR:** Pierce, F. J.; Long, D. S.; Collins, H. P.; Albrecht, S. L.; Fransen, S. C.

**PERFORMING INSTITUTION:**  
CENTER FOR PRECISION AGRIC SYSTEM  
WASHINGTON STATE UNIVERSITY  
PULLMAN, WASHINGTON 99164

***SOIL ECOSYSTEM CHANGES IN C AND N BUDGETS INDUCED BY A SHIFT TO BIOFUELS PRODUCTION***

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**ACCESSION NO:** 0205041 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1156 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUN 2004 **TERM:** 30 SEP 2005 **FY:** 2006

**INVESTIGATOR:** Perez-Garcia, J.

**PERFORMING INSTITUTION:**  
ECOSYSTEM SCIENCES  
UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***CONSORTIUM FOR RESEARCH AND RENEWABLE INDUSTRIAL MATERIALS (CORRIM)***

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**ACCESSION NO:** 0205604 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1180 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 24 AUG 2005 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Lippke, B. R.

**PERFORMING INSTITUTION:**  
ECOSYSTEM SCIENCES

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***MULTIPLIERS FOR JOBS, REVENUES AND TAXES RESULTING FROM DNR TIMBER SALES***

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Item No. 560 of 602

**ACCESSION NO:** 0205616 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1183 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 19 SEP 2005 **TERM:** 18 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Doty, S. L.

**PERFORMING INSTITUTION:**  
ECOSYSTEM SCIENCES  
UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***ENHANCING PHYTOREMEDIATION USING SWEET POTATOES FROM EAST AFRICA***

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Item No. 561 of 602

**ACCESSION NO:** 0209687 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1207 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 FEB 2006 **TERM:** 15 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Doty, S. L.

**PERFORMING INSTITUTION:**  
COLLEGE ADMINISTRATION  
UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***63-0136 OPTIMIZING WILLOW FOR ENHANCED PHYTOREMEDIATION AND BIOFUEL PRODUCTION***

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Item No. 562 of 602

**ACCESSION NO:** 0209703 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1223 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 19 JUL 2006 **TERM:** 30 SEP 2007 **FY:** 2006

**INVESTIGATOR:** Lee, R. G.

**PERFORMING INSTITUTION:**  
COLLEGE ADMINISTRATION

UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***63-0690 MATHEMATICS IN CONTEXT: INCREASING STUDENT PERFORMANCE BY  
EXPANDING PROFESSIONAL LEARNING COMMUNITIES***

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Item No. 563 of 602

**ACCESSION NO:** 0212089 **SUBFILE:** CRIS  
**PROJ NO:** WNZ-1276 **AGENCY:** OCI WN.Z  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 16 JUL 2007 **TERM:** 30 JUN 2009

**INVESTIGATOR:** Gustafson, R.

**PERFORMING INSTITUTION:**  
COLLEGE ADMINISTRATION  
UNIVERSITY OF WASHINGTON  
SEATTLE, WASHINGTON 98195

***63-2842 INVESTIGATION OF BARRIERS TO FOREST RESOURCES FOR FUEL PRODUCTION  
IN WASHINGTON STATE***

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Item No. 564 of 602

**ACCESSION NO:** 0210513 **SUBFILE:** CRIS  
**PROJ NO:** WVA00475 **AGENCY:** CSREES WVA  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 15 MAY 2007 **TERM:** 01 OCT 2008

**INVESTIGATOR:** McNeel, J. F.

**PERFORMING INSTITUTION:**  
FORESTRY  
WEST VIRGINIA UNIVERSITY  
PO BOX 6108  
MORGANTOWN, WEST VIRGINIA 26506

***EFFICIENT UTILIZATION OF UPLAND HARDWOODS IN WEST VIRGINIA.***

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Item No. 565 of 602

**ACCESSION NO:** 0201161 **SUBFILE:** CRIS  
**PROJ NO:** WVAX-010-400 **AGENCY:** CSREES WVAX  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-38814-15043 **PROPOSAL NO:** 2004-02614  
**START:** 01 SEP 2004 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2004  
**GRANT AMT:** \$209,944

**INVESTIGATOR:** Huber, D. H.

**PERFORMING INSTITUTION:**  
BIOLOGY  
WEST VIRGINIA STATE UNIVERSITY  
PO BOX 1000  
INSTITUTE, WEST VIRGINIA 25112

***DEVELOPING DNA MICROARRAYS FOR THE MICROBIAL ANALYSIS OF ANAEROBIC DIGESTERS***

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Item No. 566 of 602

**ACCESSION NO:** 0203827 **SUBFILE:** CRIS  
**PROJ NO:** WVAX-BIOPLEX5 **AGENCY:** CSREES WVAX  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2005-38850-02292 **PROPOSAL NO:** 2006-06227  
**START:** 15 JUN 2005 **TERM:** 14 JUN 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$639,382

**INVESTIGATOR:** Chatfield, J. M.; Huber, D. H.; Liedl, B. E.; Ruhnke, T. R.

**PERFORMING INSTITUTION:**  
BIOLOGY  
WEST VIRGINIA STATE UNIVERSITY  
PO BOX 1000  
INSTITUTE, WEST VIRGINIA 25112

***AGRICULTURAL WASTE TREATMENT UTILIZING THERMOPHILIC ANAEROBIC DIGESTION (BIOPLEX PHASE 6)***

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Item No. 567 of 602

**ACCESSION NO:** 0211696 **SUBFILE:** CRIS  
**PROJ NO:** WVAX-HUBER **AGENCY:** CSREES WVAX  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** NEW  
**START:** 01 MAR 2007 **TERM:** 28 FEB 2009

**INVESTIGATOR:** Huber, D. H.

**PERFORMING INSTITUTION:**  
AGRICULTURAL & ENVIRONMENTAL RES STATION (AERS)  
WEST VIRGINIA STATE UNIVERSITY  
PO BOX 1000  
INSTITUTE, WEST VIRGINIA 25112

***LINKING MICROBIAL COMMUNITY STRUCTURE AND FUNCTION IN ANEROBIC DIGESTION***

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Item No. 568 of 602



**ACCESSION NO:** 0204762 **SUBFILE:** CRIS  
**PROJ NO:** WVAX-REALTIMEPCR **AGENCY:** CSREES WVAX  
**PROJ TYPE:** EVANS-ALLEN **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2002 **TERM:** 31 AUG 2006 **FY:** 2006

**INVESTIGATOR:** HUBER, D. H.

**PERFORMING INSTITUTION:**  
BIOLOGY  
WEST VIRGINIA STATE UNIVERSITY  
PO BOX 1000  
INSTITUTE, WEST VIRGINIA 25112

***DEVELOPING REAL-TIME PCR FOR QUANTITATIVELY MONITORING MICROBIAL  
ACTIVITY IN A THERMOPHILIC METHANOGENIC BIOREACTOR***

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Item No. 569 of 602

**ACCESSION NO:** 0405590 **SUBFILE:** CRIS  
**PROJ NO:** 3655-21630-003-01S **AGENCY:** ARS 3655  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 25 JUN 2002 **TERM:** 24 JUN 2007 **FY:** 2006

**INVESTIGATOR:** GRABBER J H; POSNER J

**PERFORMING INSTITUTION:**  
COLLEGE OF AGRICULTURE  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***CROP AND LIVESTOCK PRODUCTION SYSTEMS FOR IMPROVED STEWARDSHIP AND  
PROFITABILITY***

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Item No. 570 of 602

**ACCESSION NO:** 0405760 **SUBFILE:** CRIS  
**PROJ NO:** 3655-41000-004-01S **AGENCY:** ARS 3655  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 20 AUG 2002 **TERM:** 19 AUG 2007 **FY:** 2006

**INVESTIGATOR:** WEIMER P J; SHINNERS K J

**PERFORMING INSTITUTION:**  
BIOLOGICAL & AGR ENGINEERING  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***HARVESTING, PREPROCESSING, AND STORAGE OF CROP RESIDUES FOR BIOBASED  
PRODUCTS***

**ACCESSION NO:** 0407709 **SUBFILE:** CRIS  
**PROJ NO:** 3655-41000-004-02S **AGENCY:** ARS 3655  
**PROJ TYPE:** USDA COOPERATIVE AGREEMENT **PROJ STATUS:** NEW  
**START:** 15 SEP 2003 **TERM:** 14 SEP 2008

**INVESTIGATOR:** WEIMER P J; SHINNERS K J

**PERFORMING INSTITUTION:**  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***HARVESTING, PREPROCESSING, AND STORAGE OF PERENNIAL GRASSES FOR  
BIOENERGY FEEDSTOCKS***

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Item No. 572 of 602

**ACCESSION NO:** 0197508 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4709-3-T **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 31 JUL 2002 **TERM:** 30 JUL 2007 **FY:** 2006

**INVESTIGATOR:** Rudie, A.; Atalla, R. H.; Weinstock, I. A.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS LAB, MADISON LAB HQ - MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

***DEVELOPING NEW AND INNOVATIVE METHODS TO CONVERT WOOD AND OTHER  
LIGNOCELLULOSICS INTO FIBERS AND CHEMICALS***

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Item No. 573 of 602

**ACCESSION NO:** 0197514 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4710-2-T **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 31 JUL 2002 **TERM:** 30 JUL 2007 **FY:** 2006

**INVESTIGATOR:** Zhu, J.; Klungness, J. H.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS LAB, MADISON LAB HQ - MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

***DEVELOP TECHNOLOGIES FOR CONVERSION OF WOOD TO PULP AND PAPER WITH LESS  
OF AN ENVIRONMENTAL IMPACT***

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Item No. 574 of 602

**ACCESSION NO:** 0197402 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4712-1-T **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 31 JUL 2002 **TERM:** 30 JUL 2007 **FY:** 2006

**INVESTIGATOR:** Jeffries, T. W.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS LAB, MADISON LAB HQ - MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

*BIOCONVERSION*

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Item No. 575 of 602

**ACCESSION NO:** 0212930 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4712-1A **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 23 JUL 2007 **TERM:** 22 JUL 2012

**INVESTIGATOR:** Illman, B. L.; Jeffries, T. W.; Crooks, C.

**PERFORMING INSTITUTION:**  
FPL FOREST PRODUCTS LAB, MADISON LAB HEADQUARTERS, MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

*BIOCONVERSION OF WOOD SUGARS TO FUELS AND OTHER CHEMICALS*

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Item No. 576 of 602

**ACCESSION NO:** 0197404 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4712-3-T **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** TERMINATED  
**START:** 31 JUL 2002 **TERM:** 30 JUL 2007 **FY:** 2006

**INVESTIGATOR:** Jeffries, T. W.; Kenealy, W. R.

**PERFORMING INSTITUTION:**  
FOREST PRODUCTS LAB, MADISON LAB HQ - MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

**ENZYMATIC PROCESSING OF WOOD FIBER**

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Item No. 577 of 602

**ACCESSION NO:** 0212944 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4851-3A **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 23 JUL 2007 **TERM:** 23 JUL 2012

**INVESTIGATOR:** Skog, K. E.; Ince, P. J.; Spelter, H. N.; McKeever, D. B.; Lebow, P. K.

**PERFORMING INSTITUTION:**  
FPL FOREST PRODUCTS LAB, MADISON LAB HEADQUARTERS, MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

***THERE IS A NEED TO MONITOR AND MODEL MARKET EQUILIBRIA, PRODUCTION TRENDS, AND TECHNOLOGY CHANGES OF THE U.S. FORESET PRODUCT INDUSTRY***

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Item No. 578 of 602

**ACCESSION NO:** 0212947 **SUBFILE:** CRIS  
**PROJ NO:** FPL-4851-6A **AGENCY:** FS FPL  
**PROJ TYPE:** USDA INHOUSE **PROJ STATUS:** NEW  
**START:** 23 JUL 2007 **TERM:** 23 JUL 2012

**INVESTIGATOR:** Skog, K. E.; Bilek, E. M.; Spelter, H. N.; Ince, P. J.; Skog, K. E.

**PERFORMING INSTITUTION:**  
FPL FOREST PRODUCTS LAB, MADISON LAB HEADQUARTERS, MADISON, WI  
FOREST PRODUCTS LABORATORY  
ONE GIFFORD PINCHOT DRIVE  
MADISON, WISCONSIN 53705-2398

***KNOWLEDGE IS NEEDED ON THE ECONOMIC VIABILITY OF NEW TECHNOLOGIES FOR CONVERTING WOOD AND FIBER INTO NEW OR IMPROVED PAPER AND PAPER PRODUCTS***

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Item No. 579 of 602

**ACCESSION NO:** 0207275 **SUBFILE:** CRIS  
**PROJ NO:** WIS01053 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2005 **TERM:** 30 SEP 2010 **FY:** 2006

**INVESTIGATOR:** Donohue, T.

**PERFORMING INSTITUTION:**  
BACTERIOLOGY

UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

**BIOENERGY RESEARCH**

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Item No. 580 of 602

**ACCESSION NO:** 0207888 **SUBFILE:** CRIS  
**PROJ NO:** WIS01090 **AGENCY:** CSREES WIS  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2006-35504-17436 **PROPOSAL NO:** 2006-02241  
**START:** 01 SEP 2006 **TERM:** 31 AUG 2008 **FY:** 2006 **GRANT YR:** 2006  
**GRANT AMT:** \$285,119

**INVESTIGATOR:** Jeffries, T. W.

**PERFORMING INSTITUTION:**  
BACTERIOLOGY  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***GLOBAL EXPRESSION ANALYSIS OF THE XYLOSE FERMENTING YEAST, PICHIA STIPITIS***

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**ACCESSION NO:** 0208863 **SUBFILE:** CRIS  
**PROJ NO:** WIS01117 **AGENCY:** CSREES WIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW  
**START:** 01 OCT 2006 **TERM:** 30 SEP 2008

**INVESTIGATOR:** de Leon, N.

**PERFORMING INSTITUTION:**  
AGRONOMY  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***EVALUATION OF PHENOTYPIC VARIATION AND IDENTIFICATION OF IMPORTANT REGIONS IN THE GENOME OF CORN ASSOCIATED WITH POTENTIAL ETHANOL PRODUCTION***

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Item No. 582 of 602

**ACCESSION NO:** 0209865 **SUBFILE:** CRIS  
**PROJ NO:** WIS01183 **AGENCY:** CSREES WIS  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** NEW  
**START:** 01 SEP 2007 **TERM:** 30 SEP 2011

**INVESTIGATOR:** Pan, X.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***BIOCONVERSION OF FOREST RESIDUES TO FUEL ETHANOL AND VALUE-ADDED  
COPRODUCTS USING ORGANOSOLV BIOREFINING PLATFORM***

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Item No. 583 of 602

**ACCESSION NO:** 0211291 **SUBFILE:** CRIS  
**PROJ NO:** WIS01243 **AGENCY:** CSREES WIS  
**PROJ TYPE:** MCINTIRE-STENNIS **PROJ STATUS:** EXTENDED  
**START:** 01 AUG 2007 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Pan, X.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***VALUE-ADDED UTILIZATION OF LIGNIN AND HEMICELLULOSE FROM LIGNCELLULOSIC  
ETHANOL PRODUCTION***

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Item No. 584 of 602

**ACCESSION NO:** 0211648 **SUBFILE:** CRIS  
**PROJ NO:** WIS01250 **AGENCY:** CSREES WIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-506  
**START:** 01 AUG 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Ventura, S.

**PERFORMING INSTITUTION:**  
LAND INFORMATION & COMPUTER GRAPHICS  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***SUSTAINABLE BIOREFINING SYSTEMS FOR CORN IN THE NORTH CENTRAL REGION***

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Item No. 585 of 602

**ACCESSION NO:** 0211910 **SUBFILE:** CRIS  
**PROJ NO:** WIS01268 **AGENCY:** CSREES WIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** NEW **MULTISTATE PROJ NO:** NC-506  
**START:** 01 AUG 2007 **TERM:** 30 SEP 2008

**INVESTIGATOR:** Bland, W.

**PERFORMING INSTITUTION:**  
SOIL SCIENCE  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***SUSTAINABLE BIOREFINING SYSTEMS FOR CORN IN THE NORTH CENTRAL REGION***

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Item No. 586 of 602

**ACCESSION NO:** 0212788 **SUBFILE:** CRIS  
**PROJ NO:** WIS01289 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2012

**INVESTIGATOR:** Noguera, D.

**PERFORMING INSTITUTION:**  
GREAT LAKES BIOENERGY RESEARCH CENTER  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***ENERGY RESEARCH***

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Item No. 587 of 602

**ACCESSION NO:** 0212875 **SUBFILE:** CRIS  
**PROJ NO:** WIS01302 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2007 **TERM:** 30 SEP 2012

**INVESTIGATOR:** Donohue, T.

**PERFORMING INSTITUTION:**  
GREAT LAKES BIOENERGY RESEARCH CENTER  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***BIOENERGY RESEARCH***

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Item No. 588 of 602

**ACCESSION NO:** 0213031 **SUBFILE:** CRIS  
**PROJ NO:** WIS01308 **AGENCY:** CSREES WIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** PENDING NEW  
**START:** 01 JAN 2008 **TERM:** 31 DEC 2009

**INVESTIGATOR:** Esker, P.

**PERFORMING INSTITUTION:**  
PLANT PATHOLOGY  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***EFFECT OF CORN PATHOGENS ON CORN PRODUCTIVITY UNDER DIFFERENT CORN-  
SOYBEAN TILLAGE CROPPING SYSTEMS***

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Item No. 589 of 602

**ACCESSION NO:** 0163637 **SUBFILE:** CRIS  
**PROJ NO:** WIS03743 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 OCT 1993 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** McCown, B. H.; Zeldin, E.

**PERFORMING INSTITUTION:**  
HORTICULTURE  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***APPLICATION OF BIOTECHNOLOGY TO CLONALLY PROPAGATED WOODY PERENNIAL  
HORTICULTURAL AND BIOENERGY***

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Item No. 590 of 602

**ACCESSION NO:** 0185792 **SUBFILE:** CRIS  
**PROJ NO:** WIS04414 **AGENCY:** CSREES WIS  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 00-35504-6341 **PROPOSAL NO:** 2000-01869  
**START:** 01 OCT 2000 **TERM:** 30 SEP 2003 **FY:** 2003 **GRANT YR:** 2000  
**GRANT AMT:** \$141,000

**INVESTIGATOR:** Austin-Phillips, S.; German, T. L.; Burgess, R. R.; Ziegelhoffer, T.

**PERFORMING INSTITUTION:**  
BIOTECHNOLOGY CENTER  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***PRODUCTION OF CELLULASES IN TRANSGENIC ALFALFA FOR USE IN BIOMASS  
CONVERSION***

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Item No. 591 of 602

**ACCESSION NO:** 0189207 **SUBFILE:** CRIS  
**PROJ NO:** WIS04517 **AGENCY:** CSREES WIS  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2001-35504-10695 **PROPOSAL NO:** 2001-01418



**START:** 15 SEP 2001 **TERM:** 30 SEP 2004 **FY:** 2004 **GRANT YR:** 2001  
**GRANT AMT:** \$200,000

**INVESTIGATOR:** Jeffries, T. W.

**PERFORMING INSTITUTION:**

BACTERIOLOGY  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***QUANTITATIVE ANALYSIS OF GENE EXPRESSION DURING XYLOSE FERMENTATION BY YEASTS***

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Item No. 592 of 602

**ACCESSION NO:** 0192348 **SUBFILE:** CRIS  
**PROJ NO:** WIS04632 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 APR 2002 **TERM:** 30 SEP 2009 **FY:** 2006

**INVESTIGATOR:** Shinnars, K.

**PERFORMING INSTITUTION:**

BIOLOGICAL SYSTEMS ENGINEERING  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***HARVESTING CORN STOVER FOR BIOMASS/BIOENERGY***

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Item No. 593 of 602

**ACCESSION NO:** 0193675 **SUBFILE:** CRIS  
**PROJ NO:** WIS04698 **AGENCY:** CSREES WIS  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** TERMINATED  
**CONTRACT/GRANT/AGREEMENT NO:** 2003-35504-12875 **PROPOSAL NO:** 2002-01867  
**START:** 15 NOV 2002 **TERM:** 14 NOV 2005 **FY:** 2005 **GRANT YR:** 2003  
**GRANT AMT:** \$220,000

**INVESTIGATOR:** Austin-Phillips, S.

**PERFORMING INSTITUTION:**

BIOTECHNOLOGY CENTER  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

***PRODUCTION OF CELLULASES IN TRANSGENIC ALFALFA FOR USE IN BIOMASS CONVERSION***

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Item No. 594 of 602

**ACCESSION NO:** 0195280 **SUBFILE:** CRIS  
**PROJ NO:** WIS04728 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** EXTENDED  
**START:** 01 JUL 2002 **TERM:** 30 JUN 2010 **FY:** 2006

**INVESTIGATOR:** Reinemann, D. J.

**PERFORMING INSTITUTION:**  
BIOLOGICAL SYSTEMS ENGINEERING  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

*RURAL ENERGY RESEARCH*

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Item No. 595 of 602

**ACCESSION NO:** 0196241 **SUBFILE:** CRIS  
**PROJ NO:** WIS04749 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 SEP 2002 **TERM:** 31 AUG 2011 **FY:** 2006

**INVESTIGATOR:** Weimer, P. J.

**PERFORMING INSTITUTION:**  
BACTERIOLOGY  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

*COMPARATIVE INVESTIGATION OF PHYSIOLOGICAL FEATURES OF CELLULOSE*

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Item No. 596 of 602

**ACCESSION NO:** 0198116 **SUBFILE:** CRIS  
**PROJ NO:** WIS04773 **AGENCY:** CSREES WIS  
**PROJ TYPE:** HATCH **PROJ STATUS:** TERMINATED  
**START:** 01 OCT 2003 **TERM:** 30 SEP 2006 **FY:** 2006

**INVESTIGATOR:** Fortenbery, T. R.

**PERFORMING INSTITUTION:**  
AGRI AND APPLIED ECONOMICS  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

*MEASUREMENT OF LOCAL AND NATIONAL IMPACTS ASSOCIATED WITH AN EXPANDED  
BIO-FUELS INDUSTRY: AN ECONOMICS ANALYSIS*

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Item No. 597 of 602

**ACCESSION NO:** 0209867 **SUBFILE:** CRIS  
**PROJ NO:** WIS04991 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** NEW  
**START:** 01 OCT 2004 **TERM:** 30 SEP 2009

**INVESTIGATOR:** Fortenbery, T. R.

**PERFORMING INSTITUTION:**  
AGRI AND APPLIED ECONOMICS  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

*ECONOMIC ANALYSIS*

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Item No. 598 of 602

**ACCESSION NO:** 0201240 **SUBFILE:** CRIS  
**PROJ NO:** WIS0M209 **AGENCY:** SAES WIS  
**PROJ TYPE:** STATE **PROJ STATUS:** TERMINATED  
**START:** 01 JUL 2004 **TERM:** 30 JUN 2006 **FY:** 2006

**INVESTIGATOR:** Lawless, G. M.; Trechter, D.

**PERFORMING INSTITUTION:**  
COOPERATIVES CENTER  
UNIV OF WISCONSIN  
MADISON, WISCONSIN 53706

*UNDERSTANDING WISCONSIN PRODUCERS' INTERESTS IN OFF-FARM AG-RELATED INVESTMENT*

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Item No. 599 of 602

**ACCESSION NO:** 0210046 **SUBFILE:** CRIS  
**PROJ NO:** WISK-2007-00326 **AGENCY:** CSREES WISK  
**PROJ TYPE:** SMALL BUSINESS GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-33610-17930 **PROPOSAL NO:** 2007-00326  
**START:** 15 MAY 2007 **TERM:** 14 JAN 2008 **GRANT YR:** 2007  
**GRANT AMT:** \$80,000

**INVESTIGATOR:** Akhtar, M.

**PERFORMING INSTITUTION:**  
BIOPULPING INTERNATIONAL, INC.  
P.O. BOX 5463  
MADISON, WISCONSIN 53705

*A NOVEL PROCESS FOR CONVERTING WOOD CHIPS INTO IMPROVED COMPOSITE BOARDS, CHEMICALS AND FUELS*

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**ACCESSION NO:** 0211865 **SUBFILE:** CRIS  
**PROJ NO:** WISN-2007-03790 **AGENCY:** CSREES WISN  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2007-51130-03909 **PROPOSAL NO:** 2007-03790  
**START:** 01 SEP 2007 **TERM:** 31 AUG 2011 **GRANT YR:** 2007  
**GRANT AMT:** \$380,000

**INVESTIGATOR:** Shepard, R. L.

**PERFORMING INSTITUTION:**  
COOPERATIVE EXTENSION  
UNIVERSITY OF WISCONSIN - EXTENSION  
432 N. LAKE STREET  
MADISON, WISCONSIN 53706

*ENERGY INDEPENDENCE, BIOENERGY GENERATION AND ENVIRONMENTAL  
SUSTAINABILITY: THE ROLE OF A 21ST CENTURY ENGAGED UNIVERSITY*

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Item No. 601 of 602

**ACCESSION NO:** 0208071 **SUBFILE:** CRIS  
**PROJ NO:** WISW-2006-06309 **AGENCY:** CSREES WISW  
**PROJ TYPE:** OTHER GRANTS **PROJ STATUS:** EXTENDED  
**CONTRACT/GRANT/AGREEMENT NO:** 2004-45076-01871 **PROPOSAL NO:** 2006-06309  
**START:** 01 JUN 2004 **TERM:** 31 MAY 2008 **GRANT YR:** 2006  
**GRANT AMT:** \$180,576

**INVESTIGATOR:** Smith, G. M.

**PERFORMING INSTITUTION:**  
SW SMALL BUSINESS DEVELOPMENT CENTER  
UNIVERSITY OF WISCONSIN - PLATTEVILLE  
1 UNIVERSITY PLAZA  
PLATTEVILLE, WISCONSIN 53818

*RURAL BUSINESS ENHANCEMENT, WI PROJECT AT THE UNIVERSITY OF WISCONSIN-  
PLATTEVILLE*

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Item No. 602 of 602

**ACCESSION NO:** 0211667 **SUBFILE:** CRIS  
**PROJ NO:** WYO-00596 **AGENCY:** CSREES WYO  
**PROJ TYPE:** NRI COMPETITIVE GRANT **PROJ STATUS:** NEW  
**CONTRACT/GRANT/AGREEMENT NO:** 2008-35107-18681 **PROPOSAL NO:** 2007-03161  
**START:** 15 NOV 2007 **TERM:** 14 NOV 2009 **GRANT YR:** 2008  
**GRANT AMT:** \$100,000

**INVESTIGATOR:** Norton, J. B.; Stahl, P. D.; Kelleners, T. J.; Krall, J. M.; Peck, D. E.; Mount, D. E.;  
Frost, S. M.

**PERFORMING INSTITUTION:**  
RENEWABLE RESOURCES  
UNIVERSITY OF WYOMING  
LARAMIE, WYOMING 82071

***EFFECTS OF CROPPING-SYSTEM-RELATED SOIL MOISTURE AND NUTRIENT DYNAMICS  
ON THE SUSTAINABILITY OF SEMIARID DRYLAND AGRICULTURE***

Terms searched: ((biofuel[?] or biogas[?] or biodiesel[?] or gasohol or ((ethanol\* or alcohol or cellulosic) and fuel[?]) or bioenergy) not (medicin\* or diet[?] or nutrition\* or patient[?])) and (sustain\* OR future? OR century OR "long term" OR renew\* OR continu\* OR economic?)

**CRIS — SELECTED  
PROJECTS SEARCH**



NATIONAL  
AGRICULTURAL  
LIBRARY

**Current Research Information System (CRIS)  
USDA Funded Research – Selected Projects**

Item No. 1 of 59

ACCESSION NO: 0402814 SUBFILE: CRIS

PROJ NO: 5325-41000-037-00D AGENCY: ARS 5325

PROJ TYPE: USDA INHOUSE PROJ STATUS: TERMINATED

START: 12 MAY 1999 TERM: 11 MAY 2004 FY: 2004

INVESTIGATOR: ROBERTSON G H; OFFEMAN R D; ORTS W J; WOOD D F

PERFORMING INSTITUTION:

WESTERN REGIONAL RES CENTER

ALBANY, CALIFORNIA 94710

ENABLING TECHNOLOGIES FOR WHEAT STARCH AND PROTEIN SEPARATION, DRYING,  
AND UTILIZATION

**OBJECTIVES:** Devise large-scale technologies to enable the efficient and environmentally sound separation of wheat starch and protein from wheat flour, evaluate the quality of resulting products and co-products, and determine economic feasibility at different scales. Create and evaluate selective membrane barriers for the separation of ethanol-from-water and water-from-ethanol, and optimize appropriate films by applying chemical or enzymatic treatments. Develop models to improve separation strategies.

**APPROACH:** Invent improved separation concepts combining mechanical separation with fluid displacement methods based on the refrigerated ethanol method developed here, and evaluate scale-up potential. Apply the techniques to simulate pilot and commercial processes and produce large samples of gluten and starch. Use the fractions to quantify quality factors in conventional food uses (such as flour fortification) and in new uses (polymer formulations) that make use of the unique properties. Quality factors include drying rate of gluten; ease of fractionation, protein distribution, protein vitality, and functionality (vis-a-vis bread making). Analyze process potential for solubility-based subfractionation of the protein into gliadin and glutenin fractions. Test highly selective and permeable biomaterial films for their ability to separate ethanol from water and water from ethanol, ensuring that these films can withstand a large pressure drop encountered during industrial pervaporation. Optimize these films by chemical and enzymatic modifications. FY02 Prog. Inc.

**PROGRESS:** 1999/05 TO 2004/05

1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? What does it matter? Over the past twenty years, exports of US wheat have been both unpredictable and declining. A potentially huge market for wheat is the biorefining and bioconversion of wheat into biobased products, including fuel-grade ethanol and fine chemicals. A key biorefining step is the fractionation of the wheat into starch and protein concentrates. Current separation technologies, which produce concentrates of starch and gluten, are costly and have difficulty competing with foreign imports. Contributing to the expense of the commercial methods are: (1) outdated, nonstandard mill technologies; (2) the inefficient use of energy; and (3) the generation of copious amounts of wastewater. This project researches new and relevant separation technologies and systems. One of these is the cold-ethanol process invented at WRRC, in which ethanol serves as a process fluid to largely replace the use of water and reduce energy use. The cold-ethanol method of separation has the potential to reduce energy and water usage, leading to optimal use of all co-product streams. Another important technology is the separation of ethanol and water, which is important to the cold ethanol method, as well as to the eventual production of fuel-grade ethanol from surplus starch. The overall project goal is to improve wheat

refining, increase wheat usage in bioproducts and biofuels (ethanol), and improve grain-to-ethanol processing efficiency. The total value of US wheat exports is 2/3 of its 1987 value, yet the total production has remained constant. The amount of wheat available for domestic non-food use is roughly 30 billion pounds and growing. Of this amount, the US gluten industry currently separates a little more than 2 billion lbs of wheat into starch and protein for food and non-food uses. This represents 58% of the total domestic gluten market; the rest of which is mostly imported from Europe due to their relative cost advantage. The potential of improving separation processes to improve starch and gluten separation would lead to increased domestic production of gluten, reduced imports, and improved attractiveness of all fractionated wheat components including starch for fuel-grade ethanol. Wheat starch as a fermentation feedstock could significantly expand grain-to-ethanol production in the US, help to reduce dependence on imported fuels and toxic oxygenates, and improve the nation's ability to produce ethanol in a wider range of diverse regional locations. Improved energy-efficiency through improved ethanol-water separations is crucial to the future of the wheat biorefinery.

2. List the milestones (indicators of progress) from your Project Plan. (FY 2002)

a. Complete evaluation of lab scale separation using a screening/drying system to model full-scale operation in an analog of the conventional batter process.

b. Complete evaluation of the influence of drying conditions (particularly temperature) on changes to gluten vitality. (FY 2003)

a. Complete development of new project component for using biopolymer membranes to separate ethanol from water during fermentation to fuel- grade ethanol.

b. Complete countercurrent extraction experiments on wheat separation. Evaluate opportunity for pentosan recovery. (FY 2004)

a. Establish new project: biopolymer-based barriers to separate ethanol from water from ethanol fermentation fluids and from cold-ethanol separation of wheat gluten and starch.

b. Establish collaborative research through MU or CRADA for additional evaluation and engineering assessment.

c. Assess current project and develop project plan for next 5 years subject to peer review by OSQR.

3. Milestones: FY (2003)

a. Completed countercurrent extraction experiments on wheat separation. Evaluated opportunity for pentosan recovery. Substantial progress. Reevaluation of this milestone suggested a more critical need for compositional studies including the assessment of soluble and insoluble protein removed during the washing of dough with cold ethanol. These studies were completed. Collaboration has been formed with WRRRC scientist to assist in the pentosan assessment.

FY (2004)

a. Established new project: biopolymer-based barriers to separate ethanol from water from ethanol fermentation fluids and from cold-ethanol separation of wheat gluten and starch. Successfully met. New support position filled and analytical instrumentation installed and tested. Literature analysis of ethanol- selective membranes substantially completed and experimentation initiated.

b. Established collaborative research using Memorandum of Understanding or CRADA for additional evaluation and engineering assessment. Successfully met. Three companies with interest in barrier separations, plant design, and grain refining have indicated the desire in writing to collaborate with us in the evaluation and development of this research.

c. Assess current project and develop project plan for next 5 years subject to peer review by OSQR. Successfully met. New project plan formulated and in final evaluation received the highest scoring level by peer panel.

B. Refer to the annual report for new CRIS project, pending OSQR process completion.

4. What were the most significant accomplishments this past year?

A. Single Most Significant Accomplishments With unpredictable and declining exports of US wheat over the past 20 years, creation of new markets for US wheat hinges on efficiently separating or biorefining this grain into its constituents to optimize its value as a feedstock for bioproducts, fine chemicals and ethanol. Researchers at Western Regional Research Center (WRRRC) developed and scaled-up cold-ethanol based methods for separating and refining wheat into its major constituents. During this year WRRRC researchers developed and implemented technology that resulted in the ability to track each protein constituent and to identify how ethanol composition and temperature affected the removal, quality and end-use value of each protein. This new knowledge is being used to predict the full-scale capability of this process, define the separation equipment required, and to facilitate industrial adoption of improved wheat bio-refining.

B. Other Significant Accomplishments Barrier-based separation of ethanol and water is critical in all ethanol fermentation processes, and thus has widespread implications. It is particularly pertinent in the present research because of the need to manage ethanol concentrations in the cold ethanol starch/gluten separation with the requirement to eliminate added processing water. Researchers at WRRRC, Albany invented a "New Filtering Device Utilizing a Combination of Membrane Materials which Allows for Selective Isolation of Target Compounds from a Production Stream" which can be used for separating ethanol from fermentation broths. This invention, which has been approved by the Area-wide Patent Committee and will be filed shortly, is based on experimental evaluation of ethanol-selective extractants as components of a novel hybrid barrier system employing both selective barriers and solvent extraction.

C. Significant Accomplishments/Activities that Support Special Target Populations None.

D. Progress Report Barrier-based separation of ethanol and water: This effort is critical in all ethanol fermentation processes,



and thus has widespread implications. A complete overview and analysis of the existing barrier literature is substantially complete. We initiated experimental evaluation of ethanol- selective extractants as components of a novel hybrid barrier system employing both selective barriers and solvent extraction.

Wheat separation: Kilogram-scale wheat separation methods are now regularly employed to disperse and separate wheat fractions using enclosed vibratory screening. In addition to producing high quality vital gluten, this process has the added benefit of creating separate phases in the chilled ethanol starch "wash-off" that contain pentosans and soluble and insoluble protein. An improved understanding of the composition of the wash-off is important in the identification of co-product and process equipment and was sought during this period. Recovery of these components could have important implications to the overall attractiveness of the cold-ethanol method eg. the pentosans have specific food-ingredient and potential health benefits. Differences in both starch and protein functionality/composition between cold-ethanol-produced and water- produced vital products continue to be studied. Using the cold-ethanol process, gluten properties are generally better, and starch is more specifically fractionated into its morphological components, such as A- type starch, B-type starch. New processing capabilities have been acquired, installed, and tested by the team, including a solvent ready basket centrifuge, a solvent-ready decanter centrifuge, and capillary electrophoresis. Substantial progress was made in the development of thermoformed gluten polymers. A variety of crosslinking and formulation strategies were assessed for their impact on elastic properties of these pliable polymers.

5. Describe the major accomplishments over the life of the project, including their predicted or actual impact. This project developed the fundamental basis for optimally separating wheat components in non-aqueous ethanol systems. It established significant new knowledge about the material and chemical properties of sensitive proteins and natural protein combinations following exposure to ethanol. This information is crucial to the development of the novel cold-ethanol method patented by WRRRC. Specific accomplishments include: (1) discovery that the cold ethanol extraction method improves wheat gluten quality as determined in farinograph, mixograph, and baking evaluations. It maintains quality through severe drying conditions, (2) definition of the use of novel "dough-ball" and "dispersed-batter" methods for the production of wheat gluten concentrates, and (3) development of new fundamental knowledge about selective protein solubility and the composition of proteins in processing fluids applied to developed wet-dough. As a whole, these findings provide critical support for adoption of the cold-ethanol method as a processing technology that can produce improved wheat quality. This should lead to market advantages for domestically- produced wheat components. Further, the body of information developed within this project has recently stimulated interest by grain processing companies for further investigation. Advancement of this technology will require preliminary costing, further process definition and small pilot- scale evaluations. In addition, these findings help to improve the fundamental understanding of the chemical and functional properties of native and processed wheat fractions. The accomplishments were reported in 7 publications and one patent with additional manuscripts in preparation. Oral presentations and individual meetings with company representatives have been included in the ongoing effort to effect technology transfer. Substantially all scientific milestones have been, or will be addressed in these publications. This project was consistent with two components of the National Program 306 Action Plan (a) "New knowledge derived from improved understandings of the structure, properties, metabolism, and function of crop and animal components, particularly carbohydrates, proteins, and lipids, will generate development of a variety of new food, feed, and industrial products." and (b) "New technologies to convert commodities and processing byproducts into important value-added products such as fat substitutes, high-quality animal feeds, improved textiles, pharmaceutical ingredients, enzymes, and cosmetics will fill demonstrated needs." This project was consistent with two components of the National Program 307 Action Plan (a) "New technologies that integrate feedstock pretreatment, biological conversion and product recovery processes, as well as fundamental knowledge regarding fermentation, milling and membrane separations. The information gained will result in a reduction in capital and processing costs associated with biofuel production." (b) "Higher value coproducts generated from current low-value production byproducts. Envisioned coproducts include specialty oils, novel polysaccharides that will compete with imported gums, sugar alcohol food additives that are currently imported, enzymes, and inexpensive aquaculture feeds."

6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? The technology is currently available through patent and publications. Information has been conveyed to a number of interested companies through reference to web summaries, printed brochures and personal discussions at trade related meetings such as the Fuel Ethanol Workshop and the Corn Utilization and Technology Conference held this year. Particular targets have been grain-processing companies and design firms. Constraints: the separation technology affects many parameters of the overall

process system and would require retirement of complex existing facilities and installation of new processing operations. Therefore, reliable data on product quality, drying properties, etc. and larger scale evaluations are essential to implementation. The technology may become available for small-pilot evaluation (outside WRRC) within the next 1-2 years as scale-up experiments proceed. 7. List your most important publications in the popular press and presentations to organizations and articles written about your work. "Creating and capturing total value of agricultural resources for biofuels and biobased products." 8pp. Posted at <http://www.pw.usda.gov>. Also distributed as brochure at trade meetings.

PUBLICATIONS (not previously reported): 1999/05 TO 2004/05

1. Robertson, G.H., Cao, T.K. Effect of processing on functional properties of wheat gluten prepared by cold-ethanol displacement of starch. *Cereal Chemistry*. 2003. v. 80. p. 212-217.
2. Robertson, G.H., Cao, T.K. Mixograph responses of gluten and gluten-fortified flour for gluten produced by cold-ethanol or water displacement of starch from wheat flour. *Cereal Chemistry*. 2002. v. 79. p. 737-740.
3. Robertson, G.H., Cao, T.K. Options and opportunities for Biorefining of Wheat. American Institute of Chemical Engineers. 2002. Abstract Page No. 293a.
4. Robertson, G.H., Cao, T.K. Altering gluten mixing and baking quality by method of separation and drying. American Association of Cereal Chemists. 2002. Abstract No. 419.

Item No. 2 of 59

ACCESSION NO: 0408878 SUBFILE: CRIS

PROJ NO: 5325-41000-045-00D AGENCY: ARS 5325

PROJ TYPE: USDA INHOUSE PROJ STATUS: TERMINATED

START: 12 MAY 2004 TERM: 06 JUN 2005 FY: 2005

INVESTIGATOR: ROBERTSON G H; OFFEMAN R D; ORTS W J; WOOD D F

PERFORMING INSTITUTION:

WESTERN REGIONAL RES CENTER

ALBANY, CALIFORNIA 94710

ENABLING TECHNOLOGIES FOR WHEAT STARCH AND PROTEIN SEPARATION, DRYING, AND UTILIZATION

OBJECTIVES: Devise large-scale technologies to enable the efficient and environmentally sound separation of wheat starch and protein from wheat flour, evaluate the quality of resulting products and co-products, and determine economic feasibility at different scales. Create and evaluate selective membrane barriers for the separation of ethanol-from-water and water-from-ethanol, and optimize appropriate films by applying chemical or enzymatic treatments. Develop models to improve separation strategies.

APPROACH: Invent improved separation concepts combining mechanical separation with fluid displacement methods based on the refrigerated ethanol method developed here, and evaluate scale-up potential. Apply the techniques to simulate pilot and commercial processes and produce large samples of gluten and starch. Use the fractions to quantify quality factors in conventional food uses (such as flour fortification) and in new uses (polymer formulations) that make use of the unique properties. Quality factors include drying rate of gluten; ease of fractionation, protein distribution, protein vitality, and functionality (vis-a-vis bread making). Analyze process potential for solubility-based subfractionation of the protein into gliadin and glutenin fractions. Test highly selective and permeable biomaterial films for their ability to separate ethanol from water and water from ethanol, ensuring that these films can withstand a large pressure drop encountered during industrial pervaporation. Optimize these films by chemical and enzymatic modifications. Formerly 5325-41000-037-00D (07/04).

PROGRESS: 2004/05 TO 2005/06

1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? What does it matter? Over the past twenty years, exports of US wheat have been both unpredictable and declining. A potentially huge market for wheat is the biorefining and bioconversion of wheat into biobased products, including fine chemicals and fuel-grade ethanol. A key biorefining step is the fractionation of the wheat into starch and protein concentrates. Current separation

technologies, which produce concentrates of starch and gluten, are costly and have difficulty competing with foreign imports. Contributing to the expense of the commercial methods are: (1) outdated, nonstandard mill technologies; (2) the inefficient use of energy; and (3) the generation of copious amounts of wastewater. This project researches new and relevant separation technologies and systems. One of these is the cold-ethanol process invented at WRRRC, in which ethanol serves as a process fluid to largely replace the use of water and reduce energy use. The cold-ethanol method of separation has the potential to reduce energy and water usage, leading to optimal use of all co-product streams. Another important technology is the separation of ethanol and water, which is important to the cold ethanol method, as well as to the eventual production of fuel-grade ethanol from surplus starch. The overall project goal is to improve wheat refining, increase wheat usage in bioproducts and biofuels (ethanol), and improve grain-to-ethanol processing efficiency. The total value of US wheat exports is 2/3 of its 1987 value, yet the total production has remained constant. The amount of wheat available for domestic non-food use is roughly 30 billion pounds and growing. Of this amount, the US gluten industry currently separates a little more than 2 billion lbs of wheat into starch and protein for food and non-food uses. This represents 58% of the total domestic gluten market; the rest of which is mostly imported from Europe due to their relative cost advantage. The potential of improving separation processes to improve starch and gluten separation would lead to increased domestic production of gluten, reduced imports, and improved attractiveness of all fractionated wheat components including starch for fuel-grade ethanol. Wheat starch as a fermentation feedstock could significantly expand grain-to-ethanol production in the US, help to reduce dependence on imported fuels and toxic oxygenates, and improve the nation's ability to produce ethanol in a wider range of diverse regional locations. Improved energy-efficiency through improved ethanol-water separations is crucial to the future of the wheat biorefinery. This is a bridging project from 5325-41000-037-00D to 5325-41000-047-00D. 2. List the milestones (indicators of progress) from your Project Plan. This project is being terminated and replaced by 5325-41000-047-00D. Please see the report for 5325-41000-047-00D for milestones. 3a List the milestones that were scheduled to be addressed in FY 2005. For each milestone, indicate the status: fully met, substantially met, or not met. If not met, why. 1. This project is being terminated and replaced by 5325-41000-047-00D. Please see the report for 5325-41000-047-00D for milestones. Milestone Substantially Met 3b List the milestones that you expect to address over the next 3 years (FY 2006, 2007, and 2008). What do you expect to accomplish, year by year, over the next 3 years under each milestone? This project is being terminated and replaced by 5325-41000-047-00D. Please see the report for 5325-41000-047-00D for milestones. 4a What was the single most significant accomplishment this past year? Recovery of ethanol from water solutions is critical for fuel ethanol production and use of ethanol as a biorefining solvent in wheat fractionation. The energy balance for ethanol production using standard technology, distillation, is energy-intensive. Solvent extraction and membrane permeation are two low-energy alternatives. Researchers at WRRRC, Albany have screened a large number of solvents for performance in extracting ethanol, including a variety of biobased solvents, and have developed structure/performance correlations useful for prediction. This has led to discovery of several solvents with significantly better extraction performance than those typically considered for this application. 4b List other significant accomplishments, if any. The use of wheat as a platform to produce new biobased products and biofuels can be advanced with the ability to produce stable and enriched wheat gluten protein subfractions with non-varying compositions and properties. These could be used as platform chemicals. WRRRC scientists have conducted extraction studies to assess the separation of wheat gluten components using ethanol and reduced temperatures that lower the risk of protein denaturation; hence, both food and non-food markets may be met. The data obtained by capillary electrophoresis of flour extracts provide composition maps useful to the design of separation processes. 4d Progress report. Wheat Fractionation: Wheat protein and protein fraction solubility at low temperatures has not been previously reported except for very broad classes of protein. This information was acquired to develop strategies for fractionation of narrow classes of protein that can potentially be recombined without loss of functionality. The adoption of the technologies being developed here are partially dependent on valuation of the fractions produced. This is especially true for wheat gluten intended for bread flour fortification. We have elicited collaboration from a domestic producer, importer, and supplier of wheat gluten and have processed about 75 kilo of flour to produce both water-based and cold-ethanol based gluten from two commercial sources of flour (the collaborator and a local ingredient supplier). Samples will be provided to the collaborator and others expressing interest. Ethanol-Extraction Solvents: The reasons why isomers of the higher alcohol solvents show differences in ethanol extraction performance are unknown. Molecular simulation is being used to determine if intermolecular associations between solvent molecules, and between solvent, water, and ethanol molecules, can explain these observations. Preliminary indications are very positive, and will be a significant improvement in understanding the fundamentals of solvent performance. Membrane

Permeation: Membrane processes for recovery of ethanol from water solutions are attractive due to their low energy requirements, compared to distillation. Currently available ethanol-selective membranes cannot economically compete with distillation because of their low throughput, requiring large membrane area. Supported liquid membranes, and mixed matrix membranes incorporating fine particles into the polymer, can have enhanced properties compared to standard polymer membranes. We have built an apparatus for measuring the permeation performance of membranes, and have instituted preparation of new membranes for evaluation. A patent application, "Spiral-Wound Liquid Membrane Module for Separation of Fluids and Gases" has been filed.

5. Describe the major accomplishments over the life of the project, including their predicted or actual impact. This is a bridging project. Prior reports for the parent project may be found in annual reports for project 5325-41000-037-00D and the continuation is found in 5325-41000-047-00D. The parent project developed the fundamental basis of separability of wheat components in non-aqueous ethanol systems and established significant new knowledge about the material and chemical properties of sensitive proteins and natural protein combinations following exposure to ethanol. This information is crucial to the development of the novel cold-ethanol method patented by WRRC. Specific accomplishments include: (1) discovery that the cold ethanol extraction method improves wheat gluten quality as determined in farinograph, mixograph, and baking evaluations, and maintains quality through severe drying conditions, and (2) definition of the use of novel "dough-ball" and "dispersed-batter" methods for the production of wheat gluten concentrates, and (3) development of new fundamental knowledge about selective protein solubility and the composition of proteins in processing fluids applied to developed wet-dough. As a whole, these findings provide critical support for adoption of the cold-ethanol method as a processing technology that can produce improved quality. This should lead to market advantages for domestically-produced wheat components. Further, the body of information developed by us has recently stimulated interest by both process development and grain processing companies for further investigation. Advancement of this technology will require preliminary costing, further process definition and small pilot-scale evaluations. In addition, these findings help to improve the fundamental understanding of the chemical and functional properties of native and processed wheat fractions. The accomplishments were reported in 10 peer reviewed publications and one patent with additional manuscripts in preparation. Oral presentations and individual meetings with company representatives have been included in the ongoing effort to effect technology transfer. Substantially all scientific milestones have been, or will be addressed in these publications. This project was consistent with two components of the National Program 306 Action Plan: (a) "New knowledge derived from improved understandings of the structure, properties, metabolism, and function of crop and animal components, particularly carbohydrates, proteins, and lipids, will generate development of a variety of new food, feed, and industrial products." and (b) "New technologies to convert commodities and processing byproducts into important value-added products such as fat substitutes, high-quality animal feeds, improved textiles, pharmaceutical ingredients, enzymes, and cosmetics will fill demonstrated needs." This project was consistent with two components of the National Program 307 Action Plan: (a) "New technologies that integrate feedstock pretreatment, biological conversion and product recovery processes, as well as fundamental knowledge regarding fermentation, milling and membrane separations. The information gained will result in a reduction in capital and processing costs associated with biofuel production." and (b) "Higher value coproducts generated from current low-value production byproducts. Envisioned coproducts include specialty oils, novel polysaccharides that will compete with imported gums, sugar alcohol food additives that are currently imported, enzymes, and inexpensive aquaculture feeds."

6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? The technology is currently available through patent and publications. Information has been conveyed to a number of interested companies through reference to web summaries, printed brochures and personal discussions at meetings such as the Fuel Ethanol Workshop (June 2005) and the 4th Starch Utilization Technology Conference (June 2005). Scientists on the staff have been invited to make oral reports for staff of a principal firm involved with ethanol plants. Particular targets have been grain processing companies and design firms. Constraints: the separation technology affects many parameters of the overall process system and would require retirement of complex existing facilities and installation of new processing operations. Therefore, reliable data on product quality, drying properties, etc. and larger scale evaluations are essential to implementation. The technology may become available for small-pilot evaluation (outside WRRC) within the next 2-3 years as scale-up experiments proceed.

PUBLICATIONS (not previously reported): 2004/05 TO 2005/06

1. Wong, D., Batt, S.B., Lee, C.C., Robertson, G.H. Rapid selection of alpha- amylase mutants in yeast libraries for raw starch activity. 2003. Society of Biomolecular Screening Annual Conference, Portland, Oregon.
2. Wong, D., Batt, S.B., Lee, C.C., Robertson, G.H. Engineering apha-amylase for enhanced activity by molecular evolution. American Society of Biochemistry and Molecular Biology Annual Meeting, June 12-16, 2004, Boston, Massachusetts. Abstract No. B38.
3. Wong, D., Batt, S.B., Lee, C.C., Robertson, G.H. 2004. Direct screening of libraries of yeast clones for alpha-amylase activity on raw starch. *Journal of Biomolecular Screening*. 10:459-468.
4. Robertson, G.H., Cao, T. 2004. Proteins extracted by water or aqueous ethanol during refining of developed wheat dough to vital wheat gluten and crude starch as determined by capillary-zone electrophoresis (cze). *Cereal Chemistry*. 81(5):673-680.

Item No. 3 of 59

ACCESSION NO: 0409351 SUBFILE: CRIS  
 PROJ NO: 5325-41000-046-00D AGENCY: ARS 5325  
 PROJ TYPE: USDA INHOUSE PROJ STATUS: NEW  
 START: 24 MAR 2005 TERM: 23 MAR 2010 FY: 2006

INVESTIGATOR: WONG D; LEE C C; SMITH M R; WAGSCHAL K C; WOOD D F

PERFORMING INSTITUTION:  
 WESTERN REGIONAL RES CENTER  
 ALBANY, CALIFORNIA 94710

#### EVOLUTIONARY ENZYME DESIGN FOR IMPROVED BIOREFINING OF CROPS AND RESIDUES

**OBJECTIVES:** Objective 1: Develop novel starch-degrading enzymes and enzyme-based systems that can convert starch from corn, wheat, and barley to glucose more efficiently. The aim is to improve activity at low pH, and increase catalytic conversion to lower the chemical and energy cost of liquefaction and saccharification. Objective 2: Develop novel enzymes and enzyme-based systems for solubilization and saccharification of hemicellulose components of corn fibers, crop residues, straws and grasses to simple sugars. Special focus will be to engineer high activity xylanases with decreased end-product inhibition and that can be produced in microbes, which make active cellulases. Objective 3: Utilize and evaluate the evolved enzymes and enzyme systems for the hydrolysis of corn, wheat, and barley starch (Objective 1) and solubilization and saccharification of hemicellulose components of corn fibers, crop residues, straws, and grasses (Objective 2) in laboratory and pilot scale operations. The improved enzymes will be evaluated on industrial substrates. Large-scale process development will be conducted in collaboration with corn ethanol companies.

**APPROACH:** New biocatalysts are created through directed evolution, in which libraries of enzyme variants are created by the mutation of encoding genes. The libraries are screened for target properties, and the candidate molecules selected can further undergo cycles of mutation, amplification, and selection until the desired enzyme variant is obtained. To create novel starch-degrading enzymes toward improved performance, the following steps are involved: (1) isolate, clone and express amylase genes; (2) mutate the gene sequences to create libraries; (3) screen the libraries for desired functions; (4) Purify the evolved enzymes for biochemical studies; (5) define the structure-function relationship; and (6) construct novel hybrid enzymes. To develop enzymes for the solubilization of hemicelluloses, the following approach is used: (1) screen by molecular techniques for a full set of genes encoding xylanolytic enzymes that are individually or collectively highly active in xylan degradation; (2) clone and express the genes in suitable expression systems; (3) conduct directed evolution by computational and experimental enzyme mutation; (4) purify the evolved enzymes for biochemical studies; (5) test the enzymes by combinatorial approaches; and (6) produce the enzymes in microbial systems which also produce active cellulases. As the best-fit enzymes are evolved and selected, the enzyme will be purified to homogeneity for the determination of kinetic properties. A variety of microscopic techniques will be applied to elucidate the action of the individual enzymes developed in this research. Several formats of bench scale enzyme reactions will be evaluated. These include liquefaction and saccharification as a distinct process, liquefaction and saccharification integrated with fermentation, and differentiated liquefaction and saccharification at high solids concentrations. Replacing 5325-41000-041-00D (February 2005).

PROGRESS: 2005/10 TO 2006/09

Progress Report 1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? Why does it matter? This project is aligned with National Program 307 Bioenergy and Energy Alternatives and also contributes to National Program 306 Quality and Utilization of Agricultural Products. The conversion of crop components--corn or wheat starch, grain fiber, and crop residue--to a fermentation feedstock for the production of high value products such as ethanol always involves partial disassembly of natural polymers to achieve solubility and full disassembly to simple sugars like glucose or xylose. For grain starches this is accomplished by cooking followed by a two-step enzyme reaction. For fibers and residues this begins with a process like acid hydrolysis and is followed by enzymatic conversion of the cellulose to glucose. These disassembly steps are energy intensive and costly. This research seeks to reduce or eliminate the disassembly costs by developing new enzymes for these tasks using the emerging methodology of directed molecular evolution. The goal is to provide alternate polymer disassembly methods for fuel and chemical fermentation and sweetener manufacture. Currently the US grain ethanol industry produces nearly 3 billion gallons of ethanol per year. This is from corn grain (85-90%) or from wheat grain (10-15%). Grains or their starch granules are cooked and enzymatically converted with the use of 10-15% of the fuel value of the ethanol from the fermentation. This energy could be saved by the elimination of the cooking step. Grain fibers and straw residues also may be disassembled to monomer sugars for fermentation feedstock, but even more energy-intensive and enzyme-intensive operations keep the cost higher than that for grains. These low cost and plentiful sources of fermentable sugars have been of interest because of their potential for increasing the contribution of renewable fuels in the United States. Energy cost reduction was the highest priority action item for ethanol producers at the 17th International Fuel Ethanol Workshop (2001). Conversion to glucose is also an integral part of other fermentation processes such as those leading to isomerized glucose and sweeteners.

2. List by year the currently approved milestones (indicators of research progress) Year 1 (FY 2005). For amylases: (1) Isolation, cloning and expression of amylase genes; (2) Initiate directed evolution experiments to create libraries of mutants; (3) Initiate screening of libraries for desired activity; (4) Initiate purification of evolved enzymes for biochemical studies. For hemicellulases: (1) Initiate isolation by molecular techniques for a full set of genes encoding xylanolytic enzymes that are individually or collectively highly active in xylan degradation. Year 2 (FY 2006). For amylases: (1) Complete cloning and expression of individual amylases; (2) Continue directed evolution on individual amylases based on initial biochemical studies; (3) Initiate construction of hybrid enzymes; (4) Continue purification of evolved enzymes for biochemical studies; (5) Initiate kinetic evaluation of evolved enzymes. For hemicellulases: (1) Continue screening more environmental genomic DNA libraries; (2) Clone and express the genes in suitable expression systems; (3) Initial development of high-throughput assays for the discovery of hemicellulases; (4) Initiate directed evolution experiments. Year 3 (FY 2007). For amylases: (1) Complete directed evolution on individual amylases; (2) Complete purification of evolved enzymes; (3) Complete construction of hybrid enzymes; (4) Complete kinetic evaluations on individual enzymes; (5) Initiate directed evolution on hybrid enzymes; (6) Initiate scale-up purification and characterization using bioreactors. For hemicellulases: (1) Continue screening of microbial genomic libraries for novel enzymes; (2) Complete cloning and expressing the key enzymes in xylan degradation; (3) Continue directed evolution experiments. Year 4 (FY 2008). For amylases: (1) Complete directed evolution on hybrid enzymes; (2) Conduct scale-up production; (3) Test new enzymes by combinatorial approaches; (4) Initiate pilot scale fermentation. For hemicellulases: (1) Complete screening and isolation of enzymes from genomic libraries; (2) Complete biochemical studies of individual enzymes; (3) Produce the xylanolytic enzymes in microbial systems that co-express active cellulases; (4) Initiate scale-up purification and characterization of enzymes individually and combinatorially. Year 5 (FY 2009). For amylases: (1) Continue testing new enzymes; (2) Continue studies on pilot scale fermentation; (3) Continue process evaluation. For hemicellulases: (1) Conduct development of microbial systems co-expressing active cellulases and xylanolytic enzymes; (2) Perform scale-up enzyme purification and characterization; (3) Optimize conditions and enzyme combinations for high efficiency biomass degradation.

4a List the single most significant research accomplishment during FY 2006. Starch-degrading enzymes work synergistically at low temperatures: This project is aligned with National Program 307 - Bioenergy and Energy Alternatives: Component 1: Ethanol and NP306 - Quality and Utilization of Agricultural Products: Component II.(d)New and Improved Processes and Feedstocks: A key energy intensive and costly step in the bioconversion of starch is high temperature cooking of the starch granules so that they can be fermented rapidly. BCE scientists cloned and characterized raw starch-degrading enzymes that act synergistically at low temperatures and eliminate the need for cooking. This research leads to markedly improved economy

and efficiency in biofuel production from starches thus with the potential to increase markets for cereal crops and reduce dependence on foreign oil. 4b List other significant research accomplishment(s), if any. High-throughput assays validated for enzyme screening: This project is aligned with National Program 307 - Bioenergy and Energy Alternatives:Component 1: Ethanol and NP306 - Quality and Utilization of Agricultural Products: Component II.(d)New and Improved Processes and Feedstocks. A significant problem for making fuels and chemicals from biomass is the lack of suitable, highly efficient enzymes for breaking the biomass down so that it can be chemically or biologically converted. Furthermore, finding new enzymes for converting biomass into fuels and chemicals is hampered by the lack of appropriate high-throughput screening techniques. BCE scientists developed assays for the detection and characterization of enzymes using natural substrates and especially a high-throughput assay for screening enzymes for starch and biomass degradation and utilization. The screening technique will accelerate the discovery and isolation of improved enzymes that are key to the production of biofuels and chemicals. 5. Describe the major accomplishments to date and their predicted or actual impact. This project is aligned with National Program 307 - Bioenergy and Energy Alternatives:Component 1: Ethanol and NP306 - Quality and Utilization of Agricultural Products: Component II.(d)New and Improved Processes and Feedstocks. Scientific firsts for this project include: first expression of active barley- amylase in yeast, first expression of barley alpha-amylase in E. coli, first application of directed molecular evolution to plant source enzyme, first attempt to utilize directed molecular evolution on enzymes as large as those of the amylase family. Specific major project accomplishments include the following. (1) Isolated both low and high pI alpha-amylase genes from barley cDNA library. (2) Constructed the barley gene into suitable vectors to achieve expression in yeasts and E. coli. (3) Selected and identified peptide ligands that bind to barley low pI alpha-amylase. (4) Purified alpha-amylase and identified a putative raw starch binding domain. (5) Expressed the functional raw starch-binding domain in E. coli and yeast. (6) Developed a novel assay for monitoring enzymatic digestion of solid substrates. (7) Developed immunodetection methods to quantify recombinant amylase in individual clones, which enable the fine analysis of enzyme activities. (8) Isolated a glucoamylase gene, and cloned it into *Saccharomyces* for expression. (9) Construction and screening of libraries and tens of thousands of mutants leading to several enzyme clones with increase in total activity. (10) Isolated more than 20 novel genes of xylanolytic enzymes by direct screening of genome collections of microbial populations in unique ecological environments. (11) Developed novel solid-phase assays for functional selection of genes in metagenomic libraries. (12) Developed activity assays for alpha-xylooxidase and other xylanolytic enzymes using natural substrates that can be adapted to high-throughput formats. (13) Cloned and expressed several xylanolytic enzymes (endo-xylanase, alpha-xylosidase, arabinofuranosidase, ferulic acid esterase, acetylxyloxyesterase, and endoglucanase), some of which are bifunctional enzymes, in E. coli or yeast systems. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end-user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? We have established collaboration with a corn ethanol producer to test our improved enzymes. This work has collaborations with (1) faculties in the Animal Science Department and in the Department of Molecular and Cellular Biology at the University of California, Davis, and (2) faculties at the University of Saskatchewan. This work also has co-investigations with faculties of the University of Kentucky on State of Kentucky and NRI grants. Our work also results in Material Transfer Agreements with faculty members in Italy, and other scientists in the United States. A CRADA has been started this year working on key xylanolytic enzymes. A second CRADA is also in place, working on starch hydrolysis. 7. List your most important publications in the popular press and presentations to organizations and articles written about your work. (NOTE: List your peer reviewed publications below). (1) "Break it Down Now" by Jessica Williams summarizing oral presentation at June 2005 meeting. January 2006 issue ([http://www.ethanol-producer.com/article.jsp?article\\_id=319&q=robertson&category\\_id=37](http://www.ethanol-producer.com/article.jsp?article_id=319&q=robertson&category_id=37)); and (2) Long summary of JAgFoodChem. "Native Starch Digestion..." Biofuels Journal. by Susan Reidy. January-March issue. 2006. Hemicellulose: (1) "USDA Researchers Modifying Yeast for Cellulosic Ethanol Production" Green Car Congress © 2006 BioAge Group, LLC ([http://www.greencarcongress.com/2005/11/usda\\_researcher.html](http://www.greencarcongress.com/2005/11/usda_researcher.html)); (2) A Mushrooming Approach for Biofuels, <http://www.renewableenergyaccess.com/rea/news/story?id=40154>; (3) Better ethanol production through GM technology <http://archives.foodsafetynetwork.ca/agnet/2005/11-2005/agnet.nov.30.html>.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09

1. Wong, D., Batt, S.B., Lee, C.C., Wagschal, K.C., Robertson, G.H. 2005. Characterization of active *lentinula edodes* glucoamylase expressed and secreted by *saccharomyces cerevisiae*. Protein Journal. vol 24, pp 455-463.

2. Wong, D. Feruloyl esterase - a key enzyme in biomass degradation. 2005. Applied Biochemistry and Biotechnology, 133:87-112.
3. Wagschal, K.C., Franqui Espiet, D., Lee, C.C., Robertson, G.H., Wong, D. 2005. Enzyme-coupled assay for beta-xylosidase hydrolysis of natural substrates. Applied and Environmental Microbiology. 71:5318-5323.
4. Robertson, G.H., Wong, D., Lee, C.C., Wagschal, K.C., Smith, M.R., Orts, W. J. 2006. Native or raw starch digestion: A Key step in energy efficient biorefining of grain. Journal of Agricultural and Food Chemistry, 54:353- 65.
5. Smith, M.R., Zahnley, J.C. 2005. Production of amylase by arthrobacter psychrolactophilus. Journal of Industrial Microbiology and Biotechnology. 32:277-283:56
6. Smith, M.R., Zahnley, J.C. 2005. Characteristics of the amylase of arthrobacter psychrolactophilus. Journal of Industrial Microbiology and Biotechnology, 32:439-448.
7. Lee, C.C., Smith, M.R., Accinelli, R., Williams, T.G., Wagschal, K.C., Wong, D., Robertson, G.H. 2006. Isolation and characterization of a psychrophilic xylanase enzyme from flavobacterium sp. Current Microbiology, 52(2):112-116.
8. Wong, D., Robertson, G.H., Lee, C.C., Wagschal, K.C. 2006. Synergistic action of barley alpha-amylase and lentinula edodes glucoamylase on raw starch hydrolysis. Approved 10/27/2005. American Society of Biochemistry & Molecular Biology, San Francisco, CA. April 1-4, 2006, Program 73.16, vol A27.
9. Lee, C.C., Accinelli, R., Wagschal, K.C., Robertson, G.H., Wong, D. 2006. Cloning and characterization of cold-active xylanase enzymes. 28th Symposium on Biotechnology for Fuels and Chemicals. Paper No. 1A-41.
10. Robertson, G.H., Wong, D. 2005. Raw starch digestion or non-cooking breakdown of starch prior to fermentation. Fuel Ethanol Workshop and Trade Show, June 28, 2005, Kansas City, MO. Paper No.8:1.

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ACCESSION NO: 0067383 SUBFILE: CRIS  
 PROJ NO: CA-D\*-MCB-3146-H AGENCY: CSREES CALB  
 PROJ TYPE: HATCH PROJ STATUS: REVISED  
 START: 01 OCT 2006 TERM: 30 SEP 2011 FY: 2006

INVESTIGATOR: Doi, R. H.

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#### STRUCTURE, FUNCTION, AND REGULATION OF CLOSTRIDIUM CELLUVORANS CELLULASE

**NON-TECHNICAL SUMMARY:** We will investigate the structure and function of the Clostridium cellulovorans cellulosome - an extracellular enzyme complex that can degrade plant cell walls. The efficient degradation of plant biomass can lead to alternate sources of fuel energy such as ethanol. The rate limiting step is the degradation of plant cell wall material by enzymes to sugars. Since the cellulosome contains a large number of cellulolytic enzymes and the composition can vary, we will determine which combination of enzymes can be most active in the degradation of plant cell walls. Furthermore we will try to convert non-cellulose degraders to cellulose degraders. This could lead to utilization of agricultural waste as inexpensive substrates for the synthesis of value-added products.

**OBJECTIVES:** Studies on synergism between Clostridium cellulovorans cellulosomal cellulases and hemicellulases to improve the function of cellulosomes. Production of more efficient C. cellulovorans cellulosomes by in vitro and in vivo methods. Designer cellulosomes will be constructed by genetic engineering and by growth of the organism on specific substrates. Conversion of non-cellulose utilizers to cellulose degrading organisms. We will convert Bacillus subtilis into a cellulose user. This could serve as a model system to convert industrially important organisms into cellulose utilizers and result in use of less expensive substrates for the production of valuable products.

**APPROACH:** We have cloned and sequenced five family 9 and two family 5 glycosyl hydrolase genes. We will add his tags to these genes and express and produce these enzymes in E. coli and purify each by nickel



columns. We will test for synergy within and between family members to see which combinations may have the highest activity. We will then test the activity by combining with mini-scaffolding proteins (mini-CbpA) to form mini-cellulosomes. We will also produce mini-cellulosomes containing cellulases and hemicellulases and test their activity on artificial and natural lignocellulose substrates. These tests should demonstrate which combinations are most active on pure cellulose substrates and on natural substrates such as corn fiber. Preliminary experiments have shown that growth of *C. cellulovorans* on different carbon sources yield cellulosomes with different enzymatic compositions. We will obtain cellulosomes grown on cellulose, xylan, and pectin and combine the cellulosomes and test the activity of the combination on natural substrates. These tests should determine whether a combination of natural cellulosomes would be more effective in degrading natural substrates. We are currently attempting to express *C. cellulovorans* cellulosomal genes in *Bacillus subtilis*. We will transform mini-CbpA gene and cellulase genes, *engB* and *engE* and hemicellulase gene, *xynB*, into *B. subtilis*. We hope that *B. subtilis* will express these genes and make mini-cellulosomes. This will be a first step in demonstrating that *B. subtilis* can be converted into a cellulose utilizer. This should serve as a model system for the conversion of non-cellulose utilizers into cellulose utilizers. This may have an important impact in reducing the substrate costs for organisms used in industry.

#### PROGRESS: 2006/01 TO 2006/12

A large amount of agricultural waste such as rice straw, corn stalks, and wheat straw is currently produced in this country. If these cellulosic materials could be degraded to sugars, and the sugars fermented to ethanol, it would solve many problems in terms of the environment and energy. Our research is continuing on the enzymatic degradation of lignocellulosic materials by investigating the structure, function, regulation, and assembly of the cellulosome from *Clostridium cellulovorans*. The cellulosome is an extracellular enzyme complex that is capable of degrading cellulose and hemicellulose, the major components of plant cell walls. Our recent studies have shown that the cellulosome is not a homogeneous enzyme complex, but consists of many subpopulations of cellulosomes that differ in terms of enzymatic composition. The subunit composition varies depending on the growth substrate. Thus the organism is capable of degrading a variety of plant cell walls that it may encounter. In another study we have found that an apparent redundant population of family 9 cellulosomal endoglucanases actually allows the cellulosome to attack substrates with differing structures. In addition the products that were produced by the family 9 endoglucanases also were varied indicating that the family 9 enzymes attacked substrates in a differing manner and increased the versatility of the cellulosome. Further studies on the interaction of cellulosome with non-cellulosomal enzymes indicate that there is synergistic activity between the cellulosome and non-cellulosomal enzymes. The non-cellulosomal hemicellulases apparently attack the plant cell wall and expose the cellulosic components and facilitates the activity of the cellulosome. These studies will allow us to construct more efficient designer cellulosomes with greater capacity for degrading lignocelluloses.

#### IMPACT: 2006/01 TO 2006/12

These studies will lead to better methods for disposing and utilizing cellulosic agricultural and forest wastes. The enzymatic digestion of plant cell wall materials to sugars and the conversion of the sugars to ethanol will provide biofuel. These methods will help to keep the environment cleaner and will lead to use of plant biomass for biofuels that could partially reduce our dependence on foreign petroleum fuels.

#### PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. Arai, T., Kosugi, A., Chan, H., Koukiekolo, R., Yukawa, H., Inui, M. and Doi, R.H. 2006. Properties of cellulosomal family 9 cellulases from *Clostridium cellulovorans*. *Appl. Microbiol Biotechnol.* 71: 654-660.
2. Kosugi, A., Arai, T. and Doi, R.H. 2006. Degradation of cellulosome-produced cellooligosaccharides by an extracellular non-cellulosomal  $\beta$ -glucan glucohydrolase, BglA, from *Clostridium cellulovorans*. *Biochem. Biophys. Res. Commun.* 349:20-23.

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ACCESSION NO: 0211297 SUBFILE: CRIS  
PROJ NO: CA-D\*-VIT-7693-CG AGENCY: CSREES CALB  
PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: NEW  
CONTRACT/GRANT/AGREEMENT NO: 2007-35504-18332 PROPOSAL NO: 2007-02140  
START: 01 SEP 2007 TERM: 31 AUG 2010 GRANT YR: 2007  
GRANT AMT: \$455,000

INVESTIGATOR: Block, D. E.

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#### A SYSTEMATIC STUDY OF THE EFFECT OF CELL LIPID BILAYER COMPOSITION ON RESISTANCE TO ALCOHOL-INDUCED CHANGES

**NON-TECHNICAL SUMMARY:** While production of biofuels such as ethanol and butanol through fermentation presents an attractive alternative to traditional petroleum-based liquid fuels, low alcohol tolerance of production microorganisms has proven to be a limiting factor in the economic feasibility of these processes. The purpose of this study is to improve alcohol tolerance in production microorganisms by altering the composition of the cell membrane lipid bilayer in a systematic manner.

**OBJECTIVES:** We are proposing to extend our studies of the effects of cell membrane composition on the interdigitation response to alcohol, leading to a better understanding of the components of alcohol tolerance. This will allow us to rationally select yeast and bacterial strains for higher alcohol production. We will pursue the following four related objectives to achieve our technical goals: (1) Correlation of membrane characteristics with ability to complete fermentations. Phospholipid headgroup composition, fatty acid chain length and saturation level, and ergosterol level will be measured for a series of fifteen common wine yeast strains from our existing fermentation database and for several *Clostridium* strains of various butanol tolerance levels. Multivariate statistics will be used to identify the most critical composition factors for alcohol tolerance. (2) Identification of the role of membrane components most associated with resistance to alcohol induced changes, e.g. interdigitation, using purified lipid/sterol bilayers. Purified lipids and sterols will be used to construct and evaluate model cell membranes in the presence of ethanol and higher alcohols. Atomic Force Microscopy (AFM) and fluorescence will be used to look for interdigitation and other microstructural changes as a function of composition. As a new technology, fluorimeter experiments will be developed to identify interdigitation in cell membranes to feed into aim 4, leading to a new high throughput method for alcohol tolerant strain selection. (3) Identification of membrane components most associated with resistance to alcohol induced changes using a multiscale simulation approach. Systematic multiscale molecular simulations will be performed to analyze the effects of membrane composition on resistance to interdigitation and other structural changes in the presence of ethanol and higher alcohols. Multiscale simulations ensure that all relevant length scales are treated correctly. (4) For Objective 1, we propose to first analyze the lipid composition of all 15 commercial yeast strains in our database using established chromatographic/GC methods. This analysis will also be performed on several *C. acetobutylicum* strains with increased butanol tolerance. Once the data on lipid composition is collected for all of the strains, datamining methods will be used to examine the relationship between the concentrations of individual components of the cell membranes and the kinetic and alcohol tolerance parameters measured for all strains.

**APPROACH:** For Objective 1, we propose to first analyze the lipid composition of all 15 commercial yeast strains in our database using established chromatographic/GC methods. This analysis will also be performed on several *C. acetobutylicum* strains with increased butanol tolerance. Once the data on lipid composition is collected for all of the strains, datamining methods will be used to examine the relationship between the concentrations of individual components of the cell membranes and the kinetic and alcohol tolerance parameters measured for all strains. For Objective 2, we propose to study the impact of ethanol, propanol, and butanol on ternary and quaternary lipid model membrane systems containing ergosterol. The major lipid class in yeast membrane is phosphatidylcholine (PC), thus we will mainly focus on ternary and quaternary mixtures containing PC headgroups and acyl chain variations (chain length, degree of

(un)saturation) and ergosterol. We will determine the partitioning of ergosterol by the behavior of the DPPC domains (i.e. do they behave like a fluid or a solid) and naphthopyrene partitioning. In this stage, AFM and FM of SLBs and FM of GUVs will be used. Subsequently, alcohol will be added, and we will look for interdigitation using AFM, changes in microstructure (using both AFM and FM), and changes in naphthopyrene partitioning. In addition, we plan to study the impact of inclusion of key lipid head groups which are associated with ethanol tolerance, namely negatively charged phosphatidylinositol (PI) and phosphatidylserine (PS). In Objective 3, atomistically detailed simulations to elucidate the effects of alcohols on the bilayer structure will be extended from our preliminary work. For this kind of modeling we rely on a highly accurate lipid model. Structural changes in the bilayer resulting from alcohol will be characterized, e.g. by order parameter, area per headgroup, degree of interdigitation and bilayer thickness, and compared to experiments. We will focus on the comparison of low molecular weight alcohols (up to butanol) to understand the underlying mechanisms of the experimentally observed Traube rule. We are additionally going to measure the influence of alcohol on the structure, including the binding sites of the alcohols, and on dynamic quantities, like diffusion and lipid rotation. In Objective 4, we will construct proof-of-concept yeast and Clostridium strains with improved alcohol tolerance in order to clearly assess the feasibility for application in a biorefinery setting. For yeast, we plan to genetically modify strains of Saccharomyces to overproduce or underproduce specific membrane components. We will chose existing commercial yeast for manipulation, one with relatively low ethanol tolerance and one with relatively high tolerance. For each of these strains, genetic modifications will be made, that, based on the information from the above objectives, should increase ethanol tolerance and other modifications that should decrease ethanol tolerance. For Clostridium, we will take a similar approach with similar targets. Genetically altered strains will be assessed for alcohol tolerance and production kinetics.

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Item No. 6 of 59

ACCESSION NO: 0185940 SUBFILE: CRIS  
 PROJ NO: CALK-2000-03113 AGENCY: CSREES CALK  
 PROJ TYPE: SMALL BUSINESS GRANT PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 00-33610-9455 PROPOSAL NO: 2000-03113  
 START: 01 SEP 2000 TERM: 31 AUG 2003 FY: 2003 GRANT YR: 2000  
 GRANT AMT: \$265,000

INVESTIGATOR: Kelly, J.

PERFORMING INSTITUTION:  
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**LOW COST FUELS PRODUCTION FROM AGRICULTURAL WASTES USING CHEMICAL REGENERATION**

**NON-TECHNICAL SUMMARY:** Bioconversion of lignocellulosic wastes to fuels and chemicals requires pretreatment to enhance conversion and reduce overall costs. Texas A&M University (TAMU) has tested an effective and low cost lime pretreatment process that can benefit from lime regeneration. Altex has identified the Low Cost Lime Regenerator (LCLR), which is more compact, less costly and more efficient than conventional regeneration systems. Based on equipment supplier cost inputs, the LCLR, lime regeneration concepts in a 2 TPD test system.

**OBJECTIVES:** Demonstrate, at a scale of 2 TPD, the capability of the Low Cost Lime Regeneration (LCLR) system to regenerate lime for use in the Texas A&M University (TAMU) bioconversion system.

Determine regeneration quality and costs, bioconversion pretreatment effectiveness and system capital and operating costs. Conclude on commercial potential of the system.

**APPROACH:** TAMU will process the biomass in their proprietary bioconversion process, using their pilot-scale reactor with lime to pretreat the biomass. This will generate precipitated calcium carbonate (PCC) that will have to be regenerated. The PCC will then be formed into pellets, using special low cost binders, and then processed in Altex's pilot-scale special kiln into a reactive lime product. During kiln processing, exhaust emissions and fuel use will be monitored to determine pollution potential and energy use. Equipment manufacturer input on estimated capital costs, and operating cost estimates derived from project results will then be used to determine system cost benefits.

**PROGRESS: 2000/09 TO 2003/08**

The regeneration of lime mud derived from a biomass pretreatment process was demonstrated using the Low Cost Lime Regenerator (LCLR) system by Altex, and lime mud received from Texas A&M University (TAMU). For reference, identical tests were also performed on lime mud from a paper plant, furnished by the Weyerhaeuser Corporation. The LCLR process consists of two critical steps. Spent lime mud is first pelletized using a commercial clay extruder, then calcined in a vertical shaft kiln. Extrusion tests have shown that lime mud from the biomass pretreatment process extrudes as well as paper plant lime mud and forms good quality pellets. In the green state, lime mud pellets have excellent handling characteristics and are readily conveyed using conventional equipment. Shaft kiln processing requires good pellet strength. Paper plant lime mud pellets have the necessary strength because sodium contaminants in the lime mud act as an effective high temperature binder. However, the sodium content of lime mud from biomass pretreatment is much less. To increase the sodium content to a level comparable to that of paper plant lime mud, a lignosulfonate was added to the TAMU lime mud prior to pelletizing. LCLR pellet strength test results showed that, with the binder addition, TAMU lime mud pellets were just as strong as the paper plant lime mud pellets, and can therefore survive shaft kiln processing. Also, ASTM reactivity test results showed that a high quality lime product was produced, with reactivity times of less than three minutes. The ultimate test of the LCLR product was its performance in the TAMU biomass pretreatment process. A sample of LCLR regenerated lime mud pellets was returned to TAMU where samples of switchgrass and bagasse were pretreated with the LCLR lime regenerated at Altex and compared with identical samples pretreated with a commercial lime. A comparison of the resultant sugar yields showed that the LCLR lime is as effective as commercial lime. These results demonstrate the capability of the LCLR process to regenerate lime mud from a biomass pretreatment process. Relative to conventional rotary kilns the LCLR system has the following important benefits. Uniform robust pellets are produced that, because of uniformity, can be optimally processed in a shaft kiln. Pellet forming equipment is simple, inexpensive, and durable. The organic energy content in the mud is fully recovered, reducing fuel costs by 50 percent, and these organics are fully oxidized, eliminating hydrocarbon pollutants from the exhaust. Shaft kilns are simple with few moving parts, can be heavily insulated for high efficiency, are low in cost, and unlike rotary kilns, are filled with the process solids, making them more compact. Fuel burning occurs within the bed, and in the presence of solids, for uniform and efficient combustion with low emissions (less than 40 ppm CO and 40 ppm NO<sub>x</sub>, versus 200 ppm NO<sub>x</sub> for rotary kilns). Also, due to pellet forming and shaft kiln processing, dust and related control problems are reduced. The greatest benefit of the LCLR is a 55 percent reduction in cost, relative to those for a rotary kiln.

**IMPACT: 2000/09 TO 2003/08**

Wherever the LCLR system is implemented, it will have many positive benefits on the production of biomass waste derived fuels. Lime pretreatment will be less costly. Lime regeneration with the LCLR system reduces the cost of producing alcohol to \$0.55/gal. This is considerably less costly than ethanol from corn (\$1.40/gal) and MBTE (\$0.90/gal). The current fuel market for ethanol derived from corn is 1 billion gallons per year. Assuming that the market for lignocellulose derived fuels is the same size, then application of the process would result in cost savings to the industry of approximately \$800 million per year. These are substantial economic benefits that will help drive the production of alcohol from waste biomass. Also, the process would consume 10 million tons/year of wastes, leaving behind a residue that is only 28 percent of the volume of the original waste. Therefore, applying the process will extend landfill use by a factor of 3.5. In addition, a lime pretreatment method avoids the hundreds of thousands of tons of waste produced per year by acid pretreatment processes, or by processes that do not regenerate the lime. These waste reductions will decrease disposal costs, which can exceed \$15/ton, and the associated negative

environmental impacts. Lastly, NOx and CO2 greenhouse gas emissions would be reduced by over 100,000 lbs/yr and 400,000 tons/yr, respectively, using the LCLR process rather than a conventional lime kiln.

PUBLICATIONS (not previously reported): 2000/09 TO 2003/08

1. United States Patent No. 5,824,244 Kelly, et al. October 20, 1998
2. United States Patent No. 5,865,898 Holtzapple, et al. February 2, 1999

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ACCESSION NO: 0200576 SUBFILE: CRIS

PROJ NO: CALK-2004-02681 AGENCY: CSREES CALK

PROJ TYPE: SMALL BUSINESS GRANT PROJ STATUS: TERMINATED

CONTRACT/GRANT/AGREEMENT NO: 2004-33610-15001 PROPOSAL NO: 2004-02681

START: 01 SEP 2004 TERM: 31 AUG 2007 GRANT YR: 2004

GRANT AMT: \$296,000

INVESTIGATOR: Clough, R. C.

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**CELLULASES FOR BIOMASS CONVERSION FROM THE TRANSGENIC MAIZE PRODUCTION SYSTEM**

**NON-TECHNICAL SUMMARY:** The production of ethanol from lignocellulosic biomass can utilize large volumes of agricultural residues that are untapped today. Ethanol fuels burn cleanly, thus the use of ethanol for partial replacement of petroleum fuels will have a positive impact on the environment. The production of ethanol fuels from lignocellulosic biomass is ready to be developed into a viable industry. Our results will show that the maize production system can meet the sensitive cost targets for cellulase enzyme production for the biomass to ethanol industry. In addition, they will show that maize has the flexibility to produce any new cellulase enzymes that are engineered to have improved performance on the vast array of lignocellulosic substrates that can be utilized in this industry.

**OBJECTIVES:** This Small Business Innovation Research Phase II project is designed to demonstrate the feasibility of cost-effective conversion of lignocellulosic biomass to sugars. The project has two major objectives--to demonstrate the activity of the transgenic corn-derived enzymes (from Phase I) on cellulose and pretreated lignocellulosic material, and to demonstrate the breadth and power of the recombinant production system by expressing an array of cellulases in maize seed.

**APPROACH:** We will produce grain from maize lines identified in Phase I experiments that express high levels of cellulase. Enzyme will be extracted from this grain, concentrated, and used in application tests. In addition, other cellulase genes will be expressed in the recombinant maize system. A breeding program will be initiated to select for high expressing lines.

**PROGRESS:** 2004/09 TO 2007/08

The principal objective in Phase II was to develop convincing data that a maize-produced cellulase could be a viable alternative to supply the large volume and low cost requirements for the conversion of lignocellulose biomass into ethanol. This centered on 1) developing a production model for supplying enzymes including economic parameters that predict the expression requirements of cellulase in grain, 2) demonstrating that maize lines that are capable of expressing cellulase at these concentrations, and 3)

demonstrating that the maize-produced cellulase will work on complex insoluble cellulose similar to what would be encountered in cellulose biomass. A model for using maize-produced cellulase for ethanol conversion was developed to illustrate the advantages and requirements that this may have over other systems. This model included the assumptions for expression levels required to be competitive for the biomass conversion of ethanol. This model estimated that concentrations in the range of 1g cellulase/kg grain would be required to meet the minimum economic incentives assuming that the maize-produced enzyme was the sole source of enzymes for ethanol conversion. Using transgenic material containing cellulase, activity of the enzymes was routinely examined using a soluble substrate. In addition, chemical and biological assays were conducted to evaluate activity on insoluble cellulase. These assays confirmed activity of maize-produced cellulase on insoluble cellulose and future work is planned to correlate this on a quantitative basis with the soluble assay results used for routine screening. Five generations of cellulase-expressing plants were grown and selected based on expression levels in the seed. This included using elite germplasm and crossing multiple alleles into the same plant. The expression levels were increased up to five-fold in bulk inbred seed. Using the production schemes with hybrid lines, we would expect to raise expression an additional two-to-four fold. These results demonstrated the potential for these seeds to reach the expression target assumed in the production model. Alternative constructs were made in an attempt to enhance expression. These included using alternative promoters, targeting sites and alternative genes. However, as of this date, they did not provide an increase in the expression in T1 seed over what had been shown earlier. Based on our results we are now in discussion with three different companies to commercialize a maize-produced cellulase. We expect to enter Phase III of this project with at least one of these companies under a contractual agreement signed by the end of this year.

**IMPACT: 2004/09 TO 2007/08**

The enzymes for cellulose conversion into ethanol are required at large volumes and low cost. The findings from this study indicate that it may be feasible to supply the necessary enzymes from maize. Having the enzymes produced from a crop that is also used to produce ethanol offers the possibility for a fully integrated system. This will not only have the potential to reduce cost but will also put less stress on the environment since there is no need to produce separate crops for cellulose and separate production systems for the enzymes.

**PUBLICATIONS (not previously reported): 2004/09 TO 2007/08**

1. John Howard and Elizabeth Hood. 2007. Methods for growing nonfood products in transgenic plants. *Crop Sci.*47:1255 to 1262.
2. Elizabeth E. Hood, Robert Love, Jeff Bray, Richard Clough, Kamesh Pappu, Carol Drees, Kendall R. Hood, Sangwoong Yoon, Atta Ahmed, and John A. Howard. 2007. Subcellular targeting is a key condition for high-level accumulation of cellulase protein in transgenic maize seed. *Plant Biotechnology* (in press).

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Item No. 8 of 59

ACCESSION NO: 0202388 SUBFILE: CRIS  
 PROJ NO: IDA01291 AGENCY: CSREES IDA  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 JUL 2004 TERM: 30 JUN 2009 FY: 2006

INVESTIGATOR: Shrestha, D. S.

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FUEL FROM OIL CROPS: PROTECTION, FEASIBILITY AND TECHNOLOGY

**NON-TECHNICAL SUMMARY:** Environmental and energy advantages of using vegetable oil for biodiesel production is unknown. Biodiesel quality is an issue that must be addressed to increase its utilization and acceptance. This research will justify the use of Pacific Northwest oil crops for biodiesel production. Farmers will be benefited by knowing how much area to devote for oil production for their profit optimization. This research is also directed to develop a quick, reliable and economical sensor which can be used to quickly assess biodiesel quality.

**OBJECTIVES:** 1. Study the feasibility of Pacific Northwest (PNW) oil crops and its derivatives to predict the future of biodiesel production from these feedstocks. 2. Improve biodiesel compatibility with diesel engines.

**APPROACH:** Experiment 1: Life cycle analysis for energy and environment assessment of oil crops and biodiesel production. In this study energy and environmental analysis for locally grown major oil crops in Pacific Northwest region will be carried out. Various forms of energy going into the production versus total energy coming out of a crop will be compared in terms of amount of energy and price. Research will be conducted in cooperation with farmers and farmer associations. A research proposal will be written and submitted to various donor organizations. Direct and indirect sources of energy inputs in various oil crops production will be studied. Direct energy is required to perform various tasks related to crop production processes such as land preparation, irrigation, intercultural operation, harvesting and transportation of agricultural inputs and processing. Indirect energy, on the other hand, consists of the energy used in the manufacture, packaging and transport of fertilizers, pesticides and farm machineries. Energy output from the crop includes energy contained in biodiesel, byproduct glycerol, oil cake and biomass. Energy as well as price of inputs to outputs will also be considered. Opportunity cost of oil crops will be calculated to estimate net gain in economical sense by using oil to produce biodiesel. Experiment 2: Biodiesel characterization for suitability in running a diesel engine. Biodiesel from different feed stocks will be exposed under electromagnetic radiation sources of different frequencies. Depending on size and concentration of molecule compositions in the biodiesel, some wave bands will be absorbed more than others. This will produce a modified transmitted and refracted radiation spectrum. We expect that depending on biodiesel composition, the measured spectrum characteristics will vary as it is exposed to the electromagnetic radiation of various wave lengths ranging from microwaves to infrared. The reflectance and refractance of the oil will be measured using radiation spectrum sensor. The oil composition will also be determined as per ASTM specified standard methods to correlate with the measured spectrum. A multivariate statistical analysis will be carried out to correlate between spectrum absorbance of biodiesel to its inherent constituents. After the transmitted and refracted spectrum measurement, the engine performance will be tested. Brake horse power, emission characteristics and other important engine performance parameters will be measured to correlate fuel quality with measured spectrum. In addition to pure biodiesel, biodiesel with different fuel additives especially to reduce NO<sub>x</sub> will be studied. Spectrums will be measured with different fuel additives and successive engine testing will be performed. As far as condition permits, both two and four stroke engines will be tested in this experiment to study the usefulness of biodiesel in running diesel engines.

**PROGRESS:** 2006/01 TO 2006/12

**Biodiesel field sensor development** This research is to develop affordable field sensors that could be used 1) to detect percent biodiesel in biodiesel-diesel blend and 2) to measure free and total glycerol in pure biodiesel. Use of ultra violet light showed a good promise in detecting blend level regardless of diesel and biodiesel type use. Two conference papers were published and one paper has been submitted for journal publication from this research. An application has been made to patent the technology. A prototype of the field sensor is being developed and industrial partners are being sought to fund further research in this area. Glycerol sensing method used a chemical reaction that produces heat and measure of the temperature rise which is then correlated to glycerol content. This research is taking the ground but more research is needed to improve the initial research results. One graduate student is doing the research to perfect the technique. If successful, this technology will sense the alcohol content along with total and free glycerin. **Biodiesel Utilization Issues** This research is focused to understand the cold flow behavior of biodiesel. I have investigated the effect of different fuel additives to improve cold flow and based on the results, published a conference proceeding and a tech-note. It was concluded that the commercial cold flow fuel additives available in the market was ineffective in lowering the gelling point of biodiesel. **Life cycle analysis of biodiesel** It has been argued by some researchers that the production of biodiesel requires more fossil

energy than the energy contained in the fuel itself. If that is the case, biodiesel is a non renewable source of energy. This is an important issue to ensure that the bioenergy is renewable source of energy to make it sustainable. One technical presentation, one technical review and one conference paper have been published from this research. A research grant was received from USDA to update the life cycle energy balance study report. One journal paper is being submitted form the review of past researches with partially updated data. Biodiesel Education The purpose of this project is to educate the public about biodiesel, its benefits and limitations. I have given several presentations in conferences, workshops and seminar. I have also given several unofficial presentations to the tour group at UI biodiesel research lab and answered numerous questions to the public about biodiesel. Precision agriculture Besides assigned research area for year 2006, I have extended my research area to include precision agriculture. A proposal was submitted to USDA's Animal and Plant Health Inspection Service (APHIS) to develop an automated soil sampler which will be used to conduct a national soil survey. Consequently I received a grant from USDA to develop an automated soil sampler to collect soil samples from a potato harvester. The prototype is under development and two undergraduate students are working on this project.

#### IMPACT: 2006/01 TO 2006/12

Biodiesel field sensor development Need of research on biodiesel quality was rated as number 1 among all research needs for biodiesel by the experts in the field. One of the problems that the producers, the distributors and the users of the biodiesel are concerned about is its quality assurance. I envision that these inexpensive field quality sensors will enhance the acceptance of biodiesel and more quality fuels in the market means fewer fuel related problem. This would definitely increase the demand for biodiesel. Biodiesel Utilization Issues Unfavorable cold flow property and higher oxides of nitrogen (NOx) emissions are two most important issues with biodiesel. NOx is a serious air pollutant and green house gas which limits its use in urban areas. Success of this research will have a big effect on acceptability of biodiesel without any doubt. Life cycle analysis of biodiesel This is an important issue to ensure that the bioenergy is renewable source of energy to make it sustainable. Biodiesel Education Awareness about biodiesel both for consumers, producers are crucial in success of the biodiesel. Biodiesel education program educates people about benefits of biodiesel to make them readily accept biodiesel as alternate fuel and producers to run a successful biodiesel industry that produces quality fuel. Precision agriculture Precision agriculture has great benefits of reducing application of agro chemicals while improving yield. With ever increasing demand on higher productivity the importance of precision agriculture can not be over emphasized.

#### PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. S. Chitrakar, C. J. Bern, D. S. Shrestha, 2006. Quantifying corn deterioration by use of CO<sub>2</sub>-sensitive gel. *Applied Engineering in Agriculture* 22(1):81-86
2. A. Zawadzki, D. S. Shrestha, B. He, 2006. Biodiesel blend level detection using ultraviolet absorption spectra. *Applied Engineering in Agriculture*
3. Pradhan, A. and D. Shrestha. 2006. An update on life cycle study of soybean oil biodiesel production. ASAE Paper No. 066142 St. Joseph, Mich.: ASAE.
4. Zawadzki, A. and D. Shrestha. 2006. Ultraviolet absorption spectra for biodiesel quality sensing. ASAE Paper No. 063043 St. Joseph, Mich.: ASAE.

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ACCESSION NO: 0405277 SUBFILE: CRIS  
 PROJ NO: 3620-41000-101-00D AGENCY: ARS 3620  
 PROJ TYPE: USDA INHOUSE PROJ STATUS: TERMINATED  
 START: 16 FEB 2002 TERM: 08 AUG 2004 FY: 2004

INVESTIGATOR: ERHAN S Z; LIU Z

PERFORMING INSTITUTION:



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## CHEMICAL SYSTEMS FOR THE CONVERSION OF VEGETABLE OILS TO INDUSTRIAL PRODUCTS

**OBJECTIVES:** Convert vegetable oil (emphasizing soybean oil) for industrial materials by polymerizing, by improving the oxidative stability and by derivatizing unsaturated acids for increased reactivity. Utilize these compounds in sheetfed, heatset, flexographic and gravure printing ink formulations, in interior/exterior architectural paint formulations and as a base stock in hydraulic fluids and lubricants.

**APPROACH:** Modify chemical and physical properties of soybean oil or its fatty acids to enhance their use as additives, or major components of lubricants, plastics, inks, surface coatings and other industrial materials. Use isomerization and addition reactions to form liquid products having improved thermal and oxidative stability and increased reactivity. Develop 100% soy oil-based sheetfed, heatset, flexographic and gravure printing inks. Improve the quality of existing architectural (interior/exterior) oil based paints by using soybean oil and solving the yellowing problem. Continue to develop soy oil based base stock for hydraulic fluids and lubricants. Test chemical, physical and rheological properties of the products and compare with existing commercial (petroleum based) products. Develop (1) reliable methodology for characterizing the products, (2) costeffective technologies and (3) preliminary marketing data.

**PROGRESS:** 2002/02 TO 2004/08

1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? What does it matter? The major use of vegetable oils (such as soybean oil) is directed to food products, salad and cooking oils, shortenings, and margarines in particular. Less than 3% is utilized in non-food applications, since a number of former vegetable oil markets are lost to petroleum products. In the years following World War II, petroleum derived products rapidly displaced vegetable oil-based materials. Certain performance and technical properties can be easily achieved using seed oil derivatives. Such products based on agro raw materials are at par with available petroleum based products in the market. The importance of natural products for industrial applications becomes very clear with increasing social emphasis on the issues of environment, waste disposal, and depleting non-renewable resources. Seed oils and products based on seed oil derivatives suffer from some technical drawbacks such as oxidation, cold flow behavior and extended stability. For applications such as composites, lubricants, plastics, fuel, and chemical intermediates; soybean oil and other vegetable oils are too viscous and too reactive toward atmospheric oxygen to establish significant markets. Limitations in molecular weight and crystallization properties restrict the uses of vegetable oils in solvents, plastics, fuels, and industrial fluids. In addition to above problems, this research project will address low volatile organic chemicals (VOC), high biodegradability in ink formulations, and low or no VOC improved oxidative stability/low temperature properties in biodegradable lubricants. U.S. Environmental Protection Agency (EPA), Clean Air Act Amendment, and U.S. Department of Labor, Occupational Safety & Health administration, (OSHA) regulations exert ever growing pressure on the graphic arts (inks, paints, coatings), lubricants and hydraulic oils, detergents, emulsifiers, and the polymer industries on limiting the use of organic solvents, creating less toxic waste, using a renewable resource, and producing more biodegradable products. Parties affected by these regulations and parties interested in enhanced marketability of soybean (American Soybean Association, United Soybean Board) and other oilseed crops will use the results and/or products of this research project to expand the market for these commodities. This project falls within component "New Processes, New Uses, and Value- Added Foods and Biobased Products" of National Program 306. This project establishes new bio-based fluid technology and their feasibility for industrial applications. This project will have direct impact on the utilization of local grown seed oils (mainly soybean oil) for non-food applications and therefore improve the local agro-economy. The research project will identify new oil-based industrial products and optimize conditions for laboratory scale up followed by field tests in close collaboration with industrial partners.

2. List the milestones (indicators of progress) from your Project Plan. Milestones and expected outcomes: Modifications, formulations and laboratory testings of the products will be completed by the end of the third year and scale-up, field testing and publications/patents will be completed at the end of the fifth year. Progress will be documented by publications in peer-reviewed journals, presentations at technical meetings, in-house annual progress reports and if applicable, patents. All of the above milestones have been accomplished and two vacant Research Chemist positions are filled.

3. Milestones: A. List the milestones (from the list in Question #2) that were scheduled to be addressed in

FY 2004. How many milestones did you fully or substantially meet in FY 2004 and indicate which ones were not fully or substantially met, briefly explain why not, and your plans to do so. A new project plan was certified by the Office of Scientific Quality Review as having completed NP 306, Quality and Utilization of Agricultural Products Panel Review on 7/15/04. In addition to completing the milestones from the expiring plan, preliminary experiments for the new project plan were conducted. B. List the milestones (from the list in Question #2) that you expect to address over the next 3 years (FY 2005, 2006, & 2007). What do you expect to accomplish, year by year, over the next 3 years under each milestone? This is the final Report of Progress (AD-421) for this project, which has been replaced with project 3620-41000-117-00D. The new project plan was certified by the Office of Scientific Quality Review as having completed NP 306, Quality and Utilization of Agricultural Products Panel Review on 7/15/04. The milestones of the new project plan are listed below: First year 1. Seed oil-based metalworking fluid for aluminum hot rolling will be formulated. 2. Complete initial preparation of grease samples with Li metal, fatty acids and check for consistency and smooth paste-like texture conforming to NLGI specifications. 3. Complete preparation of synthetic lubricant basestocks using Epoxidized vegetable oils, long chain/branched alcohols and catalyst; and further reaction on above product using acid anhydrides. 4. Complete the reaction optimization of vegetable oils with different sulfur compounds (which may or may not contain an amine functionality) using a catalyst (perchloric acid) to obtain product in higher yields and characterization using nuclear magnetic resonance (NMR), Fourier transformed infrared (FTIR) and pressurized differential scanning calorimetry (PDSC). 5. Complete initial preparation of composite samples with non-coated flax fibers using compression molding method and study their mechanical and water absorption properties. 6. Complete the sample preparation. Thermo and mechanical properties will be studied. 7. Hydrogels prepared from ring-opening polymerization and hydrolysis of obtained polymers will be studied for their temperature sensitive and pH sensitive properties. 8. Epoxidized soybean oil (ESO) will be cured with polyamine compounds to form sheets for mechanical, thermophysical properties tests. 9. Ring opening polymerization will be carried out using Lewis catalysts. Second year 1. Seed oil-based metalworking fluid for aluminum hot rolling will be tested for various performance and tribochemical properties in-house. 2. Characterization of grease samples for their penetration, oxidation and thermal stability using PDSC, micro-oxidation, oven test, rotary bomb oxidation test (RBOT). 3. Complete ring-opening reaction of epoxidized seed oil followed by esterification of resulting hydroxyl group to give lubricant base fluid. Characterize the chemically modified vegetable oil fluids for their oxidative stability and pour point and check to see if the process significantly improved the low temperature fluidity and thermal stability of the oil. 4. Complete the reactions of vegetable oils with different amines using same catalyst to synthesize bio-based anti-wear, anti-oxidants additives and characterization using NMR, FTIR and PDSC. 5. To prepare composites samples reinforced with coated flax fibers and to characterize their binding properties using transmission electron microscope (TEM). Three point bend and tensile tests will be performed on samples fabricated under task 1 (first year) using noncoated fibers and coated fibers. Compare their mechanical and water absorption properties. Evaluate polyamine curing agents. 6. Optimum clay loading, curing conditions and study the structures of clay dispersion in the host polymers. 7. Study drug loading and release rate. Effect of dissolution media such as temperature, pH on the release rate will be investigated. 8. Complete material selection and formulation. Glass transition temperatures (T<sub>g</sub>s) will be determined using differential scanning calorimetry (DSC). 9. Initiator evaluation for ring opening polymerization will be performed. Optimization of polymerization conditions necessary to obtain polymers in high yield will also be investigated. Third year 1. Tribochemical evaluation and physical property determination of metal working fluids will continue based on feed back from Cooperative Research and Development Agreement (CRADA) partner. 2. Develop methods to study wear-friction properties of grease samples. Try to establish structure-property relationship using above data. 3. Complete the formulation and blending of chemically modified vegetable oil fluids with other seed oils and suitable PPD, anti-oxidant and anti-wear additives. Evaluate the final products for pour point, viscosity, viscosity index, oxidative stability using PDSC, friction and wear characteristics using Falex to study the effect of structural variation in the oil molecules. 4. Complete the reactions of vegetable oils with different alcohol-amines using same catalyst to synthesize bio-based anti-wear, anti-oxidants additives and characterization using NMR, FTIR and PDSC. 5. Optimization of curing agents for epoxidized soybean oil and curing conditions such as pressure, temperature, and reaction time; study of fiber loading influence on the mechanical properties of composites; and analysis of water swelling data of composites. 6. Work will continue on the characterization of composites using x-ray and TEM. 7. Study drug release kinetics followed Fickian law or nonFickian law. 8. Damping and falling weight properties of soybased materials will be evaluated. 9. Hydrolysis of obtained soybean oil based polymers using sodium hydroxide to remove glycerin small molecule, purification of the samples for gel permeation chromatography (GPC) analysis.

Surface tension and contact angle measurements are performed. The critical micelle concentration (CMC) will be determined. 4. What were the most significant accomplishments this past year? A. Single most significant accomplishment during FY 2004: A soy oil based elevator hydraulic fluid technology was developed based on a request from National Park Service (Statue of Liberty, Ellis Island, NY). The bio-based fluid was developed at the NCAUR facility of USDA and independently evaluated by industrial partner (OTIS elevator). Subsequently the fluid was scaled up and retrofitted in the Statue of Liberty elevator and has been successfully operating for nearly two years. A product license has been applied for by a leading lubrication company for commercial production of the fluid. Based on this technology development activity, the NCAUR/USDA team has been awarded the FLC-2004 award for "Excellence in Technology Transfer". B. Other significant accomplishment(s), if any: 1. A US patent 6,583,302, "Chemically modified vegetable oil-based industrial fluid" was granted. 2. A U.S. Patent 6,528,571 "Extrusion Freeform Fabrication of Soybean Oil- based Composites by Direct Deposition" was granted. 3. A CRADA with Advanced Ceramic Research, Tucson, AZ, has been signed. C. Significant activities that support special target populations: None. 5. Describe the major accomplishments over the life of the project, including their predicted or actual impact. Technologies developed by the involved scientists and currently undergoing commercial development include lithographic news ink, sheet- fed and heat-set inks consisting of pigments and 100% vegetable oil (soy oil) based vehicles. U.S. Patent (5,122,188) has been awarded for news ink technology, and the potential domestic market is more than 500 million pounds per year for this technology. Ink prepared by this technology and commercial news inks consisting of vehicles prepared with petroleum resin base and either mineral oil or vegetable oil solvents were evaluated for their potential biodegradation. Gravimetric (using mixed cultures of soil microorganisms) and Modified Sturm Test (using activated sludge) methods were used. With both methods, USDA's ink degraded faster and more completely than either hybrid soy oil based or petroleum based inks. Also, comparison of de-inking properties and analysis of Volatile Organic Compound (VOC) content (using method 24, 24A, and 30) showed the superiority of vegetable oil based inks over petroleum resin based inks. For sheet-fed and heat-set ink, the market is more than 100 million pounds and 400 million pounds per year, respectively. Sheet-fed and heat- set web offset ink vehicles were prepared in the absence of petroleum products. Inks with these vehicles were formulated and tested for the physical properties, and the results were comparable to conventional mineral oil based vehicles. U.S. Patent (5,713,990) has been awarded for sheet-fed and heat-set ink technologies. Total non-food use of soybean oil is only 300 million pounds per year. The above ink technologies alone present an opportunity to triple the market. A company is in the process of completing the licensing application. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? Ink and hydraulic elevator fluid technologies have been transferred to a company. Two Cooperative Research and Development Agreements signed. One Cooperative Research and Development Agreement in progress. Three U.S. Patents allowed. Two U.S. Patent applications. One U.S. Patent application in process Two Material Transfer Agreements. These products will be available to the public in a year. 7. List your most important publications in the popular press and presentations to organizations and articles written about your work. Erhan, S.Z., Adhvaryu, A., Liu, Z. 2003. Chemically Modified Vegetable Oil-based Industrial Fluid. U.S. Patent 6,583,302 Erhan, S.Z., Adhvaryu, A., Sharma, B.K. 2004. Poly (hydroxy thioether) Vegetable Oil Derivatives Useful as Lubricant Additives. U.S. Patent Application S/N 10/887,127.

PUBLICATIONS (not previously reported): 2002/02 TO 2004/08

1. Adhvaryu, A., Sharma, B., Erhan, S.Z. 2004. Thermal and tribochemical properties of bio-based grease: structure and composition relationships. Annual Meeting and Expo of the American Oil Chemists' Society. p. 78.
2. Sharma, B.K., Adhvaryu, A., Liu, Z., Erhan, S.Z. 2004. Tribological and oxidation properties of chemically modified vegetable oils as lubricants. Annual Meeting and Expo of the American Oil Chemists' Society. p. 78.
3. Shogren, R.L., Petrovic, Z., Liu, Z., Erhan, S.Z. 2004. Biodegradation behavior of some vegetable oil-based polymers. *Polymers and the Environment*. 12(3):492351. p. 173-178.
4. Shogren, R.L., Petrovic, Z., Liu, Z., Erhan, S.Z. 2003. Biodegradation behavior of some vegetable oil-based polymers. *Bio Environmental Polymer Society*. p. 37.
5. Erhan, S.Z., Liu, Z. 2004. Soybean oil based composites. International Soybean Processing and Utilization Conference. p. 738-744.

6. Liu, Z., Erhan, S.Z. 2004. Viscoelastic and energy absorbing properties of soybased materials. Annual Meeting and Expo of the American Oil Chemists' Society. p. 75.
7. Liu, Z., Erhan, S.Z., Xu, J. 2004. Preparation, characterization and mechanical properties of epoxidized soybean oil/clay nanocomposites. Materials Research Society Proceedings. p. 322.
8. Panizzi, M.C., Erhan, S.Z. 2004. Tocopherol composition in brazilian soybean cultivars. Annual Meeting and Expo of the American Oil Chemists' Society. p. 80.
9. Erhan, S.Z., Perez, J.M. 2004. Chapter 2: socio-economical aspects and policy of renewable resources. In: Renewable Bioresources Scope and Modification for Non-food Applications. Hoboken, NJ: Wiley & Sons Press. p. 30-45.
10. Erhan, S.Z. 2003. New uses for vegetable oil. International Starch Technology Conference. p. 53-58.
11. Erhan, S.Z. 2004. Industrial applications of soybean oil. No Tillage National Congress in Argentina. p. 329-332.
12. Erhan, S.Z., Adhvaryu, A., Liu, Z. 2003. Chemical modification of vegetable oils for lubricant basestocks. American Society of Mechanical Engineers. p. 369-380.
13. Liu, Z., Erhan, S.Z., Calvert, P.D. 2004. Solid freeform fabrication of epoxidized soybean oil/epoxy composites with di, tri, and polyethylene amine curing agents. Journal of Applied Polymer Science. 93:356-363.

Item No. 10 of 59

ACCESSION NO: 0408515 SUBFILE: CRIS  
 PROJ NO: 3620-41000-110-00D AGENCY: ARS 3620  
 PROJ TYPE: USDA INHOUSE PROJ STATUS: NEW  
 START: 03 MAY 2004 TERM: 02 MAY 2009 FY: 2006

INVESTIGATOR: SKORY C D

PERFORMING INSTITUTION:  
 NORTHERN REGIONAL RES CENTER  
 PEORIA, ILLINOIS 61604

#### PATHWAY ENGINEERING OF FUNGI FOR IMPROVED BIOPROCESS APPLICATIONS

**OBJECTIVES:** The overall objective of this project is the genetic modification of filamentous fungi for improved synthesis of value added products. The primary emphasis will focus on improving the efficiency of lactic acid production by *Rhizopus oryzae* through metabolic engineering. Additionally, the techniques developed in this research will be used to assess the potential of using this industrially robust organism for directed protein expression.

**APPROACH:** Utilize metabolic engineering technologies to develop fungal strains with improved production capability for lactic acid. The general approach of this work is to sequentially increase enzymatic activities responsible for the production of lactic acid, while reducing those involved in the production of unwanted byproducts. The effects of these changes will be examined through traditional methods (i.e., fermentations, enzymatic activities, and northern data), as well as some of the newer genomic and metabolic flux analyses that will be incorporated into our work. Additionally, we will continue to develop methods for improved genetic recombination and RNA interference in *Rhizopus*. We will also design and employ strategies for the production and secretion of recombinant proteins of industrial interest using the fungus *Rhizopus*. Initial efforts of this work will include development and study of promoter/terminator constructs in *Rhizopus*. We will determine the importance of copy number compared to transcription promoter strength. Lastly, much of the work is to be focused on the necessary requirements for efficient folding and secretion. BSL-1 (2) Recertified February 15, 2007.

**PROGRESS:** 2005/10 TO 2006/09

Progress Report 1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? Why does it matter? Fossil fuels are by far the most exploited natural resource used today. The whole infrastructure of modern society is built upon oil, which has a limited reserve. Petroleum serves as the foundation for not only most of the USA's energy needs, but also for many products, such as solvents, organic acids, and numerous polymers and plastics. In 2004, the USA consumed about 5.7 billion barrels of petroleum with approximately 2-5% being used for

the production of plastics and solvents (Department of Energy (DOE) Petroleum Supply Annual 2004). Although many benefits to society are derived from the use of petroleum, potential problems, in the form of litter, landfill depletion, environmental pollution, global warming, and increased atmospheric carbon dioxide are associated with its use. Means to help alleviate these problems include the development of viable technologies for the production of industrial chemicals using renewable feedstocks (e.g., starch or cellulosic biomass) and the development of more efficient fermentation processes. Finding new uses for agricultural crops and improving the efficiency of how we utilize them is imperative for competing in today's global market. The broad objective of the CRIS Work Unit (CWU) is to develop improved technologies and novel systems for increasing yields and reducing costs of converting agricultural commodities/residues to value-added products (e.g., biofuels and organic acids) through enzyme and fermentation technology. The CWU concentrates primarily on studying the genetic control mechanisms for production of several metabolites and enzymes by the filamentous fungus *Rhizopus oryzae*. This fungus is used for large-scale manufacture of lactic acid. However, problems exist with fermentations because of synthesis of several unwanted byproducts that must be separated from the final product and decrease the overall yield of lactic acid. This fungus is also recognized as a robust organism that is routinely used for industrial enzyme production (e.g., glucoamylase, lipase, peptidase). Currently, its use is limited by the enzymes that the organism naturally produces. We have developed technologies that can now be used to genetically manipulate this fungus so that a host of useful proteins can be produced. This research contributes to the objectives of National Programs 306, Quality and Utilization of Agricultural Products. Corn and its processing byproducts (e.g., corn stover and corn fiber) will initially serve as the primary agricultural crop for this research, although technology is applicable to alternative crops. Customers of this work include: producers/consumers of lactic acid or its end-products (e.g., polylactic acid (PLA) plastic); industries requiring enzymes (e.g., biofuels, biomass conversion, food and feed, specialty chemicals); corn processors; new markets for agricultural commodities; agricultural community; scientific community with interests in fungal metabolic engineering; and general public. Cooperative Research and Development Agreements (CRADA) with appropriate companies are currently used to transfer products of this research. Much of the research focuses on the production of lactic acid because of the potential market growth of the biodegradable plastic, polylactic acid, and solvent ethyl lactate. Domestic production of lactic acid is greater than 50,000 tons/yr and will likely increase exponentially if the growth for PLA and ethyl lactate develops as expected. However, fermentation efficiency must be improved to ensure the economic feasibility of the anticipated market expansion and to ensure that the U. S. maintains its leadership role. Additionally, considerable effort is being directed towards new technologies for improved enzyme production, which currently are estimated to have annual sales in excess of \$1 billion. The ability to genetically improve the production of these enzymes, as well as other novel recombinant enzymes (e.g., cellulase, xylanase), is expected to have significant implications. Furthermore, the genetic knowledge gained from this work can easily be adapted to aid research with numerous other fungi that have industrial value.

2. List by year the currently approved milestones (indicators of research progress)

Year 1 (FY 2004) Test feasibility of using *Rhizopus oryzae* for expression of desired proteins. Continue to modify expression of various genes involved in the synthesis of lactic acid and various unwanted byproducts.

Year 2 (FY 2005) Begin study of protein secretion pathways for *Rhizopus*. Continue study of synthesis pathways for unwanted products formed during lactic acid production. Develop improved methods of integration and gene-knockout.

Year 3 (FY 2006) Design improved methods of protein secretion. Apply technology of gene integration and gene-knockout to ameliorate production of unwanted by-products. Initiate development of biochemical and analytic tools for monitoring the metabolic state of *Rhizopus* during fermentation. Initiate work to investigate inhibitors of lactic acid production in *Rhizopus*.

Year 4 (FY 2007) Utilize new analytical techniques to study modified strains and identify new targets for further improvements in lactic acid production and protein synthesis. Begin testing of pilot and large scale fermentations of modified strains. Identify targets to overcome inhibition of lactic acid production.

Year 5 (FY 2008) Test improved protein production systems using several enzymes with industrial interest. Study methods to improve product stability during lactic acid production. Utilize technology of gene modification to improve lactic acid production in the presence of inhibitors. Continue pilot and large scale testing of modified strains.

4a List the single most significant research accomplishment during FY 2006.

**INHIBITION OF GENE EXPRESSION USING RNA INHIBITION** - performed under NP 306, Quality and Utilization of Agricultural Products. Lactic acid is produced by fermentation technology using renewable agricultural products and has significant potential for market growth as a result of new interest in the biodegradable plastic, PLA. *Rhizopus* is a filamentous fungus that is currently used for industrial scale production of lactic acid, but also accumulates several unwanted by-products that decrease the potential yield and necessitate further purification. We have identified methods to decrease expression of genes and

should be able to apply this technology to eliminate by-products forming through other metabolic pathways. The results of this work are currently being exploited for the development of recombinant strains that will be tested by a major lactic acid producer. This accomplishment directly addresses National Program 306 - Quality and Utilization of Agricultural Products (100%), in particular Component 2, New Processes, New Uses, and Value-Added Foods and Biobased Products. 4b List other significant research accomplishment(s), if any. IMPROVED METHODS OF PROTEIN PRODUCTION BY RHIZOPUS - performed under NP 306, Quality and Utilization of Agricultural Products. *Rhizopus* is recognized as a robust organism that is routinely used for industrial enzyme production (e.g., glucoamylase, lipase, peptidase), but its use is limited by the enzymes that the organism naturally produces. We continued our development of expression vectors to allow secretion of important proteins with *Rhizopus*. Furthermore, these vectors contain binding sites that will be of potential benefit for purification of the final protein. The application of this technology is expected to have direct benefits to numerous industries involved in production of enzymes, including those involved in biomass conversion. 5. Describe the major accomplishments to date and their predicted or actual impact. A major thrust of this project has been to use molecular biology techniques for the development of microbial strains with improved lactic acid production. We have isolated several genes from *Rhizopus* that are associated with lactic acid formation and more recently have been collaborating in the sequencing of *Rhizopus* genome. Numerous methods have been developed to introduce genetically modified genes back into the fungal host in order to decrease production of unwanted byproducts and increase accumulation of lactic acid. Each modification of a particular enzymatic conversion step resulted in varying degrees of improvement for fermentations using this fungus. This work has been so successful that it led to a two Cooperative Research and Development Agreements (CRADA) with a major industrial partner over the last seven years. We have also begun to utilize some of these molecular techniques to investigate the ability to express proteins of interest in *Rhizopus*. This work has been very promising and also resulted in the formation of a CRADA with a midwestern biotechnology company to express important industrial enzymes. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? We have had a CRADA for the last seven years with a major industrial partner so that they may assist in our efforts to increase lactic production in the fungus *Rhizopus*. Strains modified for improved synthesis of lactic acid were routinely transferred as part of this CRADA. The numerous techniques developed by our laboratory served as a foundation to allow the formation of another CRADA with a major midwestern biotechnology company to develop improved methods of enzyme synthesis using *R. oryzae*. Several of our expression systems have been tested with various genes from the CRADA partner. Ultimately, the farmer and consumer will benefit from all of this research, since it relies on renewable agricultural materials for the final product. Other scientists also benefit from this work, since we often assist other laboratories by providing strains, DNA, and knowledge from our research.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09

1. Mertens, J.A., Skory, C.D. 2004. Discovery and characterization of a second glucoamylase gene in *rhizopus oryzae* [abstract]. Society of Industrial Microbiology. p. 96.
2. Skory, C.D. 2005. Inhibition of non-homologous end joining and integration of DNA with transformation of *Rhizopus oryzae*. *Molecular Genetics and Genomics*. 274(4):373-83.
3. Gorsich, S.W., Dien, B.S., Nichols, N.N., Slininger, P.J., Liu, Z., Skory, C.D. 2005. Tolerance to furfural-induced stress is associated with pentose phosphate pathway genes ZWF1, GND1, RPEL, and TKL1 in *Saccharomyces cerevisiae*. *Applied Microbiology and Biotechnology*. 71(3):339-349.
4. Mertens, J.A., Skory, C.D. 2005. Development of plasmids for expression of heterologous proteins in *Rhizopus oryzae* [abstract]. Society of Industrial Microbiology. p. 100.
5. Mertens, J.A., Skory, C.D., Ibrahim, A.S. 2006. Plasmids for expression of heterologous proteins in *Rhizopus oryzae*. *Archives of Microbiology*. 186:41- 50.

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ACCESSION NO: 0408950 SUBFILE: CRIS  
 PROJ NO: 3620-41000-121-00D AGENCY: ARS 3620  
 PROJ TYPE: USDA INHOUSE PROJ STATUS: NEW  
 START: 19 SEP 2004 TERM: 18 SEP 2009 FY: 2006

INVESTIGATOR: BISCHOFF K M; HUGHES S R; LIU S

PERFORMING INSTITUTION:  
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#### MICROBIAL CATALYSTS TO PRODUCE FUEL ETHANOL AND VALUE ADDED PRODUCTS

**OBJECTIVES:** The broad goal of the proposed research is to develop new microorganisms and biocatalysts that can be employed in the fermentative conversion of renewable agricultural materials to fuels and other value-added products. The research entails engineering existing fermentative microorganisms to possess desirable traits for industrial fermentation of lignocellulosic material or searching for new microorganisms that possess these traits.

**APPROACH:** Novel microorganisms, genes, and enzymes will be sought that can be employed in the fermentative conversion of agricultural commodities into biofuels and bioproducts. Specific approaches include: (1) application of high throughput screening procedures to develop, by use of directed evolution and gene shuffling, microbial strains and enzymes with superior ability to convert agricultural materials to biofuels and bioproducts, (2) apply metabolic engineering and genetic manipulation methods to existing and newly discovered/developed microbial strains to improve on ability to perform in an industrial fermentation environment and to optimize production of desired products, and (3) determine the potential for use of microorganisms from extreme environments (e.g., extreme thermophiles, halophiles, acido/alkalophiles) as biotechnological agents. BSL-1; Recertified February 9, 2006.

#### PROGRESS: 2005/10 TO 2006/09

Progress Report 1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? Why does it matter? The effective bioconversion of agricultural materials to fuels and other valuable products has been encumbered by the relatively small number of organisms suitable for use under harsh (industrial) environments and by the gaps in our understanding of the biosynthetic pathways that produce these products. New microorganisms and enzymes are needed that utilize lignocellulosic biomass to produce the desired products in high yield under conditions of extreme temperature, pH, osmotic pressure, and concentrations of substrate or end-products. These new biocatalysts may be developed through the application of metabolic and molecular screens to identify novel organisms and genes for exploitation. Once identified, the candidate organisms, genes, or enzymes can be evaluated, new expression systems developed, and bioconversion strategies optimized for production of biofuels and other microbial products. The development of new biocatalysts that will function in industrial environments will benefit not only commercial partners but farmers as well by providing new markets for agricultural based feedstocks. Expansion of the production of fuel ethanol, in particular, would reduce the nation's dependence on foreign oil and improve the environment by developing alternate energy sources from renewable resources. The broad goal of this research project is to develop new microorganisms and biocatalysts that can be employed in the fermentative conversion of renewable agricultural materials to fuels and other value-added products. The research entails engineering existing fermentative microorganisms to possess desirable traits for industrial fermentation of lignocellulosic material, and searching for new microorganisms that possess these traits. The specific objectives of the project are as follows: 1) create efficient xylose-fermenting *Saccharomyces cerevisiae* strains; 2) engineer lactic acid bacteria to make ethanol, and 3) determine the potential for microorganisms from extreme environments to serve as biotechnological agents in the fermentation industry. This research is expected to increase the efficiency of conversion of biomass to liquid fuel, and to discover new uses for agricultural by-products. Therefore, portions of the research fall under National Program 307 (Bioenergy and Energy Alternatives) and under National Program 306 (Quality and Utilization of Agricultural Products). Specifically, the research contributes to Component I (Ethanol) of the NP 307 Action Plan and to Problem Area 2b (New Uses for Agricultural By-products) of the NP 306 Action Plan. 2. List by year the currently approved milestones (indicators of research progress) Year 1 (FY 2005) 1.1. Construct functional proteomic robotic workcell. 1.2. Cloning pyruvate decarboxylase gene from *Sarcina ventriculi* and *Zymobacter palmae*. Year 2 (FY 2006) 2.1. Construct library of shuffled XI genes. 2.2. Transformation of pdc shuttle vector constructs into lactic acid bacteria. 2.3. Confirmation of transformants and examination of enzymatic activities. 2.4. Screening *G. stearothermophilus* strains for growth on xylan substrates. Year 3 (FY 2007) 3.1. In vitro transcription of XI library. 3.2. Construct *Pichia* library. 3.3. Characterization of xylan utilization enzymes and cloning of respective genes. Year 4 (FY 2008) 4.1. Mass transformation of *S.*

cerevisiae with *Pichia* library and high throughput screening. 4.2. Transform *S. cerevisiae* strains with shuffled XI clones. 4.3. Evaluate recombinant XI yeast strains and *Pichia* transformed strains for anaerobic growth on xylose and EtOH production. 4.4. Construct stable strains by chromosomal integration of plasmid- encoded genes from strains producing ethanol. 4.5. Inactivation of undesired genes like *als*, *ldh*, *ack*, and *pdh* if needed. 4.6. Application of new biocatalysts against natural xylan substrates (corn fiber). Year 5 (FY 2009) 5.1. Integration of optimized strains to large scale fermentations. 5.2. Analyze and evaluation of strains for ethanol and other value- added products production. 5.3. Genome shuffling and screening for best combinations of genes required for ethanol. 5.4. Integration of new biocatalysts in large scale fermentations.

4a List the single most significant research accomplishment during FY 2006. Construction of a Proteomic Workcell. The Ethanol component of the NP307 Action Plan seeks to reduce the cost of producing ethanol from biomass through technological advances in enzymology and microbiology, and in chemical, biochemical and process engineering. One approach to identifying new biocatalysts is to use an automated high-throughput strategy to screen tens of thousands of candidates for improved variants. In collaboration with Hudson Control Group, Inc., Springfield, NJ, scientists in the Bioproducts and Biocatalysis Research Unit at the USDA-ARS-National Center for Agricultural Utilization Research, Peoria, Illinois have developed a plasmid-based proteomic workcell that integrates all of the molecular, microbiological, and biochemical techniques used for the high-throughput strategy into a single robotic platform. Mechanical construction of the workcell is complete, and operational protocols have been tested using a multiplexed mutagenesis strategy of the *CelF* endoglucanase enzyme from the anaerobic fungus *Orpinomyces* PC-2. This workcell will ultimately be used for identifying important xylose-utilization genes and for improving strains of yeast that ferment xylose to ethanol. 4b List other significant research accomplishment(s), if any. Co-expression of ethanol production genes in lactic acid bacteria. The Ethanol component of the NP307 Action Plan seeks to reduce the cost of producing ethanol from biomass through technological advances in enzymology and microbiology, and in chemical, biochemical, and process engineering. Lactic acid bacteria are well suited to industrial fermentation environments and have the potential to be developed into biocatalysts for the production of ethanol from agricultural feedstocks. Scientists in the Bioproducts and Biocatalysis Research Unit at the USDA- ARS-National Center for Agricultural Utilization Research, Peoria, Illinois have genetically modified a strain of *Lactobacillus brevis* to express genes required for ethanol production. Genes for pyruvate decarboxylase (PDC) and alcohol dehydrogenase (ADH) were successfully cloned and expressed in *L. brevis*, but ethanol production in recombinant strains did not increase. Significant optimization and engineering of metabolic pathways in lactic acid bacteria remains to be explored for the development of new biocatalysts to convert agricultural materials to biofuels. Purification and characterization of thermophilic cellulase. The Ethanol component of the NP307 Action Plan seeks to reduce the cost of producing ethanol from biomass through technological advances in enzymology and microbiology and in chemical, biochemical, and process engineering. Thermophilic bacteria are a potential source of robust enzymes for use in the fermentation industry. Scientists in the Bioproducts and Biocatalysis Research Unit examined a collection of thermophilic bacteria for enzymes that degrade cellulose and hemicellulose. An endoglucanase enzyme from a thermophilic strain of *Bacillus licheniformis* was purified, identified, and characterized. The broad pH range and thermophilic properties of this enzyme may prove suitable for application in the conversion of biomass to glucose for production of fuel ethanol or other valuable fermentation products. Antimicrobial susceptibility of bacterial contaminants from fuel ethanol plants. The Ethanol component of the NP307 Action Plan emphasizes the need for technologies to reduce the cost of producing ethanol from cornstarch. Bacterial contamination of commercial fermentation cultures is a common and costly problem to the fuel ethanol industry. Scientists in the Bioproducts and Biocatalysis Research Unit have examined bacterial species isolated from a wet-mill and from a dry-grind ethanol plant for susceptibility to penicillin and virginiamycin, two antimicrobial agents commonly used to control contamination. Isolates from the dry-grind plant were less susceptible to this virginiamycin than isolates from the wet-mill plant, but most isolates had minimum inhibitory concentrations lower than the maximal application rate used for virginiamycin. This information is important to ethanol plant managers and will help guide intervention strategies that control bacterial contamination. 5. Describe the major accomplishments to date and their predicted or actual impact. The plasmid-based proteomic workcell developed by scientists in the Bioproducts and Biocatalysis Research Unit represents an advancement in the field of laboratory automation. The robotic integration of microbiological, molecular, and biochemical techniques will facilitate the development of improved biocatalysts for converting biomass to fuel and valuable products. The workcell will also find broad application in other fields of agricultural and pharmaceutical biotechnology. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)?



What are the constraints, if known, to the adoption and durability of the technology products?

Information derived from this research has been disseminated to producers, industry representatives, and other scientists through the presentation of data at national and international scientific meetings. Two provisional patents covering the workcell and a third covering its associated biology have been written and will be placed in conjunction with the completion of the workcell. Presently, our collaborative partner has constructed a second integrated robotic platform that has been sold for use in the pharmaceutical industry.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09

1. Hughes, S.R., Riedmuller, S., Mertens, J.A., Li, X., Bischoff, K.M., Cotta, M.A., Farrelly, P. 2005. Development of a liquid handler component for a plasmid-based functional proteomic robotic workcell. *Journal of the Association for Laboratory Automation*. 10(5):287-300.
2. Liu, S., Nichols, N.N., Dien, B.S., Cotta, M.A. 2006. Metabolic engineering of a *Lactobacillus plantarum* double *ldh* knockout strain for enhanced ethanol production. *Journal of Industrial Microbiology and Biotechnology*. 33(1):1-7.
3. Hughes, S.R., Riedmuller, S.B., Mertens, J.A., Li, X., Bischoff, K.M., Qureshi, N., Cotta, M.A., Farrelly, P.J. 2006. High-throughput screening of cellulase F mutants from multiplexed plasmid sets using an automated plate assay on a functional proteomic robotic workcell. *Proteome Science*. 4:10.
4. Liu, S., Dien, B.S., Cotta, M.A., Bischoff, K.M., Hughes, S.R. 2005. *Lactobacillus brevis*: a potential biocatalyst for lignocellulosic biomass to ethanol [abstract]. Society of Industrial Microbiology. Paper #P05.
5. Hughes, S.R., Riedmuller, S., Mertens, J.A., Li, X., Qureshi, N., Bischoff, K.M., Jordan, D.B., Cotta, M.A., Farrelly, P. 2005. Plasmid-based functional proteomic robotic workcell process for high-throughput screening of multiplexed libraries of mutagenized clones [abstract]. Optimization high-throughput Cultures for Bioprocessing 2005. p. 3.
6. Hughes, S.R., Riedmuller, S., Li, X., Qureshi, N., Liu, S., Bischoff, K.M., Cotta, M.A., Farrelly, P. 2006. Mass transformation of plasmid libraries of cDNA or mutagenized clone sets into yeast or bacteria using a functional proteomic robotic workcell [abstract]. *PepTalk 2006*. p. 10.
7. Hughes, S.R., Riedmuller, S.B., Mertens, J.A., Li, X., Bischoff, K.M., Liu, S., Qureshi, N., Cotta, M.A., Skory, C.D., Gorsich, S.W., Farrelly, P.J. 2006. Functional proteomic plasmid-based integrated workcell for high-throughput transformation of BL21 DE3 *E. coli* for expression in vivo with *Piromyces* strain xylose isomerase [abstract]. Midwest Laboratory Robotics Information Group. p. 2.
8. Liu, S. 2006. A simple method to generate chromosomal mutations in *Lactobacillus plantarum* strain TF103 to eliminate undesired fermentation products. *Applied Biochemistry and Biotechnology*. 129-132:854-863.
9. Bischoff, K.M., Skinner-Nemec, K., Leathers, T.D., Hughes, S.R. 2005. Antimicrobial susceptibility of bacterial contaminants from a wet-mill ethanol plant [abstract]. Society for Industrial Microbiology. Poster P42.
10. Bischoff, K.M., Li, X., Rooney, A.P., Liu, S., Hughes, S.R. 2005. Characterization of carboxymethylcellulase activity from *Geobacillus stearothermophilus* [abstract]. Society for Industrial Microbiology. Paper #P38.
11. Bischoff, K.M., Skinner, K.A., Leathers, T.D. 2006. Antimicrobial susceptibility of *Lactobacillus* species isolated from fuel-ethanol [abstract]. American Society for Microbiology. Poster No. O-038.
12. Liu, S. 2006. Genetically engineered lactic acid bacteria for the production of fuels and chemicals [abstract]. 10th International Symposium on the Genetics of Industrial Microorganisms. Paper #015.

Item No. 12 of 59

ACCESSION NO: 0210649 SUBFILE: CRIS

PROJ NO: ILLU-000-531 AGENCY: CSREES ILLU

PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: NEW

CONTRACT/GRANT/AGREEMENT NO: 2007-55618-18160 PROPOSAL NO: 2007-02945

START: 01 SEP 2007 TERM: 31 AUG 2010 GRANT YR: 2007

GRANT AMT: \$399,001

INVESTIGATOR: Agarwal-Tronetti, R.; Khanna, M.; Sonka, S.; Long, S.; Jain, A.

PERFORMING INSTITUTION:

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## ENVIRONMENTAL, ECONOMIC AND BUSINESS OPPORTUNITIES IN THE BIOFUELS INDUSTRY FOR SMALL/MEDIUM FARMS

**NON-TECHNICAL SUMMARY:** To be viable substitutes for fossil fuels, alternative energy sources such as biofuels should be economically competitive and environmentally sustainable. This project intends to 1) provide a detailed assessment of land use and environmental implications of biofuels from multiple feedstocks; 2) explore the industry evolution of the emerging cellulosic-based biofuels sector; and 3) examine how the liability of smallness may be mitigated through inter-firm cooperation.

**OBJECTIVES:** We propose to conduct an integrated, interdisciplinary research project that will contribute to the CSREES strategic goal of enhancing economic opportunities for agricultural producers. The research results and associated outreach efforts will examine how present and future development of the biofuels industry in the US can be exploited to the advantage of small and medium-sized farmers. There are agronomic and logistic characteristics of potential feedstock sources which may be favorable for small and medium-sized farmers. The logistical challenges of producing, assembling and transporting feedstocks suggest that there may be a need for new organizational entities to provide these functions. The collective efforts of small and medium-sized farmers are one means by which this gap could be satisfied. Therefore, it is critically important that research be focused on the strategic issues and constraints associated with the future development of cellulosic feedstock supply chains at the same time that the technological R&D efforts are underway. Discovery and documentation of targeted market channel innovations by which small and medium-sized producers can effectively support future cellulosic feedstock channels needs to occur before the marketplace need exists. Similarly, small and medium-sized producers need to be informed and educated relative to the opportunities and actions needed for them to capitalize on this potential. To address these issues, we propose a three-pronged, inter-disciplinary and integrated approach: 1) Provide a detailed assessment of the on-farm production opportunities and environmental consequences associated with production of a dedicated energy crop. The proposed research will focus on the Midwestern region, which currently is the major source of food and feedstock. The assessment of Land Use and Environmental Implications of Biofuels from Multiple Feedstocks will detail opportunities for dedicated energy crop production on currently underutilized land and in competition for corn and soybean acres. 2) Explore the industry evolution dynamics likely to characterize the emerging cellulosic-based biofuels sector. This investigation of the Liability of Smallness and Inter-firm Cooperation: A Contingent Perspective of Biofuels Technology Evolution will discover key insights from the relatively rapid emergence of the grains-based biofuels sector and interpret them through the lens of the industry evolution and strategic management to establish templates for alternative evolutionary paths in which small and medium sized farms may benefit in the cellulosic-based biofuels sector. 3) Deliver active learning based tools and information which will better enable Small and Medium-Sized Farmers Achieve Success as Providers of Cellulosic-Based Feedstocks. Intensive, active learning sessions will be conducted with targeted producers and leaders of associated producer organizations. In addition to informing these participants, these outreach and educational sessions themselves will contribute to knowledge creation efforts that can be extended to broader audiences of small and medium-sized producers.

**APPROACH:** This project is composed of three interrelated components: 1) The first component examines the optimal allocation of existing cropland for mix of feedstock production in Illinois. We will use detailed GIS data, at a 2x2 km level, for Illinois on soil quality, climate and land use to determine the costs and revenues from producing row crops, stover and perennial grasses, with simulation models MISCANMOD. To investigate the implications of utilizing CRP land for biofuel production, we will identify the land parcels (at the 2x2 km level) that are currently enrolled in the CRP and include those with the cropland parcels considered above, so as to determine the optimal allocation of land for biofuel production and the mix of feedstock that will be produced at various prices of corn, gasoline and ethanol and at various levels of incentive payments for using CRP land for bioenergy crops. To determine optimal mix of feedstock and spatial allocation of land use, we will estimate the greenhouse gas mitigation potential of various feedstocks with models including ISAM-2 and life cycle analysis. 2) The second component explores the industry evolution dynamics of the emerging biofuels sector (both grain and cellulosic-based), with four objectives. First, we will investigate the effect of biofuels technology evolution on the strategic decisions and performance of small and medium-sized firms in terms of their survival, likelihood of successfully

participating in supply chains and the entry decision of small/medium sized farms to the biofuels industry, with a multiple levels (national, regional and state level) and methods (quantitative and qualitative) approach. Second, we will analyze quantifiable differences in survival and growth rates based on firm size with all firms engaged in the biofuels industry in the United States from 1990-2006, using the Generalized Estimation Equation (GEE) and the Cox proportional hazard survival methodology. Third, to analyze the effects of key industry, environmental, and regional factors which differentially advantage small firms that adopt the new technology, we will integrate findings from the first component into our survey data from a stratified sample (based on locational characteristics) of small and medium- sized. Finally, we will use survey method and limited dependent regression techniques such as probit and logit analysis to study the impact of strategic relationships on potential entry into grain-based and cellulosic technology regimes. 3) An outreach component that will deliver active learning-based tools and information to facilitate small and medium-sized farms as providers of cellulosic-based feedstocks. The outreach efforts will be accomplished in three stages; materials development and testing, delivery of producer workshops, and implementation of web-based tools/information. These workshops will employ state of the art computer-based tools that illustrate the challenges and opportunities associated with cellulosic-based feedstocks for biofuels, and provide simulation-based learning modules emphasizing the dynamics that dictate success within supply chain alliances.

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ACCESSION NO: 0205057 SUBFILE: CRIS  
 PROJ NO: IND045076H AGENCY: CSREES IND  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 OCT 2005 TERM: 30 SEP 2010 FY: 2006

INVESTIGATOR: Tyner, W.

**PERFORMING INSTITUTION:**

AGRI ECONOMICS  
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**ECONOMIC AND POLICY ANALYSIS OF BIOMASS ENERGY ALTERNATIVES**

**NON-TECHNICAL SUMMARY:** Higher oil prices have led to increased interest in economic and policy analyses with respect to renewable energy. This project will provide economic and policy analyses for specific renewable energy technologies and will estimate national impacts of certain renewable energy policy alternatives.

**OBJECTIVES:** 1)To evaluate the economics of biomass energy alternatives under a wide range of technical and economic assumptions relative to current and future technical change and current and future alternative energy pricing scenarios. 2)To examine the consequences of energy policy alternatives with respect to development of alternative fuels, impacts of the policy alternatives on the agricultural sector, and impacts on the environment. 3)To design and evaluate new energy policy options such as alternative subsidy or tax policies.

**APPROACH:** This research will draw upon a standard collection of tools used for benefit-cost analysis, policy analysis, and environmental impact analysis. Some of the tools to be employed are as follows: Descriptive-engineering (or process) modeling - Descriptive engineering models are used to capture the physical and economic flows in some engineering process such as ethanol production from corn. The models contain multiple triggers that can be set on or off to test sensitivity to different assumptions on processing technology. They then can be used to test the impacts of changes in technology on the

economics of the underlying processes. Also, they can be used to test the impacts of different policy alternatives on the economic viability of the technology. Monte Carlo simulation models - Monte Carlo simulation can be used with descriptive engineering models or other policy models to trace the inherent uncertainty in input or conversion values through the system to the impact on output variables. In other words, this approach yields output variable distributions that reflect the uncertainty in the different input values. Policy simulation models - these models are constructed for each unique policy problem to be addressed. They normally are spreadsheet models containing all the needed data and parameters for the policy simulation. Integer mathematical programming - this technique will be used to examine optimal location of biomass facilities. Cellulosic biomass is costly to transport, and we envision evaluating alternative transport mechanisms and possible location of regional slurry sites to reduce costs. Life-cycle costing - this technique, which borrows extensively from the methods used in benefit-cost analysis, will be used for evaluating life-cycle costs of technological alternatives. Standard regression techniques - regression will be used to capture historical trends and variability in prices of inputs and outputs such as corn, ethanol, and gasoline. The variability and trend estimates can then be fed into the Monte-Carlo simulation models described above. Environmental impact analysis - mostly techniques from benefit-cost will be used for quantifying and valuing the environmental impacts of various technical and policy alternatives. Depending on the environmental question at hand, we might use dose response methods, contingent valuation, or alternative cost calculation methods. Some of the anticipated specific application areas are as follows: Estimating the impacts of using an ethanol subsidy that varies with the price of corn and the price of gasoline (or ethanol) instead of being fixed at 51 cents per gallon as at present. Estimate the economic impacts of new technologies for treating and processing distillers dried grains and solubles (DDGS) to increase conversion of some of this material to ethanol. Integer programming and life-cycle costing will be used to determine the optimal configuration for collecting, transporting, and processing corn residue (or other cellulosic biomass) into ethanol.

**PROGRESS: 2006/10 TO 2007/09**

**OUTPUTS:** The outputs of this project for 2006/07 include the following: journal articles, conference proceedings, extension publications, conference presentations, media interviews and reporting, and graduate student research. The publications are listed in the section below. Tyner made more than 20 conference presentations during the year and did more than 200 media interviews. He was quoted in *The Economist*, *New York Times*, *Wall Street Journal*, *DTN*, *Bloomberg*, *Reuters*, and many other sources. He did multiple TV and radio interviews and two half hour radio programs. The outputs described here focused on the objectives of this project, being analysis of alternative biofuels energy policies. His work was used by members of Congress, and he did briefing sessions for Congressional staffers on biofuels policy alternatives. **PARTICIPANTS:** Post doc: Farzad Taheripour. Current energy graduate students: Dileep Birur, David Perkis, Jayson Beckman, Bhwana Bista, Sarah Brechbill, Craig Rismiller, Delphine Simon. Professional development: Did a session on energy economics and policy for Indiana K-12 economics teachers. Farm Foundation has provided travel support. Purdue has generously funded the post-doc. We have obtained funding from DOE and NSF to continue this work. **TARGET AUDIENCES:** There are six target audiences: academics, government officials, members of Congress and state legislature, industry, media, and the general public. Tyner has made use of the media to reach many of these audiences with hundreds of media interviews. He works directly with Congressional staff and with state legislators. he did a briefing for the state budget committee on the Indiana legislature. He has done multiple briefings for staffers on Capital Hill. He has reached academic, government, and industry audiences through conference presentations. The journal publications also reach academic audiences.

**IMPACT: 2006/10 TO 2007/09**

Because of the research and extension activities under this project, multiple audiences now have a much better understanding of biofuels policy alternatives available to our nation. Senator Richard Lugar included one of the alternatives developed by Tyner in legislation proposed in the Senate. At a recent conference, Tyner was introduced as follows: "Whether I talk to folks in industry, academia, media, or politics, they all say that the go-to person in the country for biofuels policy is Dr. Wallace Tyner." The person doing the introduction was someone Tyner had never met. This is just one indication that the work conducted under this project has had significant impact. We have been able to characterize and describe the impacts of a wide range of biofuels policy alternatives including staying with current policy, a subsidy that varies with the price of crude oil, a two-part subsidy designed to target energy security and reduced greenhouse gas emissions, a national renewable fuels standard, cellulose specific subsidies, and a RFS combined with a variable subsidy.

## PUBLICATIONS (not previously reported): 2006/10 TO 2007/09

1. Quear, Justin, and Tyner, Wallace E. Development of A Variable Ethanol Subsidy and Comparison with the Fixed Subsidy. Staff paper 06-16, Department of Agricultural Economics, Purdue University, December 2006.
2. Hurt, Chris, Tyner, Wally, and Doering, Otto. Economics of Ethanol. Purdue Extension Publication ID-339, December 2006. <http://www.ces.purdue.edu/bioenergy>.
3. Tyner, Wallace E. U.S. Ethanol Policy: Possibilities for the Future. Purdue Extension Publication ID-342, January 2007. <http://www.ces.purdue.edu/bioenergy>.
4. Tyner, Wallace E., and Maxime Caffe. US and French Biofuels Policy: Possibilities for the Future. Paper presented at the OECD Workshop on Bioenergy Policy Analysis, Umea, Sweden, 22-23 January 2007.
5. Tyner, Wallace E.; and Taheripour, Farzad. Future Biofuels Policy Alternative., Paper presented at the Farm Foundation/USDA conference on Biofuels, Food, and Feed Tradeoffs, April 12-13, 2007, St. Louis, Missouri. <http://www.farmfoundation.org/projects/documents/Tynerpolicyalternativesrevised4-20-07.pdf>
6. Tyner, Wallace E. What We Know and What We Need to Know on Biofuels, Food, and Feed Tradeoffs. Presentation concluding the Farm foundation/USDA conference on Biofuels, Food, and Feed Tradeoffs, St. Louis, MO, April 12-13, 2007. <http://www.farmfoundation.org/projects/documents/biofuelspaper-tyner.pdf>
7. Taheripour, Farzad, and Tyner, Wallace E. Ethanol Subsidies: Who Gets the Benefits. Paper presented at the Farm Foundation/USDA conference on Biofuels, Food, and Feed Tradeoffs, April 12-13, 2007, St. Louis, Missouri. <http://www.farmfoundation.org/projects/documents/TaheripourandTynerStLouis.pdf>
8. Tyner, Wallace E. Biofuels, Energy Security, and Global Warming Policy Interactions. Paper presented at the National Agricultural Biotechnology Council conference, South Dakota State University, Brookings, SD, May 22-24, 2007.
9. Birur, Dileep, T. Hertel, and W. Tyner. Impact of Biofuel Production on World Agricultural Markets: A Computable General Equilibrium Analysis. Paper presented at the 10th annual GTAP conference, June 7-9, 2007, Lafayette, IN. <https://www.gtap.agecon.purdue.edu/resources/download/3225.pdf>
10. Tyner, Wallace E. The U.S. Biofuels Market: Policy Alternatives for the Future. Paper presented at the USAEE/IAEE North American Conference, Houston, Texas, September 16-19, 2007. <http://www.usaee.org/usaee2007/submissions/ExtendedAbs/wallace%20tyner.doc>

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ACCESSION NO: 0194612 SUBFILE: CRIS  
 PROJ NO: KS1007 AGENCY: CSREES KAN  
 PROJ TYPE: HATCH PROJ STATUS: NEW MULTISTATE PROJ NO: S-1007  
 START: 01 OCT 2002 TERM: 30 SEP 2007 FY: 2006

INVESTIGATOR: Sun, X. S.; Wang, D.

PERFORMING INSTITUTION:  
 GRAIN SCIENCE AND INDUSTRY  
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 MANHATTAN, KANSAS 66506

## THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY

NON-TECHNICAL SUMMARY: Fossil resource crisis has become global concern, which is driving to seek alternatives. This research will develop technologies of utilizing agriculture materials for industry uses, mainly for fuels and bioplastics, to meet national needs.

OBJECTIVES: I. To expand the scientific knowledge leading to significant economic improvements in biofuel production processes (Objective 2); II. To develop, evaluate, and optimize integrated processes to convert biomass resources into biomaterials with commercial applications (Objective 3).

APPROACH: For objective I (objective 2), co products or by products from grain processing line will be used as substrate for ethanol fermentation. Suitable microorganisms will be selected and evaluated for hydrolysis and ethanol production. Pretreatment methods will be developed and evaluated to improve the yield of soluble sugars with reduced loadings of cellulase enzymes, thereby reducing projected costs. Efficiency of enzymatic hydrolysis of cellulose and semicellulose is critical. Pretreatments such as grinding and chopping, thermal/pressure treatments with acid or base, biological treatment with fungi, and chemical fractionation will be used to increase the hydrolysis of cellulose and semicellulose. These pretreatments are able to reduce molecular bounding strength and crystallinity of the cellulose and semicellulose at molecular level and increase specific surface area, which will improve sugar conversion rate. The combined actions of enzymes and bacteria will be conducted to increase and optimize the ethanol fermentation and production. System optimization including the physical and chemical pretreatment conditions, hydrolysis conditions, and fermentation conditions for high yield and low cost will be studied. For Objective II (Objective 3), one of the objectives in this part is to characterize and evaluate rheological and thermal behaviors of starch and protein polymers as affected by their structure. Structure variations of starch and protein will be obtained using chemical or enzymatic treatments and various sources. Rheological properties and behaviors will be studied using both static and dynamic rheometers. Thermal behaviors and phase transition properties, such as glass transition, melting, and crystallization, will be characterized using differential scanning calorimetry (DSC). Another objective in this part is to develop bioplastics from starch based materials. Coupling reagents will be used to improve mechanical properties and performance. Existing facilities for processing petroleum based plastics will be evaluated for the starch based plastic manufacturing. Formulas will be optimized to meet industry specification for various products for disposable applications.

PROGRESS: 2006/01 TO 2006/12

I. Sorghum fiber conversion for ethanol: Sorghum is a major cereal crop in the United States. However, sorghum has been underutilized as a renewable feedstock for value-added products and industrial applications. The objective of this research is to develop pretreatment method to increase bioconversion rate of sorghum for ethanol production. During the past year progress has been made in developing and optimizing pretreatment methods to improve enzymatic hydrolysis of sorghum fiber and to increase ethanol yield by increasing starch loading in the fermentation broth. The major chemical composition of sorghum fiber includes starch, cellulose and hemicellulose. Sorghum fiber is considered a low-value byproduct. More than 5.6 lb of fiber can be obtained from each bushel of sorghum, which could be converted to approximately 3.19 lb of fermentable sugars. These fermentable sugars can theoretically yield about 0.27 gal of ethanol. Methods for pretreatment and enzymatic hydrolysis of sorghum fiber involved hot water treatment, acid hydrolysis, starch degradation, and enzymatic hydrolysis with cellulase and hemicellulose enzymes. Using a combination of starch degradation, optimum hot water treatment, and optimum enzymatic hydrolysis resulted in maximum total sugar yield up to 75%. Using decortication as pretreatment method, the ethanol yields increased from 9 to 17% depending on percentage of decortication. II. Biodegradable Agriculture Mulch Film: In 2006, we successfully developed first generation of mulch film with about 0.5 to 1 mm thickness. The film was tested in field for durability, and results were encouraging. Because of this, we received \$268,000 USDA/SBRI phase II funding for developing biodegradable agriculture mulch films in collaboration with AgRenew, Inc. Phase II project started Nov 1 2006, and everything is in progress. We continue working on PLA/starch based formula for large scale mulch film production in collaboration with a large plastic company in KS. We aim to reduce the thickness of the film to 0.1 mm by improving stretching properties in 2007. III. Soy Protein Adhesives for Foundry Industry: As identified in 2005, viscosity and curing time were two main drawback of the soy protein adhesive for foundry industry. We solved the viscosity problem and identified microwave curing technology that took only about 2 min for curing. The adhesion strength also met the performance requirements. In 2006, we focused on shelf life, temperature stability of this technology. Shelf life of this adhesive was about 1-2 months and temperature stability met the required application environment. However, most current foundry industries still use gas curing. The hurdle for commercializing this technology is the capital investment by replacing the gas curing with microwave technology. Therefore, in 2006, we focused on gas curing. No significant result has been achieved so far, but we received \$120,000 from industry starting Feb 1 2007. We aim to solve gas curing problem in 2007.

IMPACT: 2006/01 TO 2006/12

I. Sorghum fiber for ethanol: A dramatic increase in ethanol production using the current grain-starch-based technology may have resource limitations because grain production for ethanol will compete for the limited agricultural land needed for food and feed production. It is obvious that other feedstocks, such as agricultural residues, wood, municipal solid wastes, and wastes from pulp and paper industry, are potential resources for low-cost ethanol production. The future of ethanol production must lie on conversion of cellulosic biomass, not starch. II. Biodegradable agriculture mulch film: About \$300 million annual sales for agriculture mulch film. Current materials used for mulch film are those derived from petroleum based plastics, which causing soil pollution. Besides, the cost of current mulch film depends on petroleum resources. If this technology is successful and commercialized, the mulch film is biodegradable and will improve soil quality, and reduce dependence on petroleum resources. III. Soy protein adhesive for foundry: current adhesive for foundry are all environmental hazardous materials, such as formaldehyde, isocyanate based, poly vinyl acetate. Environment pollution is the major reason to seek environmental friendly resins for foundry.

PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. Cheng, E.Z. and Xiuzhi Susan Sun, 2006, Effects of Wood Surface Roughness, Adhesive Viscosity, and Processing Pressure on Adhesion strength of protein adhesives, *J of Adhesion Science and Technology*, 20(9): 997-1017.
2. Corredor, D., S.R. Bean, and D. Wang. 2006. Pretreatment and enzymatic hydrolysis of sorghum fiber. *Cereal Chemistry*. Accepted on Oct. 8, 2006.
3. Mo, Xiaoqun, Zhikai Zhong, Donghai Wang, Xiuzhi Sun, 2006, Soybean glycinin subunits: Characterization of physico-chemical and adhesion properties, *J. of Agriculture and Food Chemistry*, 54(20): 7589-7593
4. Shen, Xinchun, Robyn Moore, Xiaoqun Mo, Shawnalea J. Frazier, Takeo Iwamoto, John M. Tomich and Xiuzhi Susan Sun, 2006 Adhesion and Structure Properties of Protein Nanomaterials Containing Hydrophobic-Charged Amino Acids, *J of Nanoscience and Nanotechnology* 6: 837-844.
5. Stoll, M. E. W. T. Schapaugh, Jr., M. S. Zutara, J. Hu, X. S. Sun, 2006, Genotype and environment effects on adhesive shear strength in soybean-based adhesives, *Crop Science*, 46: 2008-2012.
6. Wang, Y. X. Mo, X.S. Sun, and D. Wang. 2006. Soy protein adhesion enhanced by glutaraldehyde crosslink. *J. Applied Polymer Science*. Accepted. Wang, Y. X.S. Sun, and D. Wang. 2006. Soy protein adhesive performance enhanced by esterification. *Transactions of the ASABE*. 49(3):713-719.
7. Zhan, X. D. Wang, S.R. Bean, X. Mo, X.S. Sun and D. Boyle. 2006. Ethanol production from supercritical extrusion-cooked grain sorghum. *Industrial Crops and Products*. 23(3):304-310.
8. Zhong, Zhikai, Xiuzhi Susan Sun, Donghai Wang, 2006, Isoelectric pH of polyamide-epichlorohydrin modified soy protein improved water resistance and adhesive strength, *J. of Applied Polymer Science* , 103(4): 2261-2270

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ACCESSION NO: 0203106 SUBFILE: CRIS  
 PROJ NO: KS324 AGENCY: CSREES KAN  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 OCT 2005 TERM: 30 SEP 2010 FY: 2006

INVESTIGATOR: Walawender, W. P.; Fan, L. T.

PERFORMING INSTITUTION:  
 CHEMICAL ENGINEERING  
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## VALUE-ADDED MANUFACTURE OF CARBON ADSORBENTS FOR NATURAL GAS AND HYDROGEN STORAGE FROM BIOMASS

**NON-TECHNICAL SUMMARY:** Kansas leads the nation in producing wheat and sorghum; however, their market values are often exceedingly low because of over-production. The manufacture of carbon adsorbents for the onboard storage of natural gas and hydrogen storage from such grains will profoundly add value to them. "Economic Development through Value-added Products" is one of the five core areas singled out in the recently issued Five-Year Work Plan of the K-State Research and Extension for 2005-2009. Naturally, the proposed research will contribute towards the goals of this core area. Moreover, the consumption of natural gas (NG) and hydrogen (H<sub>2</sub>) that emit far less pollutants than the consumption of fossil fuels will immensely contribute to the quality or sustainability of environments. This proposed research aims at establishing the technical and economic feasibility of manufacturing high-quality carbon adsorbents from biomass, mainly grains including wheat and sorghum, which are suitable for the onboard storage of natural gas and hydrogen.

**OBJECTIVES:** (1) To investigate the effects of modes and conditions of the operations for preparing the fine particles from grain-based activated carbons on the properties of the resultant fine particles (yr 1). (2) To investigate the effects of modes and conditions of the operation for preparing the carbon pellets for natural gas storage from the fine particles on the properties of the resultant carbon pellets (yrs 1 and 2). (3) To investigate the effects of modes and conditions of the operation for preparing the carbon pellets containing a transition metal for hydrogen storage on the properties of the resultant pellets (yrs 3 and 4). (4) To estimate the costs and assess the sustainability of various options for manufacturing the carbon pellets based on the resultant data and information (yrs 4 and 5).

**APPROACH:** (i) To achieve objective 1, the fine carbon particles from activated-carbon substrates will be prepared by various methods of milling and grinding, such as attrition, impact, and compression, and some combinations thereof. To characterize the properties of the resultant fine carbon particles, their particle-size distributions will be determined by sieving and microscopy; their shapes, by microscopy and image analysis; and their bulk densities, by directly weighing in a vessel with a known volume. The surface areas, pore-volumes, and pore-size distributions of the fine particles will be characterized with a gas sorption analyzer through the adsorption of N<sub>2</sub>, Ar, and/or CO<sub>2</sub> to minimize erroneous results which might arise from specific interactions of any of these gases with carbonaceous materials. Their surface areas will be determined by the BET (Brunauer, Emmett, and Teller) equation; their total pore volumes, estimated from the liquid volume of the adsorbate (N<sub>2</sub>); their micropore volumes, by the DR (Dubinin-Radushkevich) method; and their pore-distributions, by the density functional theory (DFT). (ii) To achieve objective 2, the carbon pellets for natural gas storage will be molded first by binding the fine carbon particles with the addition of a synthetic binder, such as furfuryl alcohol polymers, followed by the compaction of the bound particles into the pellets by single-step or multi-step procedures of varying modes, intensities, and durations with or without the aid of mechanical vibration. The properties of the resultant carbon pellets will be characterized similar to the fine carbon particles. In addition, the adsorption capacities of the pellets for natural gas will be experimentally measured at room temperature and moderately high pressure by adopting the procedure and facilities established in the current terminating project. For convenience, the measurements will be performed first with methane, the major component of natural gas, prior to the measurements with natural gas. (iii) To achieve objective 3, the carbon pellets for hydrogen storage will be impregnated with a transition metal by adding the chloride solution of this metal prior to or after the molding of the fine carbon particles. The transition metals to be explored include Pd, Pt, and Ru with the emphasis on the last: Catalytic activity of Ru is higher than that of either Pd or Pt. Subsequently, a dehydration step and an inert-gas purge step will be performed to remove impurities, such as moisture and chloride. Finally, wet reduction will be carried out in the presence of hydrogen to activate the metal. The properties of the resultant carbon pellets will be characterized similar to the fine carbon particles. Moreover, the adsorption capacities for hydrogen will be experimentally measured similar to natural gas. (iv) To achieve objective 4, the costs and sustainability of various manufacturing options for the onboard storage systems for natural gas and hydrogen will be assessed by resorting to the methodology of total cost assessment (TCA) and the evaluation of the thermal efficiencies of these manufacturing options based on energy as well as exergy (available energy).

**PROGRESS:** 2006/01 TO 2006/12



Carbon adsorbents prepared by our group from biomass have large surface areas, high microporosity, and narrow pore-size distributions (PSD's), thereby indicating that they can be immensely effective in adsorbing and storing gases, such as natural gas and hydrogen. These characteristics of carbon adsorbents from biomass are similar to those of carbon molecular sieves (CMSs). A stochastic model for the early stage of the formation of CMSs has been derived as a pure-birth process with a constant intensity of transition. The model has been validated with available experimental data; its mean value is in excellent accord with these data. Moreover, substantial effort has been made to relocate our laboratory and upgrade our experimental facilities.

IMPACT: 2006/01 TO 2006/12

Kansas leads the nation in producing wheat and sorghum; however, their market values are often exceedingly low because of over-production. The manufacture of carbon adsorbents for the onboard storage of natural gas and hydrogen storage from such grains will profoundly add value to them. Our investigation has shown that carbon adsorbents prepared by our group from biomass have very high adsorption capacities, thereby indicating that they can be immensely effective in adsorbing and storing gases, such as natural gas and hydrogen. The consumption of natural gas and hydrogen that emit far less pollutants than the consumption of fossil fuels will immensely contribute to the quality of the environment.

PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

Chou, S. T. and A. Argoti, "A Simple Markovian Model for the Initial Stage of the Formation of Carbon Molecular Sieves by Carbon Deposition," J. Chin. Inst. Chem. Eng., 37, 431-438 (2006).

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ACCESSION NO: 0200418 SUBFILE: CRIS

PROJ NO: KYSTROBEL AGENCY: CSREES KY.

PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: EXTENDED

CONTRACT/GRANT/AGREEMENT NO: 2004-35504-14678 PROPOSAL NO: 2004-01092

START: 01 SEP 2004 TERM: 31 AUG 2007 FY: 2006 GRANT YR: 2004

GRANT AMT: \$330,000

INVESTIGATOR: Strobel, H. J.; Lynn, B.

PERFORMING INSTITUTION:

ANIMAL & FOOD SCIENCES

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PROTEOMIC ANALYSIS OF ETHANOL SENSITIVITY AND TOLERANCE IN THERMOPHILIC AND ANAEROBIC BACTERIA

NON-TECHNICAL SUMMARY: The continued use of non-renewable resources for the production of fuels and other chemicals has negative impacts on the environment, economy, and national security. There is renewed interest in the development of technologies for producing chemicals, materials, and energy using biologically-based processes. The production of bio-ethanol offers considerable promise for decreasing fuel oil consumption and increasing domestic markets for agricultural and forestry commodities. Most bio-ethanol is currently produced using yeast fermentation of corn but the use of anaerobic and thermophilic bacteria (microbes that grow in the absence of oxygen and at high temperatures) offers the promise of fermenting other types of relatively inexpensive biomass. However, one of the technological barriers to efficient use bacteria is a relatively low ethanol tolerance. This sensitivity currently limits the commercial utility of many bacteria. This project will use state of the art approaches to study protein

expression by anaerobic thermophilic bacteria. These proteomic studies will help determine the physiological reasons why the bacteria are either sensitive or tolerant to ethanol.

**OBJECTIVES:** There is renewed interest in the development of technologies for producing chemicals, materials, and energy using biologically-based processes. Much of this has been prompted by general recognition that continued use of petroleum and fossil fuels will have negative impacts on the environment, economy, and national security. The production of bio-ethanol offers considerable promise for decreasing fuel oil consumption and increasing the domestic markets for agricultural and forestry commodities. Bioconversion of fibrous organic material by thermophilic anaerobic bacteria circumvents some of the problems associated with yeast fermentations that are currently used to produce most bio-ethanol, but one of the technological barriers to efficient biomass conversion by bacteria is the relatively low ethanol tolerance that nearly all prokaryotes have when compared to yeast. Other microbial processes of commercial importance also are negatively impacted by fermentation end products, and this sensitivity constrains the commercial utility of many microorganisms. There is still relatively little detailed information on the mechanisms causing physiological cellular alterations that occur in response to ethanol. Until recently, it was tedious and time-consuming to examine the many possible changes in protein expression that a cell can exhibit in response to an environmental stress such as ethanol exposure. However, state-of-the-art proteomic approaches are now available to efficiently identify protein expression changes. Our basic hypothesis is that exposure of thermophilic anaerobic bacteria to ethanol causes specific alterations in protein expression patterns, and the overall project goal is to identify and define these changes using proteomic approaches. *Clostridium thermocellum* and *Thermoanaerobacter ethanolicus* are thermophilic anaerobes that produce ethanol, degrade polymeric carbohydrates, and have been proposed for use in biomass conversion systems. These organisms will be used to model the specific effects that ethanol has on the proteomes of thermophilic anaerobic bacteria. Our experiments will provide basic information needed to overcome present process limitations and to optimize microbial conversion of biomass to alcohol, solvents and other useful products. The specific objectives are to: Objective 1: Characterize alterations in the proteomic profile of *C. thermocellum* and *T. ethanolicus* in response to ethanol challenge. Objective 2: Determine the proteomic profile of ethanol resistant strains. Objective 3: Examine if proteomic changes elicited by ethanol are similar to those caused by environmental stresses including temperature, pH, and organic solvents. Objective 4: Evaluate alternative approaches to identify and quantify changes in proteomes of thermophilic bacteria.

**APPROACH:** The underlying hypothesis that will drive and direct this project is that exposure of thermophilic anaerobic bacteria to ethanol causes specific alterations in protein expression patterns. The overall goal is to identify and define these changes using proteomic approaches. Specifically, *Clostridium thermocellum* and *Thermoanaerobacter ethanolicus* strains will be used to model the effects that ethanol has on the proteomes of thermophilic anaerobes. The general approach is based on the well-established observations that (i) thermophilic anaerobic bacteria are relatively ethanol sensitive, (ii) alterations in membrane composition, enzyme activity, and metabolic pathways occur in response to ethanol challenge, and (iii) organisms adapted to ethanol often have altered cellular characteristics when compared to sensitive parent strains. In Objective 1, the proteomic profiles of ethanol sensitive wild-type strains will be evaluated in the absence and presence of ethanol (i. e., ethanol challenge). During this phase of the project, protocols will be developed and refined to optimize protein separation and identification from the thermophilic bacterial samples. The results of these experiments will be used for subsequent objectives and will provide the baseline proteome for both organisms. The protein profiles of wild-type and ethanol-challenged cells will then be compared to ethanol-adapted cultures in Objective 2. Although there may be similarities between ethanol-challenged and ethanol-adapted cultures, we predict that qualitative and quantitative differences will be observed and that proteome analysis will reveal potential reasons as to why and how cells adapt to ethanol. Since ethanol is an environmental stress, Objective 3 is designed to examine whether the proteome changes noted in response to ethanol are similar to those seen for other environmental stresses. These results will be useful in determining if the responses and regulatory mechanisms seen for ethanol-stressed cells are common to the better characterized systems already known for other stress factors (e. g., heat stress). Finally, Objective 4 is designed to explore new opportunities that exist in characterizing and quantifying proteomic differences. Together, the results from these four objectives will provide basic information that is needed in targeting specific metabolic steps and machinery for alteration, either through genetic manipulation or changes in process conditions during fermentation.

**PROGRESS:** 2006/01 TO 2006/12

Increased bio-fuel production in the United States is being prompted by recognition that continued use of fossil fuels has negative consequences for the environment, economy, and national security. Bio-ethanol offers promise for diversifying the national fuel portfolio, decreasing oil consumption, reducing environmental impacts, and increasing domestic markets for agricultural commodities. Nearly all bio-ethanol in the United States is currently produced using yeast fermentation of maize starch, but there are constraints to the cost-effective and long-term use of this approach. In addition, some lifecycle analyses suggest that producing bio-ethanol from corn offers little, if any, environmental advantage to petroleum-based fuels. An alternative strategy is to use thermophilic anaerobic bacteria for the conversion of cellulosic biomass to ethanol. Using cellulosic feedstocks has the potential to be economically and environmentally viable in the long-term. *Clostridium thermocellum* is a thermophilic anaerobic bacterium that directly converts fibrous feedstocks into ethanol. However, a technological barrier to efficient biomass conversion by this organism is its relatively low ethanol tolerance. We have selected an ethanol-resistant strain of *C. thermocellum* and are using state-of-the-art protein analysis techniques to characterize the molecular basis of ethanol resistance. Our initial studies utilized traditional gel-based protein separations, and we demonstrated that protein expression in the tolerant strain was dramatically different than in the sensitive wild-type. However, gel-based separations are limited by their ability to detect and resolve proteins that are high molecular weight, highly basic, or hydrophobic. With this in mind, we developed a two-dimensional liquid chromatography separation scheme coupled to tandem mass spectrometry (Multi-dimensional Protein Identification Technology; MudPIT). Our most recent work has refined this non-gel approach to provide better quantification by using a metabolic labeling strategy. Wild-type (ethanol-sensitive) cells were grown in the presence of isotopically labeled ammonium sulfate (15-N) while the ethanol-tolerant strain was grown in medium containing non-labeled ammonium sulfate (14-N). The 15-N labeled cells served as internal standards; this minimized experimental errors and provided better quantitative comparison of differences in protein levels. MudPIT analysis revealed that the expression of more than 60 proteins was significantly affected by adaptation to ethanol. These proteins take part in a wide variety of functional processes including regulation of transcription, translation, signal transduction, metabolism, transportation, post-translational modification. This is the first quantitative proteomic analysis of *C. thermocellum* based on the MudPIT approach. In summary, we have a reliable MudPIT analysis platform that can be used to profile the *C. thermocellum* proteome. These experiments will provide information needed to overcome present process limitations and to optimize microbial conversion of cellulosic biomass to alcohol, solvents and other useful products.

**IMPACT: 2006/01 TO 2006/12**

Continued dependence on fossil-based fuels has negative impacts on the environment, economy, and national security. The conversion of cellulosic biomass by microorganisms to bio-based products and bio-energy is a sustainable alternative. Estimates are that nearly 11 million tons of agricultural, forestry and urban biomass could be used each year for bio-fuel production in Kentucky. Bio-conversion of these feedstocks could yield 600 million gallons of ethanol, and this production could replace a significant quantity of the gasoline utilized in the state. However, there are still significant barriers that prevent the economical implementation of bio-based technologies. Our studies combine the information contained in genomic sequence databases with the emerging field of proteomics to examine the metabolism of anaerobic bacteria under industrially relevant conditions. The results of this work will be useful in designing economically relevant bio-based processes that utilize cellulosic biomass. The University of Kentucky Mass Spectrometry Facility is a partner in this project.

**PUBLICATIONS (not previously reported): 2006/01 TO 2006/12**

Williams, T. I., Combs, J. C., Thakur, A. P., Strobel, H. J., and B. C. Lynn. 2006. A novel bicine running buffer system for doubled sodium dodecyl sulfate polyacrylamide gel electrophoresis of membrane proteins. *Electrophoresis* 27:2984-2995.

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ACCESSION NO: 0212868 SUBFILE: CRIS  
 PROJ NO: LAB93884 AGENCY: CSREES LA.B  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 OCT 2007 TERM: 30 SEP 2012

INVESTIGATOR: Boldor, D.

PERFORMING INSTITUTION:  
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#### MICROWAVE TECHNOLOGIES FOR POSTHARVEST PROCESSING OF BIODIESEL FEEDSTOCK

**NON-TECHNICAL SUMMARY:** The current and global energy markets will require the use of alternative renewable fuels to a significant degree as fossil fuels prices have increased to new heights. The proposed research project will investigate the use of environmental-friendly microwave technology to extract oils and convert them into biodiesel through a transesterification reaction in which the oil is mixed with an alcohol in the presence of a catalyst. The resulting products are biodiesel and glycerol, an important chemical with multiple industrial and agricultural uses. Biodiesel can be used in most modern Diesel engines without any modifications and loss of performance. The main objectives are to extract, separate and characterize the lipid source in three oil feedstocks (rice bran, soybeans, and Chinese tallow trees seeds), to convert these oils into biodiesel, and to optimize the process such that it can be scaled to pilot and industrial level. The microwave extraction and transesterifications will be achieved in both batch and continuous mode. The use of alternative stocks for biodiesel production and adding values to some of the traditional crops grown in Louisiana (rice and soybeans) will generate significant new and additional revenue for the state's agricultural sector, spurring economic development.

**OBJECTIVES:** The overall objective of this research project is to foster the development of a biodiesel industry using traditional and alternative resources specific to the State of Louisiana (rice bran, soybeans, and Chinese tallow tree seeds - CTT). The economy of Louisiana is heavily dependent on the oil, gas and petrochemical industry; therefore it is exposed to fluctuations in the price of fossil fuels. While the current global environment calls for high fossil fuels prices, this is the most appropriate time to start developing the future of the energy-based economy using the abundant renewable natural resources available in Louisiana (high yield agricultural and forestry crops, favorable climate). Current technologies and feedstock for bioenergy production are not competitive with fossil fuels at low petroleum and natural gas prices. By developing cost-saving post-harvest processing methods and technologies for bioenergy production now, Louisiana will position itself at the forefront of the future renewable energybased economy. The State's economy will therefore be shielded to oscillations in fossil fuel prices due to depletion of fossil resources, political and social instability in oil-producing countries, and eventual dramatic drops in fossil fuel prices.

**APPROACH:** 1. To successfully separate, extract, and quantify the vegetable tallow and *Stillingia* oil from the CTT seeds and oil from soybeans and rice bran using batch and continuous microwave technology; 2. To characterize the composition of oil and vegetable tallow of CTT, soybeans, and rice bran; 3. To achieve microwave-assisted trans-esterification of these lipids into biodiesel; 4. To analyze the composition of the resulting streams or products and to optimize the process; 5. To scale up the extraction and trans-esterification processes to a 5 kW continuous system; 6. To estimate the feasibility and economic viability of the process.

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ACCESSION NO: 0405512 SUBFILE: CRIS  
 PROJ NO: 5447-41000-002-01S AGENCY: ARS 5447  
 PROJ TYPE: USDA COOPERATIVE AGREEMENT PROJ STATUS: NEW  
 START: 01 MAY 2002 TERM: 30 APR 2007 FY: 2006

INVESTIGATOR: ROSENTRATER K A; MCCALLA D

PERFORMING INSTITUTION:  
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IMPROVED USES AND VALUES FOR DRIED DISTILLERS GRAINS AND C4 GRASS  
 FEEDSTOCKS

OBJECTIVES: 1) Make, analyze, and test modified dried distillers grains and other dry mill residues. 2) Assess pretreatment and biorefining technologies.

APPROACH: 1) Develop high protein dried distillers grains using quick germ/fiber removal. 2) Develop beef rations from dried distillers grains and AFEX treated corn stover. 3) Develop ammonia fiber explosion pretreatment process for corn stover and C4 grass feedstocks. 4) Establish pretreatment laboratory for C4 grass feedstocks, corn stover, and corn fiber. 5) Establish pilot plant for C4 grass feedstocks, corn stover, and corn fiber.

PROGRESS: 2005/10 TO 2006/09

Progress Report 1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? Why does it matter? This project is aligned with NP 307 Bioenergy and Energy Alternatives and NP 306 Quality and Utilization of Agricultural Products. The major problems addressed by this research include depleting nonrenewable petroleum resources, making the U.S. more energy independent, providing value-added products from raw agricultural commodities, improving rural and agricultural economies, and preserving air, water, and environmental quality. This research will help resolve these problems by developing and evaluating processes and products that will increase the value of corn-to-ethanol byproducts, which are currently known as distillers dried grains (DDGS). Specifically, this projects goals include determining the potential for converting these byproduct materials into animal feeds and other value-added products, such as industrial chemicals and products. Achieving these goals will thus augment and bolster ethanol production processes and economics. In summary, this research will develop valuable coproducts from distillers dried grains currently produced in the corn-based fuel ethanol industry. For years, agricultural and rural economies have been suffering from the effects of low commodity prices. Generally speaking, the price for many agricultural commodities received by farmers has been below the cost of production. This situation has caused many farmers to go out of business which, in turn, has caused many rural economies to collapse. Furthermore, the energy security of the United States has become unstable because the U.S. increasingly imports a majority of oil from non-domestic sources. Additionally, the U.S. economy suffers when the availability, and thus the cost, of imported oil dramatically fluctuates. Research to develop value-added coproducts from the byproducts of fuel ethanol production could help ease these problems by supporting the development of the domestic bioethanol industry, by providing increased and sustainable incomes in rural economies, by the development of new bio-based products that will replace products currently made from petroleum and other non-renewable materials, and by increasing the domestic production of renewable energy which, in turn, can improve the energy security of the U. S. The majority of ethanol production facilities are currently built and operated by small companies or farm-based cooperatives that have little or no budgets for research. Thus, the successful completion of this research will directly benefit ethanol producers, farmers, and the rural communities where these industries are located. The consumer and general public will also benefit from this research through the stabilization of fuel availability as well as gasoline prices at the pump. 2. List by year the currently approved milestones (indicators of research progress) Specific tasks and deliverables that are to be accomplished by MBI International are provided in the Statement of Work which is submitted each year to ARS. Additional details regarding research can be found in the report for the parent ARS Project #5447-41000-001-00D (Fiber Extrusion to Improve Use and Production of Ethanol Byproducts). 4a List the single most significant research accomplishment during FY 2006. This project

directly contributes to the accomplishment of ARS Strategic Plan Goals #1 (Enhance Economic Opportunities for Agricultural Producers) and #2 (Support Increased Economic Opportunities and Improved Quality of Life in Rural America). The project addresses NP 307 Component I, Ethanol Coproduct Development; NP 306 Action Plan Component 2, Problem Area 2b, New Uses for Agricultural By-Products Cereals, Oilseeds, and Novel Crops; and NP 306 Component 2, Problem Area 2c, New and Improved Processes and Feedstocks Cereals, Oilseeds, and Novel Crops. During FY2006, an agreement was signed between MBI and a significant ethanol producer to develop a biorefinery utilizing the AFEX treatment process to produce succinic acid from dry mill corn fiber. 4b List other significant research accomplishment(s), if any. Completed work under a Value Added Producer Grant (VAPG) between Heartland Grain Fuels, Aberdeen, SD, and USDA Rural Development. The Heartland plant was used as a model to demonstrate the biorefinery concepts of dry corn fractionation in an ethanol plant to produce corn oil, high protein DDG, and corn germ meal as value added byproducts. Developed relationship with a significant ethanol partner to proceed with the commercial development of the AFEX Process. Using AFEX treated corn fiber as the feedstock in simultaneous saccharification and fermentation (SSF), with batch feeding, we were able to obtain solids loadings up to 34%, ethanol concentrations in the broth of 70 grams per liter, and 87% of the total glucose (from starch and cellulose) was converted to ethanol. From the broth of these fermentations we were able to precipitate a pellet that contained 75.86% of the xylan and 67.30% of the arabinose. Analysis of the precipitated pellet indicates it is 50.75% sugars, 26.3% crude protein, 5.53% ash, and 17.43% other material. The pellet sugars were 58.46% xylan and 25.83% arabinan, mostly in polymeric form. 4c List significant activities that support special target populations. The work on discovering and developing new value-added coproducts from the corn-to-ethanol process will support small farms by improving ethanol production economics and thus creating a higher demand for corn, thereby increasing profits to small farms. 4d Progress report. This report serves to document research conducted under a specific cooperative agreement between ARS and MBI International. Additional details regarding research can be found in the report for the parent CRIS #5447-41000-001-00D (Fiber Extrusion to Improve Use and Production of Ethanol Byproducts). The research conducted under this cooperative agreement is aimed at developing valuable coproducts from the distillers dried grains produced in the corn-to-bioethanol manufacturing process, as well as investigating the potential for using other lignocellulosic feedstocks for the bioethanol manufacturing process. Objectives of this cooperative agreement are to investigate the use of new technologies to enhance the value of the byproducts of ethanol manufacturing, with particular emphasis on products with animal feed value, to investigate pretreatment technologies (i.e., AFEX pretreatment) on biomass materials that could become feedstocks for fermentation into ethanol, particularly corn fiber, corn stover, switchgrass, and other warm season grasses, and to investigate the potential for these materials to impact the economy of the North Central region of the U.S. Research conducted thus far has focused on four broad areas: 1) evaluation of de-germed and de-fibered corn that generates high protein, low phosphorous DDGS streams; 2) evaluation of AFEX treated corn stover, corn fiber, and DDGS fiber; 3) the development of a bench scale AFEX treatment process to process corn fiber, corn stover, switchgrass, and DDGS fiber; and 4) the development of a pilot-scale, continuous AFEX treatment process. Research is currently underway in each of these areas. Bench-scale analysis has been completed, and the resulting data has been used to create a computer model of an AFEX-based biorefinery that is operated concurrently with a dry mill ethanol plant. To achieve biorefining, the manufacturing process includes corn fractionation, corn oil extraction, AFEX treatment of corn fiber, and subsequent fermentation into ethanol. Results from this model have been used to develop engineering designs for a biorefinery pilot plant, including process, layout, and construction plans. In order to implement these plans for a biorefinery pilot plant, a partnership base and business plan are currently being assembled for construction and operation. 5. Describe the major accomplishments to date and their predicted or actual impact. This project directly contributes to the accomplishment of ARS Strategic Plan Goals #1 (Enhance Economic Opportunities for Agricultural Producers) and #2 (Support Increased Economic Opportunities and Improved Quality of Life in Rural America). The project addresses NP 307 Component I, Ethanol Coproduct Development; NP 306 Action Plan Component 2, Problem Area 2b, New Uses for Agricultural By-Products Cereals, Oilseeds, and Novel Crops; and NP 306 Component 2, Problem Area 2c, New and Improved Processes and Feedstocks Cereals, Oilseeds, and Novel Crops. Toward these ends, the research work conducted within this project is focused on investigating and conducting research on value-added uses for residue streams resulting from the manufacture of bioethanol, and is administered under the auspices of ARS National Program #307 (Bioenergy and Energy Alternatives) and #306 (Quality and Utilization of Agricultural Products). Major accomplishments for the research project have been reported to ARS in annual reports from MBI International, and are also documented in this report. To date, the major accomplishments of this project include bench- scale analysis of sugar production from corn stover, warm

season grasses, and DDGS fiber utilizing novel processing technologies (i.e., AFEX pretreatments). This research has shown that various low-value biological materials have potential viability for utilization as feedstocks for conversion into ethanol. In general, results to date have provided an essential step in assessing the feasibility of scaling up AFEX pretreatment and biorefining operations to commercial production, which have the potential to increase the profitability of current ethanol manufacturing operations, and ultimately could help support small farms by creating an increased demand for corn grain, corn stover, as well as other low-value cellulosic materials. Additionally, computer simulation models for a biorefinery pilot plant, as well as a commercial ethanol manufacturing plant have been constructed and analyzed. Furthermore, a pilot plant to implement these concepts has been designed; process, layout, and construction plans have been completed; and feasibility studies have been completed. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? During FY2006, MBI reached agreement with a commercial partner for the commercialization of the AFEX technology as a pretreatment for dry mill fractionated corn fiber. 7. List your most important publications in the popular press and presentations to organizations and articles written about your work. (NOTE: List your peer reviewed publications below). 28th Symposium on Biotechnology for Fuels and Chemicals, Nashville, TN April 30 May 3, 2006 Conference Proceedings: "Separation of Glucose and Pentose Sugars by Selective Enzyme Hydrolysis of AFEX-treated Corn Stover". Hanchar, Teymouri, McCalla and Stowers. 2005 American Institute of Chemical Engineers Annual Meeting, Cincinnati, OH October 30 November 4, 2005 Technical Presentation: "Simultaneous Saccharification and Fermentation (SSF) of AFEX-treated Corn Fiber, Bagasse and CLM Using Fed-batch Technique". Teymouri, Guettler, McCalla and Stowers.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09  
No publications reported this period.

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ACCESSION NO: 0194307 SUBFILE: CRIS  
PROJ NO: MICL02047 AGENCY: CSREES MICL  
PROJ TYPE: HATCH PROJ STATUS: NEW MULTISTATE PROJ NO: S-1007  
START: 01 OCT 2002 TERM: 30 SEP 2007 FY: 2006

INVESTIGATOR: Lira, C.

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SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY

NON-TECHNICAL SUMMARY: New technologies and educational programs are needed to support a biobased economy. This project will generate new technologies and educational programs to support a biobased economy.

OBJECTIVES: Objective 4: Biobased Chemicals. Objective 5: Education and Outreach.

APPROACH: Objective 4, Biobased Chemicals: Proteins will be used as biocatalysts to produce high-value products from renewable raw materials. Objective 5, Education and Outreach: Three educational and outreach tasks will be directed at identifying needed educational materials, developing those materials in distance-based delivery methods and developing a trained work force to support a biobased economy. The tasks include (1) development of an advisory board for the National Resource Center, (2), development of educational materials in high-priority topic areas, and (3) development of a national resource center for biomass education.

PROGRESS: 2006/01 TO 2006/12

The elevated pressure reactive distillation column designed by Dr. Lira and Dr. Miller is in its final stages of construction. All column components have been acquired and are being installed. The supporting

framework for the column is in place. The column is expected to be operational in February, 2007 and will be immediately put to use for two new projects that Dr. Miller and Dr. Lira are leading. One project, funded by the MEDC 21st Century Jobs Fund, is the production of succinic acid esters via reactive distillation. The second project, funded by the USDA NRI Program, is for the use of reactive distillation to produce an improved composition of biodiesel. The successful proposals submitted for these projects were significantly strengthened by the commitment of funds from the USDA 'Enabling Biorefineries' project. Mark Worden's lab is using nanofabrication methods to develop new, high-performance catalytic interfaces containing dehydrogenase enzymes, which carry out oxidation and reduction reactions. The resulting bioelectronic interfaces can use spontaneous chemical reactions to generate electricity (biological fuel cells) or use electricity to drive chemical reactions (biocatalytic reactors). Site-directed mutagenesis resulted in production of a new secondary alcohol dehydrogenase enzyme that used NADH as opposed to the much more expensive NADPH. Also, methods have been developed that allow the labile components of the bioelectronic interfaces to be regenerated. Dr. Bruce Dale's lab is working on developing integrated pretreatment, hydrolysis and fermentation systems to convert cellulosic biomass to fuels such as ethanol. Five doctoral students and a post doc are currently involved in these integrated projects. Among the important advances achieved this year are: reduction in the amount of ammonia required and concentration of ammonia required for effective application of the ammonia fiber expansion (AFEX) process, better understanding of the fundamental mechanisms that make AFEX effective, development of microplate screening methods for high throughput analysis of treated cellulosic biomass and the first demonstration that pretreated biomass (by AFEX) can be fermented by recombinant organisms without any detoxification or nutrient supplementation. Detoxification and nutrient supplementation are absolutely required for acid pretreated biomass. A major corn dry miller is now involved in scaling up and commercializing AFEX. The 2006 multi-state meeting was attended by Professor Dennis Miller.

#### IMPACT: 2006/01 TO 2006/12

The reactive distillation work will facilitate the simultaneous production and purification of biobased products, thereby making them more competitive with petroleum derived products. Biodiesel economics will be improved by this process. The large scale column will give us the opportunity to test concepts and develop process economics in a way that cannot be done with smaller devices. Biological fuel cell technology is improved by the nanofabrication technology. This marriage of biotechnology and nanotechnology is among the most fertile areas for advancing the use of biology to process agricultural materials for chemicals and fuel production. Finally, the work on cellulosic ethanol production is directly related to President Bush's call to reduce the cost of ethanol production from domestic energy crops such as switchgrass. The intense interest in this area is highlighted by the fact that the AFEX process is now in the early stages of commercial application.

#### PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. Vu, D.T.; Lira, C.T.; Asthana, N.S.; Kolah, A.K. Miller D.J. Vapor-liquid equilibria in the systems Ethyl Lactate + Ethanol and Ethyl Lactate + Water, *J. Chem. Eng. Data* 51, 1220-1225, (2006)
2. Brian L. Hassler, Megan Dennis, Maris Laivenieks, J. Gregory Zeikus, and Robert M. Worden (2007) Mutation of Tyr-218 to Phe in *Thermoanaerobacter ethanolicus* secondary alcohol dehydrogenase: effects on bioelectronic interface performance, *Applied Biochemistry and Biotechnology*, (in press)
3. Dale, B. E. Impacts of Ethanol on the Farm Economy. A High Growth Strategy for Ethanol. p. 31-42. Report of an Aspen Institute Policy Dialogue, published by the Aspen Institute, Queenstown, Maryland (2006)
4. Bals, B.; Dale, B. E.; Balan, V. Enzymatic Hydrolysis of Distillers Dry Grains and Solubles (DDGS) using Ammonia Fiber Expansion Pretreatment. *Energy and Fuels* 20, 2732-2736, (2006).
5. Saffron, C.; M., Park, J. H.; Dale, B. E.; Voice, T. C. Kinetics of Contaminant Desorption from Soil: Comparison of Model Formulations using the Akaike Information Criterion. *Environmental Science and Technology* 40, 7662-7667, (2006).
6. Laureano-Perez, L.; Dale, B. E.; ODwyer, J. P.; Holtzapple, M. Statistical Correlation of Spectroscopic Analysis and Enzymatic Hydrolysis of Poplar Samples. *Biotechnology Progress* 22, 835-841, (2006).

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ACCESSION NO: 0203508 SUBFILE: CRIS  
 PROJ NO: MICL03414 AGENCY: SAES MICL  
 PROJ TYPE: STATE PROJ STATUS: NEW  
 START: 01 MAY 2005 TERM: 30 APR 2010 FY: 2006

INVESTIGATOR: Dale, B. E.; Lira, C. T.; Worden, R. M.; Miller, D. J.

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#### ENABLING BIOREFINERIES

**NON-TECHNICAL SUMMARY:** Excessive reliance on decreasing supplies of petroleum underlies many of our national security, economic, social and environmental problems. These problems will only increase in the future, unless they are addressed and solved now. Our purpose is to enable the economic and widespread adoption of biorefineries converting plant biomass into fuels, chemicals and other products. We will develop economic, efficient processing technology and system wide models to promote biorefinery deployment and ensure their economic and environmental viability.

**OBJECTIVES:** We are in the early phases of a truly historic transition--from an economy based largely on petroleum to a more diversified economy in which renewable plant biomass will become a significant feedstock for food, fuel and chemical production. While remaining supplies of petroleum, coal and natural gas are very large, it is nonetheless obvious that the world is using these essentially nonrenewable resources at a huge and growing rate. Some experts believe that the peak rate of production of conventional oil will occur within this decade, while others predict this turning point will occur before mid century. After that point, conventional production of cheap oil will irreversibly decline. Although other sources of petroleum exist (eg, tar sands, deepwater oil), they will be more difficult and much more expensive to produce. Whatever the exact date of peak oil production, it is obvious that we are approaching a major change in the way we must provide energy and other services to the population of the world. Our overall research objective is to help develop and deploy biorefineries that will convert plant biomass into replacements for petroleum derived products. Specifically we are interested in developing new processing technologies that effectively and economically convert plant biomass into fuels, chemicals and materials. We are also developing system wide models that allow us to better understand the economic and environmental performance of biobased products. The purpose of this modeling and systems research is to help guide research efforts so that biobased products achieve their full economic and environmental potential to improve our well being.

**APPROACH:** Although biomass has some disadvantages compared to petroleum, its embedded energy content and costs suggest significant potential to provide raw material and energy services. We believe the disadvantages of biomass will be overcome by upgrading biomass in large, integrated processing facilities called biorefineries. Among the products derived from biomass are liquid transportation fuels, electricity and steam, a tremendous variety of chemicals, monomers and polymers, lubricants, adhesives, fertilizers as well as animal feeds. Biorefineries will first separate and react the raw materials to a relatively small range of intermediates including carbohydrates, proteins, lipids etc. These intermediates will then be upgraded by further reaction and separation steps to a very wide variety of final products. This is exactly the way we now process petroleum. This proposal supports our overall effort to refine biomass. We will develop the processing technology to effectively and efficiently convert biomass to fuels, chemicals and materials. We will also develop economic and environmental models to support biorefinery development. Specifically, our first three years of research will focus in the following areas: 1) Redox enzymes carry out oxidation and reduction reactions to convert biobased raw materials into high-value products. Industrial application of redox enzymes is limited by a many factors. The Worden lab will address these limitations. Novel redox enzymes will be isolated from the genome of *Galdieria sulphuraria*, a eukaryotic microbe that grows at high temperature and extremely low pH. Novel interfaces and materials that provide efficient communication

between the redox enzymes, electrodes, cofactors, and other molecules will be developed in conjunction with collaborators. 2) Research funding through MAES will assist Dr. Dennis Miller's laboratory in research on catalysis and separations for the biorefinery. More specifically, we will identify better catalysts for chemical conversions of biorenewables, enabling low cost, highly selective reactions to produce products that will replace existing petroleum based compounds. We also focus on reactive distillation as a new method for forming and purifying biobased products in a single process step. 3) Dr. Carl Lira's laboratory works in process design for separations in the biorenewable process stream. Process platforms based on biorenewables involve molecules and mixtures that are incompletely characterized in existing literature. We will more completely characterize these components and mixtures for targeted process and separation strategies. 4) Finally, MAES funds will be used in Dr. Bruce Dale's group to model biorefinery processes using chemical engineering process simulation software such as ASPEN. Our objective is to identify the most cost sensitive areas of selected processes to better target them for research. A second modeling effort is life cycle analysis of integrated biorefining systems to identify needed areas for environmental improvement and to better compare the environmental performance of these systems with that of petroleum refining systems.

#### PROGRESS: 2006/01 TO 2006/12

The elevated pressure reactive distillation column designed by Dr. Lira and Dr. Miller is in its final stages of construction. All column components have been acquired and are being installed. The supporting framework for the column is in place. The column is expected to be operational in February, 2007 and will be immediately put to use for two new projects that Dr. Miller and Dr. Lira are leading. One project, funded by the MEDC 21st Century Jobs Fund, is the production of succinic acid esters via reactive distillation. The second project, funded by the USDA NRI Program, is for the use of reactive distillation to produce an improved composition of biodiesel. The successful proposals submitted for these projects were significantly strengthened by the commitment of funds from the USDA Enabling Biorefineries project. Mark Worden's lab is using nanofabrication methods to develop new, high-performance catalytic interfaces containing dehydrogenase enzymes, which carry out oxidation and reduction reactions. The resulting bioelectronic interfaces can use spontaneous chemical reactions to generate electricity (biological fuel cells) or use electricity to drive chemical reactions (biocatalytic reactors). Site-directed mutagenesis resulted in production of a new secondary alcohol dehydrogenase enzyme that used NADH as opposed to the much more expensive NADPH. Also, methods have been developed that allow the labile components of the bioelectronic interfaces to be regenerated. Dr. Bruce Dale's lab is working on developing integrated pretreatment, hydrolysis and fermentation systems to convert cellulosic biomass to fuels such as ethanol. Five doctoral students and a post doc are currently involved in these integrated projects. Among the important advances achieved this year are: reduction in the amount of ammonia required and concentration of ammonia required for effective application of the ammonia fiber expansion (AFEX) process, better understanding of the fundamental mechanisms that make AFEX effective, development of microplate screening methods for high throughput analysis of treated cellulosic biomass and the first demonstration that pretreated biomass (by AFEX) can be fermented by recombinant organisms without any detoxification or nutrient supplementation. Detoxification and nutrient supplementation are absolutely required for acid pretreated biomass. A major corn dry miller is now involved in scaling up and commercializing AFEX.

#### IMPACT: 2006/01 TO 2006/12

The reactive distillation work will facilitate the simultaneous production and purification of biobased products, thereby making them more competitive with petroleum derived products. Biodiesel economics will be improved by this process. The large scale column will give us the opportunity to test concepts and develop process economics in a way that cannot be done with smaller devices. Biological fuel cell technology is improved by the nanofabrication technology. This marriage of biotechnology and nanotechnology is among the most fertile areas for advancing the use of biology to process agricultural materials for chemicals and fuel production. Finally, the work on cellulosic ethanol production is directly related to President Bush's call to reduce the cost of ethanol production from domestic energy crops such as switchgrass. The intense interest in this area is highlighted by the fact that the AFEX process is now in the early stages of commercial application.

#### PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. Brian L. Hassler, Megan Dennis, Maris Laivenieks, J. Gregory Zeikus, and Robert M. Worden (2007) Mutation of Tyr-218 to Phe in *Thermoanaerobacter ethanolicus* secondary alcohol dehydrogenase: effects on bioelectronic interface performance, *Applied Biochemistry and Biotechnology*, (in press)

2. Dale, B. E. Impacts of Ethanol on the Farm Economy. A High Growth Strategy for Ethanol. p. 31-42. Report of an Aspen Institute Policy Dialogue, published by the Aspen Institute, Queenstown, Maryland (2006)
3. Bals, B.; Dale, B. E.; Balan, V. Enzymatic Hydrolysis of Distillers Dry Grains and Solubles (DDGS) using Ammonia Fiber Expansion Pretreatment. *Energy and Fuels* 20, 2732-2736, (2006).
4. Saffron, C.; M., Park, J. H.; Dale, B. E.; Voice, T. C. Kinetics of Contaminant Desorption from Soil: Comparison of Model Formulations using the Akaike Information Criterion. *Environmental Science and Technology* 40, 7662-7667, (2006).
5. Laureano-Perez, L.; Dale, B. E.; ODwyer, J. P.; Holtzaple, M. Statistical Correlation of Spectroscopic Analysis and Enzymatic Hydrolysis of Poplar Samples. *Biotechnology Progress* 22, 835-841, (2006).

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ACCESSION NO: 0210467 SUBFILE: CRIS  
 PROJ NO: MICL03448 AGENCY: SAES MICL  
 PROJ TYPE: STATE PROJ STATUS: NEW  
 START: 01 MAY 2007 TERM: 30 APR 2012

INVESTIGATOR: Joshi, S. V.

**PERFORMING INSTITUTION:**

AGRI ECONOMICS  
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**ECONOMIC AND ENVIRONMENTAL ASESMENT OF BIOFUEL AND BIO-BASED MATERIALS**

**NON-TECHNICAL SUMMARY:** A. Bio-fuels and bio-based materials hold a great promise for sustainable development because of their potential to reduce global warming effects and alleviate dependence on fossil fuels and non-renewable material sources. B. Recognizing this potential, the President's Executive Order 13134 calls for tripling of the use of bio-based products in the US economy by 2010. Similarly, the 2020 vision statement of the American chemical industry sees a bright future for bio-based products. C. However, both economic feasibility and environmental superiority of bio-based products are being hotly debated. A. The overall objective of the project is technical, economic and environmental evaluation of emerging biofuel and biobased material industries. B. The initial focus is on evaluation of the ligno-cellulosic ethanol industry along with corn-ethanol and bio diesel industries.

**OBJECTIVES:** The overall objective of this project is technical, economic and environmental evaluation of emerging biofuel and biobased material industries. Focus of the current research is on the evaluation of the ligno-cellulosic ethanol industry and related biofuels namely corn-ethanol and biodiesel. The aspects analyzed will include feedstock supply estimation, conversion technology assessment, supply chain and infrastructure feasibility analyses, and comprehensive environmental impact assessment under various policy scenarios.

**APPROACH:** The main components of the research and the analytical approach are as follows: 1. Assessment of potential supply of ligno-cellulosic materials such as agricultural residues, municipal solid waste, forest residues etc. The primary method is to build county level inventories and supply curves and aggregating to the national level. 2. Assessing potential supply of dedicated energy crops such as switchgrass. This requires modeling the switching from current cropping mix to energy crops. This analyses will be carried out using the AGMOD a multi commodity model of US agriculture developed by Dr. Ferris, Professor Emeritus, MSU. 3. Conversion technology assessment through literature review and in collaboration with engineers working in this area. 4. Assessing potential supply chain configurations. This

will be done using engineering- economic modeling. 5. Environmental assessment using life cycle assessment (LCA) techniques

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ACCESSION NO: 0212350 SUBFILE: CRIS  
PROJ NO: MICL03462 AGENCY: SAES MICL  
PROJ TYPE: STATE PROJ STATUS: NEW  
START: 01 SEP 2007 TERM: 31 AUG 2012

INVESTIGATOR: Saffron, C. M.

PERFORMING INSTITUTION:  
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**THERMOCHEMICAL CONVERSION OF WOODY BIOMASS TO FUELS AND CHEMICALS**

**NON-TECHNICAL SUMMARY:** The value-addition contributed by thermochemical conversion is at least partially dependent upon the rates and extents of product formation, the energy quality of the fuel, and the composition of the product stream. This project aims to elucidate and alleviate the limiting mechanisms inherent in thermochemical conversion of woody biomass.

**OBJECTIVES:** The project scope is to investigate the thermochemical conversion of woody biomass to fuels and chemicals. Economic models, for both a stand-alone thermochemical conversion facility and an integrated cellulosic ethanol biorefinery with thermochemical conversion, are to be formulated. The results of the economic model will be used to identify the processes or process steps that are sensitive to alterations. Beneficial alterations will be investigated to discern the nature of limiting mechanisms. A physicochemical model will be derived to describe the resultant data and assist in interpreting experimental results. A revised economic model, including information from the experimental results, will provide decision-making capability to industry regarding the deployment of thermochemical conversion.

**APPROACH:** The use of thermochemical conversion of woody biomass will be explored in a stand-alone and an integrated biorefinery format. Economic models will be formulated to provide insight into process limitations and to focus research effort. Process alterations that result in beneficial observations deviating from established theory will be investigated. Hypothesis formulation and experimental design will be tailored to elucidate the nature of limiting mechanisms. Physicochemical models will be formulated to describe the data and assist in interpreting experimental results. Both the stand-alone and integrated biorefinery models will be updated to reflect the scientific findings. A series of economic models will be constructed to identify the processing steps in the thermochemical conversion of woody biomass that are most sensitive to process improvements. Profitability metrics will be used to rank different processes (e.g. gasification followed by Fischer-Tropsch synthesis, gasification followed by synthesis gas fermentation to ethanol, pyrolysis oil formation, etc.) and process configurations (i.e. different methods of fractionating thermochemical products). Model results will guide experimentation in the laboratory by focusing resources on processes and process steps that are most economically sensitive to improvement. Hypothesis formulation will follow observation of limiting phenomena in the laboratory. The nature of the limiting mechanisms will be elucidated by bench-scale exploratory research--i.e. whether mass transfer rates, heat transfer rates, reaction rates, etc., are responsible for limiting the efficacy of the thermochemical routes under consideration. Spectroscopic methods, such as GC/MS, will measure the composition and quantity of the pyrolysis products. Physicochemical models will be formulated to describe the data and assist in interpreting the results. This detailed investigation is expected to result in an improved scientific

understanding of the thermochemical conversion of woody biomass and of the fractionation of pyrolysis products. Further process and equipment design will be investigated in an attempt to alleviate the aforementioned limitations. In addition to the energy value of the upgraded fuel, the fractionation of value-added co-products will be considered. Revision of the economic model will commence upon interpretation of the experimental results. Integration of thermochemical conversion into cellulosic ethanol facilities (woody biomass or otherwise) will be explored to increase the product suite and energy quality of the biorefinery. Areas of focus include, but are not limited to: 1) thermochemical conversion of a fraction of the cellulosic feedstock, 2) the use of thermochemical methods as pretreatments, and 3) the thermochemical conversion of fermentation residue solids (i.e. cake solids). Profitability of the biorefinery will be estimated upon economic model formulation and is dependent upon the process material and energy balances. This biorefinery model is expected to be used as a decision-making tool for subsequent design and experimentation at the bench scale.

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Item No. 23 of 59

ACCESSION NO: 0206809 SUBFILE: CRIS  
 PROJ NO: MICL07709 AGENCY: CSREES MICL  
 PROJ TYPE: SPECIAL GRANT PROJ STATUS: EXTENDED  
 CONTRACT/GRANT/AGREEMENT NO: 2006-34189-17124 PROPOSAL NO: 2006-06143  
 START: 15 JUL 2006 TERM: 14 JUL 2008 FY: 2006 GRANT YR: 2006  
 GRANT AMT: \$512,942

INVESTIGATOR: Dale, B. E.

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 MICHIGAN STATE UNIV  
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**BIOPROCESSING FOR UTILIZATION OF AGRICULTURAL RAW MATERIALS**

**NON-TECHNICAL SUMMARY:** The United States is increasingly dependent on increasingly expensive imported petroleum as a raw material to produce fuels, chemicals and materials. At the same time, rural America is hard hit by a lack of industries to process our inexpensive agricultural commodities. The purpose of this project is to develop cost effective processing technology to convert inexpensive agricultural raw materials into valuable fuels, chemicals and materials.

**OBJECTIVES:** The MSU/MBI USDA grant funds are leveraged with other funding to accelerate the development of biobased industrial product technologies critical to the sustainability of the agricultural and rural economy. These technologies have not received adequate support from the private sector because they represent new products and processes not yet adopted by industry and the return on investment is not yet determined. MSU and MBIs missions provide for a synergistic approach to fulfill the objectives of the USDA Special Grants Program: to bring new uses for agricultural products to the stage where there is sufficient commercial interest to create new companies. MSU/MBI focus on identifying industrial and consumer uses for commodity crops, which encourages a pattern of business development that will result in stable rewarding jobs, and support communities or disadvantaged groups in the U.S. that have not employed the benefits of technology based growth. Discoveries from MSU, other universities and federal laboratories are developed and scaled up by MBI so that they are ready for commercialization. This development work provides the critical scientific and engineering information necessary to secure capital financing to construct a manufacturing facility or introduce a new process to an existing facility. Multidisciplinary teams with in depth technical expertise and strong business acumen are formed to ensure that the technology being developed fits an unmet market need. Funding from the USDA Special Grants Program enables MSU/MBI to bring basic research ideas that have demonstrated proof of principle to proof

of commercial feasibility. The approach taken by MSU/MBI is a unique partnership that allows for the acceleration of new products and processes into the marketplace to create new jobs and launch new business opportunities. USDA CSREES funds will help support work in the project areas described below. Michigan State University and MBI International have several interdisciplinary teams that work on each of the project areas outlined. USDA CSREES funds are leveraged with funding from the State of Michigan, other federal agencies, industry and other State agencies to allow the consortium to significantly expand the work performed under the USDA CSREES grant. Combining funds from several sources allows the consortium to develop and demonstrate the technical and economic feasibility of a broader range of new technologies at a much faster pace.

**APPROACH:** The focus of this years funding will address the continuation of the following five project areas: Project 1. Developing Valuable Protein Products & Fermentable Sugars from Distillers Grain: This project has the long-term objective of producing valuable protein products and additional fermentable sugars from distillers grains. The technical approach is to treat distillers grains with the AFEX process to enhance digestibility and to assist in subsequent protein extraction and recover. The work will be done at MSU under the direction of Dr. Bruce Dale. Project 2. Design and Engineering of High Strength Compatibilized Green Structural Materials from AFEX-treated Cellulosic Materials: This project seeks to advance new fundamental knowledge through integrated research directed towards the reduction of energy use and adverse environmental impact in the development of green nanocomposites for structural applications. The work will be done at MSU under the direction of Dr. Larry Drzal. Project 3. Biomass Pretreatment: This project is aimed at development and validation of the integrated technologies that will convert low-value lignocellulosic materials into high-value products that include ethanol, specialty chemicals, biomaterials and animal feeds, i.e., a sugar-based biorefinery. This effort will occur at MBI under the direction of Dr. Mark Stowers. Project 4. Fermentation Production of Fine and Specialty Chemicals: This project is aimed at development and validation of an integrated process to produce succinic acid and butanetriol from a low cost biomass sugar stream. This effort will take place at MBI under the direction of Dr. Mark Stowers. Project 5. Identification of Commercially Attractive Biobased Technologies: This project continues the effort to bring new ideas, including broad based, competitive solicitations to industry and academia, seed projects for investigating new technological tools or approaches, and new ideas submitted by researchers into the program for consideration. This project occurs at MBI under the direction of Dr. Mark Stowers.

**PROGRESS: 2006/07 TO 2007/07**

**Protein Extraction:** Several solvents were screened to determine the best approach to removing proteins from distiller's grains. Ethanol and weak bases like ammonia were ineffective, while a strong base like sodium hydroxide had a larger effect. Extracting with 0.5M NaOH, 2mM b-mercaptoethanol, and 0.3% SDS at 70C for 90 minutes, 32% of the total protein was solubilized, while 22% of the remaining protein was solubilized during the subsequent fiber hydrolysis. However, the soluble protein was low in lysine, and the resulting hydrolysis produced low sugar yields. Attempts to solubilize protein after hydrolysis also saw low yields, with no more than 30% of the remaining protein being extracted in concentrated alkaline solutions. **High Strength Materials:** Both Microfibrillated Cellulose (MFC) and Cellulose Nanowhiskers (CNWs) were successfully extracted from wheat straw with yields of 34.6 % and 13.6 % respectively. The extracted MFC consisted of long slender fibrils with width ranging from 20 nm to several um. The CNWs were rod-like crystals with a width and length of 5-10 nm and 100-200 nm respectively. Both MFC and CNW reinforced polyvinyl alcohol composite films were prepared by a solvent casting technique. Excellent dispersion of the MFC and CNW in the matrices was confirmed by electron microscopy analysis of the cryo-fractured surfaces and plasma-etched surfaces. The thermal and mechanical properties of the composite films were studied and compared. MFC and CNW are now being used to produce Polylactic Acid (PLA) based biocomposites. **Pretreatment:** MBI successfully installed the 5-gallon reactor. The most effective AFEX conditions for corn fiber were identified. The fed batch enzyme hydrolysis method was adopted to perform high gravity (20, 30 and 40% solid loadings), obtained a relatively high glucose yield (85%) and generated hydrolysate containing as high as 135g/l of glucose. Implementing the fed batch simultaneous saccharification and fermentation (SSF) method enabled us to perform the AFEX-treated corn fiber fermentation at about 40% solid loading with final ethanol concentration of 98g/l. AFEX-treated DDG fermentation at 40% solid loading with the ethanol concentration reached 45 g/l. A mixed sugars (C5+C6) stream was generated from AFEX-treated corn fiber by enzyme and acid hydrolysis for the production of succinic acid. **Fermentation:** Hydrolysis of cellulosic feedstocks generates 5-and 6-carbon sugar streams, and lignin. The predominant organism used for ethanol production is *S. cerevisiae*, an organism that

currently cannot utilize the 5-carbon components. MBI international has a proprietary organism, A. succinogenes, capable of consuming C6 and C5 sugars simultaneously and fermenting them to succinic acid. We demonstrated the fermentation of corn-fiber derived sugars streams to succinic acid using only C5 sugars, or a mixed sugar stream of C6 and C5 sugars. Titters and yields of succinic acid production were measured. We demonstrated that >60% of the sugars in the fermentation can be biomass-derived.

**IMPACT: 2006/07 TO 2007/07**

Distiller's grains are a major and growing byproduct of corn dry mills. But due to the extreme conditions required to remove even a fraction of the protein from DDGS, coupled with the poor amino acid ratios obtained and low sugar yields, this extraction/hydrolysis process does not currently appear to provide a potential industrial use. Agricultural wastes such as wheat straw can be utilized to produce high strength and modulus and low density microfibrillated cellulose (MFC) and cellulose nanowhiskers (CNWs). Polylactic Acid (PLA), also derived from renewable resources such as corn starch, is a commercially available biodegradable polymer. MFC and CNW reinforced PLA nanocomposites are environmentally friendly materials with improved thermal and mechanical properties compared to neat PLA. We produced ethanol from AFEX-treated corn fiber and AFEX-treated DDGs at a level that met the technical and economical limit for industrial-scale alcohol distillation. A corn dry-mill bio-refinery that produces ~50MM gal of ethanol from starch annually could increase their product portfolio by fermenting the bran portion (~11% of corn in B-Frac operations). Assuming theoretical efficiencies of conversion this could lead to the production of an additional 3.8MM gal of ethanol (C6 sugars) and 20 MM lbs of succinic acid OR 16MM lbs of BT (C5 sugars) Alternatively, the entire bran portion (C6 and C5 sugars) could be used for succinic production, which could yield 75 MM lbs succinic acid. Furthermore, the succinic fermentation has the environmental benefit of CO2 incorporation.

**PUBLICATIONS (not previously reported): 2006/07 TO 2007/07**

Bals, B., Dale, B.E., Balan, V. 2006. Enzymatic hydrolysis of distillers dry grain and solubles (DDGS) using ammonia fiber expansion. Energy & Fuels. 20: 2732-2736

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ACCESSION NO: 0211757 SUBFILE: CRIS  
PROJ NO: MIN-12-075 AGENCY: CSREES MIN  
PROJ TYPE: HATCH PROJ STATUS: NEW  
START: 01 OCT 2007 TERM: 30 SEP 2010

INVESTIGATOR: Wang, P.

**PERFORMING INSTITUTION:**

BIOPRODUCTS & BIOSYSTEMS ENGINEERING  
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**BIOSYNTHESIS OF METHANOL FROM BIOMASS DERIVED CARBON DIOXIDE**

**NON-TECHNICAL SUMMARY:** The proposed synthetic strategy reflects a new venue for cellulosic and lignocellulosic liquid fuels (Fig. 7). The proposed synthetic pathway also provides a new platform for conversion of biomass carbon. Methanol can also be synthesized chemically from syngas (H<sub>2</sub>, CO<sub>2</sub> and CO) generated by gasification of biomass. This route is an established thermo-chemical process. In the chemical industry this process is most efficiently operated starting from natural gas in petrochemical plants at a very large scale (5,000t/d). Compared to the existing thermo-chemical process, a biological CO<sub>2</sub> ? CH<sub>3</sub>OH process will be much more selective, consume less energy, generate less pollution, cause fewer safety concerns and thus facilitate operation of smaller plants for "distributed" production of methanol.

These plants could be located where biomass can be harvested, transported and converted economically. The long-term goal of this project is to promote efficient and clean synthesis of easy-to-handle liquid fuel, methanol, from nonfermentable Minnesota biomass-derived carbon sources.

**OBJECTIVES:** The objectives are to investigate and develop a sequential multienzyme biocatalytic pathway for the production of methanol from CO<sub>2</sub> (Fig. 3). CO<sub>2</sub> may come either from the gasification of non-fermentable biomass such as lignin, from high intensity sources of CO<sub>2</sub> such as power plants or refineries, or from the atmosphere. The biosynthesis of methanol from CO<sub>2</sub> is the reverse process of a biological metabolic pathway.

**APPROACH:** The multienzyme catalytic system will couple the synthesis of methanol from CO<sub>2</sub> with the production of dihydroxyacetone (DHA) from glycerol (Fig. 4). Glycerol, which contributes the protons needed for methanol synthesis, is a byproduct from biodiesel production from soybean oil. These two sets of reactions are coupled through the recycling of the cofactor, NAD(H) by the enzyme glycerol dehydrogenase (GDH). The processing of glycerol for production of diol is currently achieved through microbial processes. The proposed synthetic strategy will integrate two microbial pathways found in different biological sources and thus achieve one-pot synthesis of methanol and diol from renewable resources. We will explore the feasibility of the proposed concept that can be used for provisional patent filings and for future proposals for external funding. Specifically, we will (1) investigate reaction kinetics and equilibrium at different conditions including pH, substrate concentration and temperature; (2) examine the feasibility and methodology to construct the proposed multienzyme catalysis with immobilized enzymes using meso-porous inorganic and polymer supports; and (3) study of the reaction kinetics of the immobilized multienzyme catalyst system.

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ACCESSION NO: 0091840 SUBFILE: CRIS  
PROJ NO: MIN-13-078 AGENCY: SAES MIN  
PROJ TYPE: STATE PROJ STATUS: REVISED  
START: 01 JUL 2004 TERM: 30 JUN 2009 FY: 2006

INVESTIGATOR: Gronwald, J. W.

PERFORMING INSTITUTION:  
AGRONOMY & PLANT GENETICS  
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**MOLECULAR AND BIOCHEMICAL APPROACHES FOR DEVELOPING ALFALFA AS A BIOFUEL FEEDSTOCK**

**NON-TECHNICAL SUMMARY:** There is a need to increase the production of renewal energy sources such as bioethanol. Alfalfa has potential as a cellulosic bioethanol feedstock but conversion efficiency needs to be improved. This project will address the need to improve bioconversion efficiency by generating knowledge that can be used to modify cell wall composition of alfalfa.

**OBJECTIVES:** Investigate the importance of the myo-inositol and nucleotide sugar oxidation pathways in the biosynthesis of cell wall matrix polysaccharides in alfalfa. Characterize the myo-inositol and nucleotide sugar oxidation pathways in transgenic alfalfa modified with genes that alter cell wall matrix polysaccharide biosynthesis.



**APPROACH:** Characterize the expression of UDP-glucose dehydrogenase and glucuronic acid 1-P pyrophosphorylase in alfalfa. Compare expression of UDP-glucose dehydrogenase and glucuronic acid 1-P pyrophosphorylase with changes in cell wall structure and composition in developing alfalfa stems.

**PROGRESS:** 2006/01 TO 2006/12

A large proportion of plant cell walls consists of matrix polysaccharides (pectin and hemicellulose). In alfalfa, the amount and structure of these polysaccharides influence the efficiency of converting cell wall biomass into ethanol. The myo-inositol oxidation pathway plays a key role in the synthesis of cell wall matrix polysaccharides in plants and UDP-sugar pyrophosphorylase (USP) is an important protein in this pathway. In earlier research conducted with the model plant *Arabidopsis*, we identified the gene that makes the USP protein. Our research also provided the first report that USP plays a critical role in cell wall synthesis in pollen. In current research to better define the role of USP in cell wall development, we prepared an antibody to the purified *Arabidopsis* USP protein. Research conducted with the antibody indicated that there are two isoforms of USP in *Arabidopsis* tissues. Immunoprecipitation assays conducted with the antibody indicated that USP is responsible for UDP-glucuronic acid pyrophosphorylase activity measured in *Arabidopsis* tissue extracts. These results provide evidence that USP serves as the terminal enzyme of the myo-inositol pathway and therefore plays a key role in cell wall synthesis. We have also examined the role of USP in cell wall formation in developing soybean embryos. Both gene expression and enzyme activity of USP increased during the growth of soybean embryos suggesting that USP plays an important role in cell wall synthesis. In future research, we plan to use gene silencing to block USP in developing soybean embryos and determine whether this extra carbon will be redirected toward the synthesis of more seed oil and protein. The results of this research have advanced understanding of an important metabolic pathway that regulates the formation and composition of plant cell walls. This new knowledge will be used to plan future research to modify alfalfa cell walls and increase the potential of alfalfa as a bioenergy crop. This knowledge will also be used to develop molecular approaches to redirect carbon into metabolic pathways that increase soybean seed oil and protein content.

**IMPACT:** 2006/01 TO 2006/12

There is a need to develop renewable energy sources to decrease dependence on imported fossil fuels and reduce the negative impact of fossil fuel use on the environment. In Minnesota, alfalfa offers considerable potential for development as a cellulosic feedstock for ethanol production. Basic knowledge generated by this research project will be used to develop transgenic alfalfa varieties that exhibit enhanced potential for cellulosic ethanol production. Knowledge regarding the regulation of cell wall synthesis in developing soybean seeds will be used to increase oil and protein content.

**PUBLICATIONS** (not previously reported): 2006/01 TO 2006/12

1. Litterer, L.A., Schnurr, J.A., Plaisance, K.L., Storey, K.K., Gronwald, J.W., Somers, D.A. 2006. Characterization and expression of *Arabidopsis* UDP-sugar pyrophosphorylase. *Plant Physiology and Biochemistry* 44:171-180.
2. Schnurr, J.A., Storey, K.K., Jung, H.G., Somers, D.A., Gronwald, J.W. 2006. UDP-sugar pyrophosphorylase is essential for pollen development in *Arabidopsis*. *Planta* 224:520-532.
3. Litterer, L.A., Plaisance, K.L., Schnurr, J.A., Storey, K.K., Jung, H.G., Gronwald, J.W., Somers, D.A. 2006. Biosynthesis of UDP-glucuronic acid in developing soybean embryos: possible role of UDP-sugar pyrophosphorylase. *Physiologia Plantarum* 128:200-211.

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Item No. 26 of 59

ACCESSION NO: 0093725 SUBFILE: CRIS  
 PROJ NO: MIN-14-064 AGENCY: CSREES MIN  
 PROJ TYPE: HATCH PROJ STATUS: REVISED  
 START: 01 OCT 2007 TERM: 30 SEP 2012 FY: 2006

INVESTIGATOR: Runge, C. F.

PERFORMING INSTITUTION:  
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TRADE, ENVIRONMENT AND AGRICULTURAL SCIENCE IN THE GLOBAL COMMONS

**NON-TECHNICAL SUMMARY:** This project focuses on international trade conflicts in agriculture, sustainability of biofuels and the role of plant biotechnology to break out of the food-fuel dilemma. The purpose is to provide trade policy recommendations, analyze biofuels policy and propose solutions to the food-fuel dilemma.

**OBJECTIVES:** 1. Trade: to evaluate proposals to advance the Doha Round of multilateral trade negotiations, with specific attention to 2007 farm bill alternatives and proposals for reform. 2. Environment: to analyze the environmental impacts of biofuels on (a) land use in the U.S. and developing countries; (b) consequent water pollution impacts; (c) cellulosic and non-food alternatives as raw inputs; and (d) environment/trade interactions related to biofuel imports to the U.S. 3. Agriculture: to re-examine the role of plant biotechnology in the food-fuel debate over biofuels, both (a) in terms of improved productivity of food cropping; (b) reduced environmental impacts of planted crops; and (c) developing non-food inputs to the biofuels sector.

**APPROACH:** 1. Trade: evaluation of proposals through interviews with key participants in the trade and agricultural policy sphere, including joint collaboration with private sector, foundation, government representatives and colleagues (eg., Johnson, Tutweiller, Pearson, Senauer, Tiffany, Taff). Work with Johnson and Tutweiller will focus on Doha Round and Farm Bill alternatives, using interviews with government and private sector actors in the legislative and negotiating process. Consultation with Pearson will be on trade policy issues. Pearson is currently Chairman of the Federal Trade Commission. Work with Senauer and Tiffany will focus on biofuels and related trade matters, analyzing impacts of the 54 cent-per-gallon tariff on imported ethanol from federal trade data. Data will be drawn from interviews and federal trade statistics sources. Work with Taff will involve use of his energy simulation model to analyze alternative scenarios. 2. Environment: analysis of (a) shifts in land use from other crops to corn and soybeans and (b) their environmental consequences for soil loss and water pollution; (c) comparative consequences of various cellulosic and non-food alternatives; (d) environmental impacts of substituting imported biofuels for domestic sources, both in the U.S. and in exporting countries (eg., Brazil). Data will be drawn from U.S. Geological Survey and USDA sources as well as World Resources Institute data bases. The shift in land use from other crops to corn and soybeans will utilize USDA crop-reporting data on shifts in crop acreage. Comparative consequences for cellulosic and non-food alternative inputs will include cost analysis, environmental effects on land and water resources, and international environmental implications of shifts in land uses. 3. Agriculture: to re-examine the 2004-2005 inventory of the global diffusion of plant biotechnology undertaken for the Council on Biotechnology Information (CBI) with specific reference to laboratory experiments, field trials and commercialization of traits specific to the challenges posed by biofuels. These traits include (a) yield and quality improvements in food crops currently used as stocks (corn, soybeans, rapeseed, canola, oil palm) and (b) traits related to environmental impacts of alternative stocks (tree crops, grasses). The extension of the 2004-2005 inventory will employ APHIS data sets on registration and field trials, but would focus on biofuel-related traits, including enzyme properties allowing more rapid conversion to ethanol or biodiesel fuels. Also considered would be biotech crops with a combination of these traits and more environmentally benign traits.

**PROGRESS:** 2006/01 TO 2006/12

Research continues into U.S. and international aspects of international trade and the food system. In addition, the new stream of research focusing on school feeding programs has generated journal article acceptances, three M.S. theses, and a pending book proposal. This is consistent with the U of M's initiative on Healthy Foods, Healthy Lives and has provided economic analysis of the choices made by school food administrators. In addition, I have published a journal article on intellectual property rights in an international context in *World Development*, an article in *The American Interest* on trade, a new entry for

Agricultural Economics in The New Palgrave Dictionary of Economics (first published as a CIFAP Working Paper), and an assessment of the role of the federal Production Tax Credit for wind farms.

IMPACT: 2006/01 TO 2006/12

Decisions by state and federal policy makers concerning trade, agriculture and intellectual property policy, and school feeding program decisions at the local, state and federal level.

PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

1. Agriculture of Corruption. *The American Interest* (Winter-Jan./Feb. 2007): 70-78.
2. Exclusion, Inclusion and Enclosure: Historical Commons and Modern Intellectual Property. *World Development* 34(10)(2006): 1713-1727.
3. Re-examining the Production Tax Credit for Wind Power: An Assessment of Policy Options (with Douglas Tiffany). St. Paul, MN: Fresh Energy. March 1, 2006.
4. Agricultural Economics: A Brief Intellectual History. Center for International Food and Agricultural Policy (CIFAP) Working Paper WP06-1, June 2006. Department of Applied Economics, University of Minnesota.
5. Grainger, Corbett A. 2005. Measuring Innovation in a High School Cafeteria: A Case Study of Hopkins, Minnesota. Masters Plan B Paper.
6. Wagner, Barbara J. 2006. Demographic, Budgetary and Regulatory Factors Constraining the Nutritional Quality of Foods Served in the National School Lunch Program. Masters Thesis.
7. Agiwal, Swati. 2006. Financial Analysis of School Lunch: Hopkins, Minneapolis and Saint Paul School Districts. Masters Plan B Paper.

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Item No. 27 of 59

ACCESSION NO: 0087768 SUBFILE: CRIS  
 PROJ NO: MIN-43-068 AGENCY: CSREES MIN  
 PROJ TYPE: HATCH PROJ STATUS: REVISED  
 START: 01 OCT 2005 TERM: 30 SEP 2010 FY: 2006

INVESTIGATOR: Sarkanen, S.

PERFORMING INSTITUTION:  
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LIGNIN BIOSYNTHESIS, BIODEGRADATION AND DERIVATIVE PLASTICS

NON-TECHNICAL SUMMARY: This project seeks to rectify three fundamentally misconceived ideas that have long plagued the lignin field. The manner in which lignins are non-randomly assembled in plant and wood cell walls will be elucidated; the correct enzymatic basis for lignin biodegradation will be established; and formulations for useful thermoplastics with high (above 80 percent) contents of simple lignin derivatives will be developed. The results are expected to play important roles in the development of processes that will be used in biorefining plant and woody materials on a commodity scale.

OBJECTIVES: This project constitutes an umbrella for three different areas of lignin research. In regard to lignin biosynthesis, the mode of dehydrogenative monolignol polymerization will be examined in the presence of species that could act as templates for assembling the macromolecules being formed. Plausible template species include high molecular weight lignin components and proline-rich proteins from plant/wood cell walls. The work will be focused upon the working hypothesis that the final step in lignin biosynthesis could involve the transcription and replication of macromolecular configurations through

template polymerization processes. Compatible molecular contours among the interacting substructures involved in the replication process have already been identified through molecular modeling. Preliminary molecular orbital calculations have suggested that the nonbonded orbital interactions between the aromatic rings in lignins can be equivalent in strength to two or more hydrogen bonds. As far as lignin biodegradation is concerned, an enzyme has been isolated in the project leader's group from the white-rot fungus *Trametes cingulata* that can completely depolymerize high molecular weight softwood kraft lignin components without requiring a cofactor or mediator. Since lignin depolymerase is naturally produced by white-rot fungi in extremely low concentrations, the enzyme will be expressed at much higher levels in a suitable host organism. The stability and catalytic activity of the recombinant enzyme will be improved, and the extent of its glycosylation will be reduced (so that it is not counterproductively lost through adsorption on surfaces). Finally, the utility of the improved recombinant lignin depolymerase will be documented in facilitating the conversion of renewable lignocellulosic plant materials into feedstocks for further bioprocessing. In creating new lignin-based polymeric materials, softwood kraft, organosolv and milled wood lignins will be methylated and blended with 15% target levels of miscible low-glass-transition-temperature polymers to create thermoplastics that can compete with polystyrene and other commodity plastics. Building on recent insights gained in the project leader's research group, the new kraft lignin-based polymeric materials will pave the way for developing thermoplastics from the organosolv and milled wood lignins, which will share common features with corresponding biorefinery byproduct lignins. These new thermoplastics will be unique among polymeric materials in that their mechanical properties will rest on supramacromolecular complexes containing many thousands of individual components. The integrity of these huge entities will need to be preserved as the content of the low-glass-transition-temperature polymeric plasticizer in the blend is systematically minimized. This will be accomplished by reducing both the lignin-lignin and plasticizer-plasticizer interactions at the molecular level, while adjusting the lignin-plasticizer interactions to the threshold required for blend homogeneity.

**APPROACH:** The studies of lignin biosynthesis seek to delineate how lignin template species can determine the configurations of macromolecular dehydropolymerisates formed from monolignols. The possibility that the primary structures of lignin chains are transcribed from proline-rich cell-wall proteins will be investigated. Upon formation at the surface of such a protein, a progenitorial lignin chain is expected to undergo replication through a template polymerization mechanism. The lignin templates employed will vary according to chain length, frequencies of different interunit linkages, monomer residue configuration, and methylation of their aromatic hydroxyl groups. The effects of these template characteristics upon monolignol dehydropolymerization will be examined with respect to the molecular weights and radii of gyration of the dehydropolymerisates formed, the identities of the interunit linkages, template compatibility with coniferyl and sinapyl alcohol monomers, and their preference for monolignols or the corresponding radicals. Molecular orbital calculations will be employed to estimate the strengths of the dominant intermolecular nonbonded orbital interactions involved in these processes. The lignin biodegradation study will have a profound impact on efficient biomass utilization in biorefineries. De novo peptide sequencing of the lignin depolymerase will be used to identify the most closely related gene(s) in *Phanerochaete chrysosporium*, whose genome has been completely sequenced. These genes are not expected to be among those previously identified as coding for ligninolytic enzymes in white-rot fungi. The lignin depolymerase gene will be cloned and expressed in a suitable host organism. Through directed evolution strategies and classical protein engineering, the stability and catalytic activity of the recombinant enzyme will be improved. To minimize the adsorption of the protein onto surfaces during industrial applications, the extent of its glycosylation will be reduced. The utility of the improved recombinant lignin depolymerase will also be documented in enhancing enzyme-catalyzed polysaccharide degradation in lignocellulosic substrates. In regard to lignin-based plastics, formulations based on the methylated Organosolv and milled wood lignin derivatives will be different from previously created alkylated kraft lignin-based thermoplastic blends. Some exploratory work will be needed to discover what types of low-glass-transition-temperature polymers act as plasticizers in forming homogeneous blends with the two former lignin derivatives. To improve plasticizer efficacy in these new polymeric materials, the intermolecular plasticizer-plasticizer and lignin-lignin interactions have to be reduced without decreasing the plasticizer-lignin interactions below the threshold required for blend miscibility. This will be accomplished by (i) judicious manipulation of the configuration of the low-glass-transition-temperature polymer, and (ii) introduction of particular low molecular weight compounds that synergistically enhance plasticization of the resulting blends by interacting preferentially with the lignin components.

**PROGRESS:** 2006/01 TO 2006/12

A complete hypothetical mechanism has been developed for the replication of primary structure during lignin biosynthesis. It has been proposed that the necessary information is encoded in (relatively rigid) double-stranded lignin templates dynamically poised in a state of single-strand elongation and compensating double-strand dissociation at the advancing front of every lignifying domain. The most significant progress in understanding template structure during this reporting period was made with density functional theory using the new M05-2X hybrid meta exchange-correlation functional that is parametrized for kinetics, thermochemistry and non-covalent interactions. Computations for guaiacyl complexes involved in 8-O-4', 8-5' and dibenzodioxocin lignin substructures have yielded estimates of ~7-9 kcal/mol for the stabilization energies between the interacting aromatic rings that maintain the double-stranded template structure. The latter are all approximately parallel, but cofacially offset from one another, with perpendicular spacings of ~3.4 angstroms. Such interaction energies can be equivalent in their effects to two or more hydrogen bonds, and thus should be sufficient to ensure that the primary structure of a parental chain may be replicated during lignin biosynthesis through an endwise dehydropolymerization process. It is noteworthy that, compared to MP2/6-31G(d) level wave function theory, the more accurate M05-2X/6-31+G(d,p) density functional theory requires far fewer computational resources, and yet the results from both methods have been quite comparable. Significant progress has been made in the work devoted to the isolation, characterization and production of the lignin depolymerizing enzyme, lignin depolymerase. Two lignin depolymerase enzymes from *Trametes cingulata* had been previously evaluated according to their ability to depolymerize soluble high molecular weight kraft lignin components. Both enzymes have been subjected to tryptic digestion after a lengthy iso-electric focusing procedure that separates the extracellular fungal enzymes from one another and the residual lignin substrate. The resulting polypeptides have been analyzed by electrospray ionization-ion trap mass spectrometry. Using the PEAKS software package from Bioinformatics Solutions Inc., many of the resulting fragmentation patterns have successfully yielded reliable de novo sequence information. More significantly, characteristic posttranslational modifications of certain oligopeptides have provisionally identified the type of mechanism that lignin depolymerase employs. Moreover, in certain cases, sets of primers constructed from the polypeptide sequences have facilitated specific PCR amplification of polynucleotide sequences in the cDNA library obtained from *T. cingulata* cultures under conditions where lignin biodegradation was taking place.

IMPACT: 2006/01 TO 2006/12

Interest in effective ways of handling lignins during the large-scale biorefining of plant materials (including wood) has been steadily growing. The lignins must be removed efficiently and utilized in the most appropriate way as the plant polysaccharides are degraded and converted to liquid fuels and organic chemicals. Both removal and utilization will be facilitated by a clearer understanding at the molecular level of, respectively, the first step in lignin biodegradation and the structural characteristics of the biopolymer chains formed during lignin biosynthesis. The entire project is focused on implementing these goals.

PUBLICATIONS (not previously reported): 2006/01 TO 2006/12

Chen, Y.-r. and Sarkanen, S. 2006. From the macromolecular behavior of lignin components to the mechanical properties of lignin-based plastics. *Cellulose Chem. Technol.* 40(3-4): 149-163.

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ACCESSION NO: 0195065 SUBFILE: CRIS

PROJ NO: MINW-2003-06003 AGENCY: CSREES MINW

PROJ TYPE: SPECIAL GRANT PROJ STATUS: NEW

CONTRACT/GRANT/AGREEMENT NO: 2003-34291-13283 PROPOSAL NO: 2003-06003

START: 15 SEP 2003 TERM: 14 SEP 2006 GRANT YR: 2003

GRANT AMT: \$464,361

INVESTIGATOR: Nagel, J. L.

PERFORMING INSTITUTION:  
 UNIVERSITY OF MINNESOTA  
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 CROOKSTON, MINNESOTA 56716

PRODUCER ALLIANCE INFRASTRUCTURE & AGRICULTURAL DIVERSITY IN THE  
 NORTHERN GREAT PLAINS

**NON-TECHNICAL SUMMARY:** There are ongoing concerns in the region regarding the future of agriculture and farm and ranch profitability in the Region. The purpose will be to increase agricultural diversity and commercial links to the global marketplace in the Region. The project will focus on concerns regarding the future of agriculture and rural communities in the Northern Great Plains region in an effort to identify opportunities for success in the Region.

**OBJECTIVES:** This 5-state project has one primary goal and four objectives, each focusing on concerns regarding the future of agriculture and rural communities in the Northern Great Plains region. The primary goal is to bring together the many resources of the Region into a collaborative effort to address shared rural economic, environmental, energy and community issues within the 5 state region. The first objective of this project is to establish a NGP working group of the existing producer alliances within the Region. The second objective is to bring together the work being done at several land grant universities and other research institutions in the Region on the traceability of agriculture products and the use of sustainable agriculture and land management practices to develop a regional strategy for gaining marketplace advantage for producers and processors in the Region thru implementation of traceability systems and sustainable agriculture practices. The third objective is to further development of opportunities in use of biomass and biofuels as energy sources. The fourth objective is to complete Renewing the Countryside books for South Dakota and Nebraska. NGP and GPISD will continue to link past and ongoing USDA, DOE, DOL, and private foundation funded projects with the project. This includes work in agriculture diversity-especially vegetable production and processing, eBusiness training, leadership development, international education programs, Powering the Plains, sustainable agriculture, and renewable energy development. NGP and GPISD will also continue their extensive outreach and education efforts related to the work they are doing under this project.

**APPROACH:** The specific research and development activities include on-going interaction with existing producer alliances, completing an asset assessment of current infrastructure in each state, creating a regional asset/baseline analysis of activities to meet alliance needs, completing a strategic work program with alliances, design the establishment of a complete traceability system for the products typically grown in the region, research the critical components of a system of traceability for producer alliances, identify what new products could be developed from native species which will also foster a more healthy and diverse ecosystem, identify the current scientific base of knowledge and what scientific gaps exist, research the potential for cellulose as a feedstock for ethanol production, expand a website resource to include success stories and sustainable models, produce a commercially successful book that conveys a message of hope and possibility in rural communities, and develop a program that compares stories of success from the northern plains with those of climatologically similar countries in Europe.

**PROGRESS: 2003/10 TO 2004/09**

Objective 1: Producer Alliances-NGP continues to promote on-going interaction between state alliances. FarmConnect (the MN alliance) continues to serve as a model for other states. Funding for specific projects rather than cooperation between producers is an on-going concern. Objective 2: Traceability Systems-NGP sponsored a study program of leading edge agricultural developments in Europe. State ag officials, farmers, representatives of non-government organizations, NGP board members & staff participated. From this programs two publications listed below were produced. Objective 3: Biomass Energy Development-GPISD continues to investigate cellulosic bio-fuels, power development and native grass biofuels. GPISD staff provided leadership to the Bush Foundation supported Powering the Plains initiative. A report on the potential of Native Species is nearing completion. NGP has concluded that there is need for current, regional information about native flora & fauna as it pertains to adding value to farm income. Objective 4: Renewing the Countryside-Contacts have been made with RTC staff in Minneapolis. There is a continuing pursuit of funding for South Dakota and Nebraska as Northwest Area Foundation has chosen to no longer provide financial assistance. Objective 5: NGP Regional Authority-NGP convened several

meetings of the Governor's Alternates to the Authority. A regional work plan, identification of 'distressed counties' criteria, and management of the Authority were the primary focus of this group.

**IMPACT: 2003/10 TO 2004/09**

1. Several commodity groups have started education programs in traceability and many are using NGP produced materials. NGP has been asked to develop and participate in several traceability demonstration projects. 2. A Northern Tier Hydrogen Fuels program has been started as a result of the bio-fuels work. 3. A national initiative for Renewing the Countryside has been started and books are being prepared in several states. 4. NGP is helping the University of Minnesota-Crookston develop a Sustainability Institute.

**PUBLICATIONS (not previously reported): 2003/10 TO 2004/09**

1. Orngard, S. and Joannides, J., 2003. Renewing the Countryside Iowa, [www.renewingthecountryside.org](http://www.renewingthecountryside.org)  
 2. Bergan, S., Crabtree, B., Hoffman, L., Gast, J., Glassheim, E., Nagel, J., Ricord, B., Gopal, R., Hulse, D., Johnson, C., 2003. Renewing the Countryside North Dakota, [www.renewingthecountryside.org](http://www.renewingthecountryside.org)  
 3. Wagner, G.L. and Glassheim, E. 2003. Traceability of Agricultural Products, [www.ngplains.org](http://www.ngplains.org)  
 4. Glassheim, E., Nagel, J., and Roele, C. D., 2004. The New Marketplace in European Agriculture: Environmental and Social Values with the Food Chain, [www.ngplains.org](http://www.ngplains.org)

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ACCESSION NO: 0200095 SUBFILE: CRIS  
 PROJ NO: MISZ-065390 AGENCY: CSREES MISZ  
 PROJ TYPE: SPECIAL GRANT PROJ STATUS: EXTENDED  
 CONTRACT/GRANT/AGREEMENT NO: 2004-34158-14682 PROPOSAL NO: 2004-06324  
 START: 15 AUG 2004 TERM: 14 AUG 2007 FY: 2006 GRANT YR: 2004  
 GRANT AMT: \$736,009

INVESTIGATOR: Hopper, G. M.; Leightley, L. E.; Shepard, J. P.

**PERFORMING INSTITUTION:**

FOREST PRODUCTS  
 FOREST AND WILDLIFE RES CENTER  
 MISSISSIPPI STATE, MISSISSIPPI 39762

**WOOD UTILIZATION RESEARCH PROGRAM 2004**

**NON-TECHNICAL SUMMARY:** Economic and utilization research of southern wood resources is directed at improving and extending the use of these resources, adding value and economic return to forest management, developing a better understanding of the contribution of forestry and forest products industries to our economy, improving costs of producing wood products, improving performance of wood in residential housing and furniture construction, and reducing environmental impacts of wood production.

**OBJECTIVES:** The objectives of this research are to administer a continuing program of research and technical assistance to improve the utilization and values of southern timber resources, to strengthen existing efforts in timber harvesting and wood utilization and to support new research initiatives in these areas.

**APPROACH:** Utilization of Wood Based Materials in Housing: Synthesize a series of functional water repellent materials for wood in the laboratory and identify their long-term water repellency for use in oriented strand board, particle board and decking lumber. Evaluate water repellent treatments for wood which could reduce the amount of biocide needed to protect wood from biodegradation. Evaluate the durability of new engineered wood products, such as Pressed Scrim Lumber and new methods of increasing

service life. Determine the microbial breakdown of biocide treated wood and subsequent fungal colonization of the wood. New Manufacturing Systems for Wood Based industries: Develop a device for detecting knots in logs moving at speed through electrode sensors. Develop a real-time after press radio frequency device to detect moisture content (MC) and specific gravity. Pursue advanced research into the application and implementation of lean manufacturing to increase the American furniture industry's productivity, competitiveness and profitability. Fiber and Chemicals from Wood: Use flash pyrolysis to convert cellulosic materials into BioOil. Separate and identify chemical products in the BioOil. Potential supply and demand for bio-oil as an alternative fiber output for forests in Mississippi will be examined. The trade-offs in managing timber resources for bio-oil as compared to traditional timber commodities, such as sawtimber, will be evaluated. The development of an alternative fiber market will improve the production efficiencies and competitiveness in the international and domestic markets. Timber Harvesting and Wood Utilization in Mississippi: A thorough review of forestry and agricultural literature will be conducted to examine the origins and scientific basis for adopting commonly accepted BMPs in Mississippi thereby improving the understanding of the economic costs and benefits and the relative effectiveness of BMP practices at a watershed-scale. A methodology that will document and identify the relative contributions of sediment from various land-use practices and physical features in the landscape will be developed.

**PROGRESS: 2006/01 TO 2006/12**

Five new biocides have been developed, tested, and proven effective for use in engineered wood composites. Two parallel pull flow assembly lines have been designed and implemented in two furniture factories. Two compounds have been synthesized as potential water repellent and stabilization agents for wood composites, but neither were found to be improvements over currently used industrial wood treatments. A waterborne water repellent made from tall oil rosin was tested using southern pine sapwood. Detection of fungi associated with the accelerated soil contact decay test method was completed on 432 below-ground samples. Bio-oils from pine and oak species have been fractionated into water soluble and non-soluble components. Char characteristics have been analyzed and the potential utilization of the chars as a substitute for activated carbons for metals has been tested. A real-time after-press RF device and device simulation analysis on different variable effects on signal responses has been completed. A comprehensive literature review on sediment production as a function of forest management practices has been completed, and a welfare analysis has been conducted using a Muth-type equilibrium displacement model. Total graduate student FTE is 5.50.

**IMPACT: 2006/01 TO 2006/12**

Manufacturers of engineered wood products have been provided with five new alternatives for biocides, all of which showed no practical negative impacts on the products that were treated. The implementation of parallel pull flow assembly lines has increased factory productivity by approximately 50%, reduced direct labor and factory floor space by roughly 15%, reduced assembly cycle time by 33%, and increased units per worker by 73%. Synthesis of a new series of potential functional water repellents has provided the research community with a platform molecule from which new water repellents and wood adhesives can be developed in the future. The development of improved, cost effective water repellents would be very beneficial to consumers concerned with protecting above-ground wood from warping, splitting, and checking. Results from investigations of microbial populations associated with the accelerated soil contact decay test method will reduce the time to evaluate preservative treatments from years to months. The production and analysis of chemicals and fuels from lignocellulosic feed stocks is key to the development of alternative fuels from woody biomass in the Southern U.S. A non-destructive, real-time method for monitoring and locating specific gravity and MC can supply crucial information needed to control and improve manufacturing of wood composite products. Evaluations of welfare distribution suggest that future tech and financial assistance for forestry BMPs should target those who have experienced considerable financial losses: landowners and loggers.

**PUBLICATIONS (not previously reported): 2006/01 TO 2006/12**

1. Barnes, H. M., Slay, R. A., Seale, R. D., Linsey, G. B. 2006. Treatability of steam pressed scrim lumber (SPSL). *Proceedings, American Wood-Preservers Association* 102:68-72.
2. Barnes, HM, RJ Murphy. 2006. Effect of vapor boron treatment on some properties of wood strand and fiber composites. *Composites: Part A* 37(2006):1402-1405.
3. Kirker, G.T., M.L. Prewitt and S.V. Diehl. 2006. Effects of Chlorothalonil (CTN) and Butylated Hydroxy Toluene (BHT) on Microbial Communities involved in deterioration of wood using T-RFLP:I Accelerated laboratory decay study. IRG/WP 06-20332



4. Kirkpatrick, J. W., Barnes, H. M. 2006. Copper naphthenate treatment for engineered wood composite panels. *Bioresource Technology* 97(15):1959-1963.
5. Kirkpatrick, J. W., Barnes, H. M. 2006. Treatments for engineered wood composites - a review. International Research Group on Wood Protection, Document No. IRG/WP 06-40323, 21 pp.
6. Kirkpatrick, J. W., Barnes, H. M. 2005. Biocide treatments for engineered composite panels. *Proceedings of the American Wood-Preservers Association* 101:92 (Technical Abstract).
7. Leightley, L. and P. H. Steele. 2005. Energy and chemicals from wood biomass - an industry of the future for Mississippi. *Tree Talk* 27(4):15-16. The Mississippi Forestry Assoc., Jackson, MS.
8. Mohan, D., C. U. Pittman and P. H. Steele. 2006. Single, binary and multi-component adsorption of copper and cadmium from aqueous solutions on Kraft lignin - a biosorbent. *Journal of Colloid and Interface Science*, Issue 297, p 489-504.
9. Mohan, D., C. U. Pittman and P. H. Steele. 2006. Pyrolysis of wood -biomass for bio-oil: a critical review. *Energy and Fuels* 20(3):848-889
10. Schultz, T.P., D.D. Nicholas, G.T. Kirker, M.L. Prewitt, S.V. Diehl. 2006. Effect of the antioxidant BHT on reducing depletion of chlorothalonil wood after 54 months of ground-contact exposure.
11. Steele, P. H., J. E. Cooper, B. Mitchell. 2006. Identifying knot wood in green and kiln-dried southern pine lumber with dielectric scanning. Five pages in *Proceedings, Digital Imaging IX, and ASNT Topical Conference*. Mashantucket, CT. July 24-26, 2006.
12. Steele, P. H. and J. E. Cooper. 2006. Utilization of electrical impedance tomography to detect internal anomalies in southern pine logs. In *Review of Quantitative Nondestructive Evaluation Vol. 14*, ed. By D. O. Thompson and D. E. Chimenti. American Institute of Physics 0-7354-031200/06. 1942 pp.
13. Sun, C. 2006. Welfare effect of forestry Best Management Practices in the US. *Canadian Journal of Forest Research*.

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ACCESSION NO: 0210809 SUBFILE: CRIS  
 PROJ NO: MOR-2007-02131 AGENCY: CSREES MO.R  
 PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: NEW  
 CONTRACT/GRANT/AGREEMENT NO: 2007-35504-18256 PROPOSAL NO: 2007-02131  
 START: 01 SEP 2007 TERM: 31 AUG 2010 GRANT YR: 2007  
 GRANT AMT: \$425,000

INVESTIGATOR: Angenent, L. T.; Scholten, J. C.; Cotta, M. A.; Dien, B. S.

**PERFORMING INSTITUTION:**

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**MIXED COMMUNITY BIOREACTORS TO CONVERT (LIGNO) CELLULOSIC FEEDSTOCKS INTO THE LIQUID BIOFUEL BUTANOL**

**NON-TECHNICAL SUMMARY:** Energy independence is a high priority for the United States given existing trends of rising worldwide energy demand. Agricultural feedstocks in the US have potential as a considerable energy source for liquid fuels, such as ethanol and butanol, alongside realizing a carbon neutral transportation economy. The microbial breakdown and subsequent solubilization of polymeric cellulosic compounds is seen as the rate-limiting step in bioprocessing of agricultural feedstock. This makes evolutionary sense, because lignocellulosic materials form the scaffolds for plant metabolism and must resist microbial attack. However, some evolutionary biosystems, such as insect (e.g., termites) and some mammalian (e.g., ruminants) intestinal tracts, have created environments for a diverse microbial community to thrive by extracting energy from lignocellulose and passing it to the host. We will mimic

these evolutionary biosystems in the laboratory and will break down lignocellulosic feedstocks into butyrate in bioreactors. The produced butyrate solution will then be fed to a second bioreactor with a pure-culture of *Clostridium* sp. that will convert butyrate into the liquid biofuel - butanol. Producing butanol from agricultural feed stock is important, because converting agricultural waste into biofuels enhances economic opportunities for agricultural producers and rural life in general. In addition, producing carbon-neutral biofuels also protects and enhances the US natural resources and environmental quality.

**OBJECTIVES:** The overall goal of the proposed study is to improve the conversion efficiency of lignocellulosic feedstock (i.e., fractionated corn fiber) into a liquid biofuel (i.e., butanol) by understanding mixed culture microbial processing. We propose to convert corn fiber into butyrate with a mixed culture, first-stage bioprocess, and subsequently produce butanol from a butyrate-rich substrate in a second-stage bioprocess. The supporting objectives are: 1. to ascertain the effects of pretreatment on the molecular structure and microbial break down efficiency and rate for a lignocellulosic feedstock; 2. to manipulate a diverse community bioprocess to produce predominantly butyrate; and 3. to optimize the secondary bioprocess for butanol production from a mixed substrate.

**APPROACH:** To validate the perceived need to pretreat before microbial hydrolysis, pretreated (three different pretreatment methods) and nonpretreated fractionated corn fiber (i.e., corn fiber) particles will be studied by solid-state nuclear magnetic resonance (NMR) to investigate changes on the molecular level. In addition, the efficiency and rate of microbial breakdown for these materials in our primary bioprocess will be tested by long-term (one year) bioreactor studies with anaerobic sequencing batch reactors (ASBRs). Biodegradation efficiency will also be studied by removing partly degraded corn fiber from the bioreactors for molecular inquiry. The key to bioprocessing with a mixed culture is to generate a predominant fermentation end product that is not likely to be further degraded. We will investigate how several operating tools can be used to shift bacterial fermentation towards butyrate as the predominant and desired end product. Molecular techniques that do not rely on bacterial cultivation and modeling approaches will aid in understanding our experimental results. Some butyrate-producing clostridia can shift their metabolic pathway towards acetone-butanol fermentation. This shift occurs during the initiation of sporulation at low pH and is called solventogenesis. Butyrate-rich effluent from the first-stage bioprocess will be fed to the second-stage, pure-culture *Clostridium* sp. solventogenic bioprocess. Some carbohydrate must be supplemented to provide the metabolic energy to convert butyrate into butanol. An experimental and modeling approach will be used to maximize butanol generation, minimize supplementary carbohydrate addition, and test for unknown effects due to the diverse composition of the butyrate-rich feed.

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ACCESSION NO: 0192708 SUBFILE: CRIS

PROJ NO: MONK-2002-00424 AGENCY: CSREES MONK

PROJ TYPE: SMALL BUSINESS GRANT PROJ STATUS: NEW

CONTRACT/GRANT/AGREEMENT NO: 2002-33610-11881 PROPOSAL NO: 2002-00424

START: 15 MAY 2002 TERM: 14 NOV 2002 GRANT YR: 2002

GRANT AMT: \$80,000

INVESTIGATOR: McGrath, S.

PERFORMING INSTITUTION:

MONTEC RESEARCH

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BUTTE, MONTANA 59702

INNOVATIVE ENZYMATIC REACTOR FOR PRODUCTION OF ALTERNATIVE FUELS

**NON-TECHNICAL SUMMARY:** The USA produces 20 billion pounds of plant oils and 11 billion pounds of animal fats and recycled greases annually. The animal fats represent a potential biodiesel output of 1.5 billion gallons compared to the estimated production of 230 million gallons in 2000. Based on developing a truly competitive technology that can cost effectively convert fats to biodiesel, it will be possible to capture a substantial portion of this untapped market. Concerns related to feeding animal by-products (already banned in Europe) will increase the incentive to convert fats to biodiesel and further strengthen the market potential of the technology. Conservatively estimating the potential as 20% market share after 5 years, will give access to a total of 300 million gallons of biodiesel with a value of roughly \$300 million per annum at current fuel prices.

**OBJECTIVES:** The Phase I project will demonstrate the feasibility of an innovative reactor for the production of alternative fuels with complete conversion of free fatty acids coupled with continuous recovery of products. Key features of the continuous process for the conversion of agricultural by-products to biodiesel are: Ability to utilize low cost agricultural by-products such as vegetable oils, tallow, and yellow grease to develop a value-added industrial biodiesel production process; Continuous recovery of products to eliminate end-product inhibition for the process and shift thermodynamic equilibrium to the product direction. The novel reactor will be used to address all the major limitations of the contemporary processes enabling cost competitive production of biodiesel, without generation of any waste by-products. Biodiesel is a nontoxic, biodegradable replacement for petroleum diesel. Currently, biodiesel is produced by a process called transesterification. The vegetable oil or animal fat is first filtered, then preprocessed with alkali to remove free fatty acids. It is then mixed with an alcohol (usually methanol) and a catalyst (usually sodium or potassium hydroxide). The oils' tri-glycerides react to form esters and glycerol, that are then separated from each other and purified. This is an expensive, complex process. The novel process that will result out of this Phase I project circumvent these issues and provides for a process that produces a high quality biodiesel and glycerol product independent of the feedstock composition or moisture content. No waste products are produced in the one-step process. This project will result in a step change in technology development enabling the low cost production of biodiesel from a variety of feedstocks including vegetable oils, (soya, rape and canola), tallows and yellow grease.

**APPROACH:** See Objectives.

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ACCESSION NO: 0188612 SUBFILE: CRIS  
PROJ NO: NEB-29-011 AGENCY: CSREES NEB  
PROJ TYPE: SPECIAL GRANT PROJ STATUS: TERMINATED  
CONTRACT/GRANT/AGREEMENT NO: 2001-34233-10499 PROPOSAL NO: 2002-06133  
START: 01 SEP 2001 TERM: 31 AUG 2004 FY: 2004 GRANT YR: 2002  
GRANT AMT: \$59,863

**INVESTIGATOR:** Hanna, M. A.

**PERFORMING INSTITUTION:**  
INDUSTRIAL AGRICULTURAL PRODUCTS CENTER  
UNIVERSITY OF NEBRASKA  
LINCOLN, NEBRASKA 68583

INDUSTRIAL AGRICULTURAL PRODUCTS CENTER

**NON-TECHNICAL SUMMARY:** The viability of production agriculture is dependant upon good markets for the commodities. This project examines the viability of using agricultural commodities including

biomass to produce biopolymer, biofuel and biopower. The research will document feedstock resources, conversion technologies, and compatibility of multiple uses of feedstocks.

**OBJECTIVES:** The project objectives are to enhance research efforts in the areas of biopolymers, biofuels and biopower.

**APPROACH:** Composites of starch acetate and degradable synthetic polymers, including polycaprolactone (PCL) and Eastar Bio Copolyester (EBC) will be prepared by reactive extrusion. A twin-screw extruder with co-rotating mixing screws (Model CTSE-V, C. W. Brabender, Inc.) will be used to conduct the extrusions. Thin sheets will be prepared using a pair of take-off rolls (Model SE 606, C. W. Brabender, Inc.). Foams also will be made using an extruder. Alcohol will be used as the blowing agent. Molds will be manufactured for injection and compression-molding articles from the composites. Thermal properties of the composites will be determined using differential scanning calorimetry (DSC) and a thermal conductivity probe. Physical characteristics of the composites such as expansion, density, and water resistance will be determined. Mechanical properties including tensile strength, elongation, and spring index will be studied using an Instron universal testing machine. Micrographs of the composites will be obtained using a scanning electron microscope (SEM) to study the morphological characteristics of the samples. Biodegradation tests will be conducted in laboratory composting chambers. Temperature and humidity of the chambers can be adjusted. Rates of degradation will be monitored by gas chromatography. Efforts in the area of biofuels will be primarily in the area of biodiesel, as opposed to ethanol, etc. The continuous transesterification for producing biodiesel, referred to in the Progress Report above, will allow for sequential addition of the alcohol-catalyst solution. Our goal is to reduce the mole ratio of methanol to triglyceride from the 6:1 that is typically used to 4 or 5:1 and to achieve complete reaction in a matter of seconds with no mechanical mixing as is typically used. The independent variables will include the mole ratio of methanol or ethanol to triglyceride, the use of sodium hydroxide versus potassium hydroxide as the catalyst, and the volume flow rate of the reactants through the system. Soybean oil and beef tallow will be the triglyceride feedstocks used. The dependent variable will be the time required to complete the transesterification reaction. Efforts in the area of biopower will concentrate on availability of feedstocks and gasification as a method of converting biomass to a synthesis gas. A number of biomass feedstock summaries have been prepared in recent years. The data for Nebraska will be compiled. From this, projections will be made regarding the sustainability of biopower generation in Nebraska. Concurrently, gasification of selected materials such as Eastern red cedar trees will be evaluated.

**PROGRESS: 2001/09 TO 2004/08**

The biopolymers research effort included a more comprehensive look at the requirements of acetylating starch. We included the personnel from a starch company in our evaluations and interpretations. Our efforts included lab scale testing with 600ml reactors through pilot scale testing with a reactor that can process 100 kg batches. We have made numerous batches for in-house extrusions for the purpose of characterizing starch acetate as a biopolymer for use in packaging and insulation foams. Extrusions have been done with our laboratory scale C.W. Brabender extruders as well as commercial extruders at three different companies. Our commercialization efforts continue. Our in-house characterization of starch acetate has included the extrusion of starch acetate with numerous other ingredients with the goal of enhancing the functional properties of the extrudates. The other ingredients included other biopolymers such as PLA and Mater-Bi; fibers such as cellulose, corn fiber and oat fiber. Our efforts have resulted in numerous publications and follow up research grant proposals to agencies such as USDA-CSREES, the Nebraska Corn Board and several companies. The biodiesel research efforts led to an understanding of the relative solvencies of ethanol, biodiesel and diesel fuels. Our data were used to develop a phase diagram that clearly shows the proportions of each that can be mixed to form stable fuel blends. This will be published soon. The combination of our biofuels and biopower research efforts and the interest in the private sector to get involved in the production of biofuels, led us to a proposal to develop a map of the bioresources in Nebraska that could be used to identify the best location for processing facilities. We received a Value-Added Processing Grant in conjunction with the Nebraska Soybean Association to begin the development of the resources map.

**IMPACT: 2001/09 TO 2004/08**

The research on characterization of starch acetate as a basis for expanded foam production supports our commercialization efforts in the same area. Our patent is still pending. We are using the research results from both the starch acetate and the biodiesel efforts to prepare competitive grants proposals to further our

understanding of these topics and to position ourselves better for commercialization. A biodiesel proposal has been submitted to the NSF and another to USDA-CSREES. Another two proposals have been submitted to USDA-CSREES on related starch biopolymer characterization and utilization. We currently have two funded projects that are spin offs of this project

PUBLICATIONS (not previously reported): 2001/09 TO 2004/08

1. Guan, J.J. and M.A. Hanna. 2003. Post extrusion steaming of starch acetate foams. *Trans. of the ASAE*. 46(6):1613-1624.
2. Guan, J. and M.A. Hanna. 2004. Functional properties of extruded foam composites of starch acetate and corn cob fiber. *Ind. Crops and Products*. 19(3):255-269.
3. Guan, J., K. Eskridge and M.A. Hanna. 2004. Functional properties of extruded acetylated starch-cellulose foams. *J. of Polymers and the Environment*. 12(3): 113-121.
4. Guan, J., Q. Fang and M.A. Hanna. 2004. Selected functional properties of extruded starch acetate-natural fiber foams. *Cereal Chemistry*. 81(2):199-206.
5. Guan, J., Q. Fang and M.A. Hanna. 2004. Functional properties of extruded starch acetate blends. *J. Polymers and the Environment*. 12(2):57-63.
6. Guan, J., Q. Fang and M.A. Hanna. 2004. Macromolecular characteristics of starch acetate extruded with natural fibers. *Trans. of ASAE*. 47(1):205-212.
7. Seker, M., H. Sadikoglu, M. Ozdemir and M.A. Hanna. 2003. Cross-linking of starch with reactive extrusion and expansion of extrudates. *International J. Food Properties*. 6(3):473-480.
8. Seker, M., H. Sadikoglu and M.A. Hanna. 2004. Properties of cross-linked starch produced in a single-screw extruder with and without a mixing element. *J. of Food Process Engineering*. 27(1):47-63.

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Item No. 33 of 59

ACCESSION NO: 0186027 SUBFILE: CRIS  
 PROJ NO: NHR-2000-01888 AGENCY: CSREES NHR  
 PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 2001-35504-10041 PROPOSAL NO: 2000-01888  
 START: 15 DEC 2000 TERM: 30 JUN 2003 FY: 2003 GRANT YR: 2001  
 GRANT AMT: \$103,000

INVESTIGATOR: Wyman, C. E.

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**FUNDAMENTALS OF WATER-ONLY HYDROLYSIS FOR ADVANCED BIOMASS  
 PRETREATMENT**

**NON-TECHNICAL SUMMARY:** Biological processing of abundant lignocellulosic biomass sources such as agricultural residues and ultimately dedicated crops to fuels and chemicals in advanced biorefineries would create major new markets for agriculture and rural manufacturing. Such processes are powerful routes to sustainable production of organic fuels and chemicals on a large scale with unparalleled potential for environmental, economic, and strategic benefits. Enzyme-based technologies offer high product yields vital to achieving these ends, but pretreatment needed to obtain such yields is the typically the most expensive single step with significant impacts on other costs. Recently, technologies based on flow of water through biomass have been shown to promise significant cost reductions but suffer from some important limitations. The overall objective of this proposal is to better understand the mechanisms that differentiate

these advanced processes from conventional water-only technologies and build a foundation to improve pretreatment technologies. Because short-chained oligomer intermediates could be a key to explaining such differences, novel models will be developed that focus on the kinetics of oligomer formation, mass transfer, and reaction. Their predictions will be compared to those for currently applied models and data from the literature. New data will then be collected for water-only pretreatment and used to assess the applicability of the various models. The goal is to provide new data, models, insight, and mechanisms that will facilitate the development and commercialization of lower

**OBJECTIVES:** Overall Goal of the Proposed Project. The overall goal of the project is to understand factors that will help explain differences in performance between uncatalyzed steam heating and flowthrough hot water pretreatment technologies and provide a platform for developing innovative systems that can realize the unique advantages of each while overcoming their distinctive limitations. We propose to develop rate models to predict the performance of these uncatalyzed systems and determine how well typical homogeneous models can predict hydrolysis of solids and sugar accumulation and degradation versus new models based on mass transfer coupled to reaction. Particular attention will be focused on understanding the role of oligomers in hemicellulose hydrolysis, a subject that has received little attention in the past for uncatalyzed systems. The following objectives are the focus for this project: Objective 1: Design new models to integrate mass transfer effects into hemicellulose hydrolysis kinetic pathways, assess how reaction rate control is influenced by the relative rate constants, and compare to literature results. Particular focus will be on modeling the relationship among formation of oligomers in solid biomass, their mass transfer into the liquid phase, and reaction of these oligomers to monomers. These tools will be compared to conventional homogeneous reaction models and alternative models based on continued reaction in the solid. The models will also be used to define experimental conditions. Objective 2: Perform kinetic experiments to measure how reactor performance and sugar and oligomer recovery change with reaction and recovery conditions. Experiments will be run to determine how well commonly applied first order homogeneous kinetic models explain hemicellulose hydrolysis under varying conditions and to provide sugar monomer and oligomer data that will allow us to determine what role, if any, mass transfer plays in hemicellulose hydrolysis. This element will focus on novel approaches to capture oligomers and monomers at reaction conditions for batch systems. Objective 3: Characterize the solid and liquid fractions for hemicellulose hydrolysis run under various reaction conditions and product collection strategies and determine important interactions. This portion of the project will focus on characterizing the sugars and oligomers in the liquid phase and the carbohydrate composition in the residual solids. These results will support closure of material balances and provide information on kinetic irregularities between reaction rate predictions based on sugar recovery versus those based on residual solid profiles. Objective 4: Apply kinetic models to estimate appropriate rate constants and mass transfer coefficients based on performance data from experiments. The models will be calibrated based on experiments from Objective 2 and 3 and applied to project the reasons for differences in performances between flowthrough and batch systems.

**APPROACH:** The focus of the project is on understanding hemicellulose hydrolysis processes that use no added chemicals. The feedstock will be primarily sugar cane bagasse, and the proposed project will be carried out in four elements, corresponding to the project objectives. In the first element, we will build off a recently developed kinetic model to evaluate hemicellulose hydrolysis pathways to undissolved oligomers, dissolved oligomers, monomers, and degradation products. We will also extend existing homogeneous models for hemicellulose hydrolysis with and without consideration of oligomeric intermediates to understand important differences with models that include mass transfer. The results from these models will provide insight to design out experimental systems and approaches to analyze the data to differentiate between these mechanisms. The second element will be directed at running reactor experiments at different conditions to capture liquid and solid phase and develop a new picture of hydrolysis kinetics. One set of experiments will use small tubes heated to reaction temperature by a fluidized sand bath followed by quick pressure release through a valve system into an attached tube and rapid removal and quenching of the tubes in ice water. We will then conduct screening experiments to compare the oligomer profiles for different approaches to separate solids and liquid while hot from the reactor configuration above. In one decompression will be through a fritted disk or fine screen to allow passage of only dissolved material without solids. In the second experiments, the material will be discharged into a large volume of water at various run times to determine whether longer chained oligomers can be recovered before they reprecipitate back on the biomass. Another set of batch reaction experiments will focus on separation of some of the liquid from the solid at various times, continuing the reaction for a longer time, and then quenching the system. Data will be developed in the third element to provide new information on the time dependent

sugar and oligomer profiles for hemicellulose hydrolysis solid and liquid samples recovered in different approaches. In particular, we seek to learn how the concentration of sugars and oligomers in the liquid phase varies with time, temperature, and recovery methods. The fourth element will analyze the data from these experiments to develop relationships among the concentrations of various sugars and oligomers, time, temperature, reactor configuration, and other factors. As part of this approach, the application of neural networks will be explored to analyze the complex data expected. However, particular focus will be on applying the most promising models identified in element 1. These will be calibrated based on a few sets of experiments such as the various modes of batch heating, and the model predictions will be compared to observed performance for a different set of experiments to determine which best describes these experimental results.

**PROGRESS: 2001/10 TO 2002/09**

This research project focused on three fundamental factors vital to understanding hemicellulose hydrolysis in just water: temperature transients, solids concentration, and biomass acetylation. A cylindrical heat conduction model was developed to predict experimental heating profiles and coupled with conventional first-order hydrolysis reaction kinetics to demonstrate that temperature transients can significantly impact performance. This information was used to devise a dimensionless expression relating the rates of reaction and heat conduction to guide design of experimental systems and to evaluate reaction rate differences for published studies. Modeling for experiments with hydrolysis of deacetylated biomass at varying acetic acid loadings showed that rate constants for xylan hydrolysis, xylooligomer hydrolysis, and monomer degradation all increased with acid concentration. It was observed that adding higher amounts of acetic acid than released from biomass could not replicate yields without deacetylation. A simple, first-order reaction model for xylan hydrolysis to oligomers that subsequently form monomers that in turn degrade was found to reasonably fit experimental data for different initial solids concentrations with 0.5 in. diameter tubular batch reactors. In addition, a one-step, first-order model was found to fit experimental profiles for the hydrolysis of bound acetyl groups to free acetic acid. However, our data and models showed that there were statistically significant differences in yields of hemicellulose sugars for solids concentrations of 5 and 20 percent with higher sugar yields obtained at lower solids loadings. Such variations are contrary to widely applied first order kinetic models. Although solids concentration affected yields, no evidence was found to support the hypothesis that oligomer solubility limits are responsible for this behavior. In addition, the heat transfer/kinetic model demonstrated that poor heat transfer at higher solids loadings could not solely account for the observed differences in yields at different solids concentrations. Modeling of data for varying solids concentrations revealed that the xylan and oligomer hydrolysis rates increased while monomer degradation rates decreased with solids loading. Therefore it was concluded that the increased concentration of acetyl groups present at higher solids concentrations is not the primary cause of observed differences in yields as a function of solids concentration. Overall, this project suggests that current models do not accurately represent the mechanism of hemicellulose hydrolysis. Plausible explanations for the solids-loading dependent yields include reduced mass transfer at higher solids loadings, increased chemical reactions of soluble sugars with other components at higher solids concentrations, and other than first-order reactions being involved. However, additional experiments such as batch autohydrolysis of completely deacetylated material at various solids loadings are needed to determine the effects of increasing the concentrations of other components released during hydrolysis without increasing acid concentration.

**IMPACT: 2001/10 TO 2002/09**

Conversion of abundant cellulosic biomass into fuels and commodity chemicals provides a unique path for sustainable, large-scale production of organic fuels, chemicals, and materials with improved energy security, reduced trade deficits, and limited net greenhouse gas emissions while disposing of problematic solid wastes and creating rural employment. Biological conversion promises the low costs required for large impacts, but the pretreatment step essential to high yields is still too expensive. This project seeks to improve the understanding of differences in pretreatment by hemicellulose removal in just water for seemingly similar conventional uncatalyzed steam heating and flowthrough hot water methods and provide a platform for developing low cost innovative systems that can realize the unique advantages of each while overcoming their important limitations.

**PUBLICATIONS (not previously reported): 2001/10 TO 2002/09**

1. Stuhler, S.L. and Wyman, C.E. 2003. Estimation of temperature transients for biomass pretreatment in tubular batch reactors and impact on xylan hydrolysis kinetics. *Applied Biochemistry and Biotechnology* 105-108: 101-114.
2. Stuhler, S.L. 2002. Effects of Solids Concentration, Acetylation, and Transient Heat Transfer on Uncatalyzed Batch Pretreatment of Corn Stover. M.S. Thesis. Thayer School of Engineering, Dartmouth College, Hanover, NH.
3. The following poster presentation was made during the reporting period: Stuhler, S.L. and Wyman, C.E. 2003. The role of solids concentration and acetylation in uncatalyzed batch hydrolysis of corn stover hemicellulose, 25th Symposium on Biotechnology for Fuels and Chemicals. Breckenridge, CO, 05/05/03.

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ACCESSION NO: 0200573 SUBFILE: CRIS  
 PROJ NO: NHR-2004-00952 AGENCY: CSREES NH.R  
 PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: EXTENDED  
 CONTRACT/GRANT/AGREEMENT NO: 2004-35504-14668 PROPOSAL NO: 2004-00952  
 START: 01 SEP 2004 TERM: 31 AUG 2008 FY: 2006 GRANT YR: 2004  
 GRANT AMT: \$401,000

INVESTIGATOR: Wyman, C.

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**LIGNIN BLOCKERS FOR LOWER COST ENZYMATIC HYDROLYSIS OF PRETREATED CELLULOSE**

**NON-TECHNICAL SUMMARY:** Biomass is unique for sustainable production of organic products with unparalleled environmental, economic, and strategic benefits possible. Cellulosic biomass is abundant and inexpensive, with cellulose at under \$40/ton potentially contributing less than \$0.40/gallon of ethanol, as an example, and the challenge is low processing costs with high yields. Application of modern biotechnology has made dramatic progress, with enzymatic processing now costing about the same as for corn. However, less expensive cellulase enzymes are still needed for major impact. Recently, we showed that proteins we term lignin blockers lower enzyme use in an apparently different way than surfactants studied before, and our goal is to develop this novel technology to significantly reduce enzyme costs for converting cellulose to fuels and chemicals. This research will identify new blockers; characterize interactions of cellulase and promising blockers; evaluate blocker effectiveness with enzymatic hydrolysis alone and with fermentation; devise novel processes to capitalize on blockers; and develop models to better understand coupled hydrolysis-blocker performance. The new data and models will define a path to significantly lower the cost of cellulose hydrolysis by enzymes and compliment recent developments in cellulase production and pretreatment to facilitate emergence of a beneficial industry. This project will develop technology that promises to substantially reduce the cost of biologically converting cellulosic biomass into fuels and chemicals such as ethanol.

**OBJECTIVES:** The primary goal is to more fully develop lignin blocker technology for biological conversion of pretreated cellulosic biomass to glucose that can be converted to ethanol and a range of other products either biologically or chemically. In particular, we seek to understand and apply lignin blockers to reduce enzyme loadings and costs for enzymatic digestion of pretreated cellulose to glucose. The first objective of the research is to screen different soluble proteins and other promising compounds not yet considered with pretreated biomass to define a library of promising lignin blockers that could reduce cellulase loadings and costs. A second objective is to measure cellulase and blocker adsorption and



desorption when applied with different lignin blockers and cellulase addition strategies and pretreatment conditions. The work will include examining adsorption and desorption of cellulase and promising lignin blockers identified alone and in combination to quantify the capacity of biomass for each and determine whether lignin blockers are best added before cellulase or can be added with or after cellulase. The next objective is to define the impact of the most promising lignin blockers on enzymatic hydrolysis of pretreated cellulose to determine how performance of the system is influenced by amounts of lignin blocker, cellulase, cellulose, and lignin; temperature; pH; glucose accumulation; beta-glucosidase supplementation; and ingredient addition strategies. Because we believe lignin blockers will be particularly effective in continuous cellulose hydrolysis, we also plan to determine how batch versus continuous operation impacts performance. Another objective is to investigate the performance of the most promising lignin blockers when used with pretreated cellulose in simultaneous saccharification and fermentation (SSF) to define the impact on performance versus cellulase use because SSF eliminates equipment and speeds rates, yields, and concentrations of ethanol production while inhibiting invasion by unwanted organisms. We will focus on how SSF performance is influenced by amounts of lignin blocker, cellulase, cellulose and lignin; temperature; pH; glucose accumulation; beta-glucosidase supplementation; ingredient addition strategies; and fermentation configuration. Our final objective is to develop models to relate enzymatic hydrolysis rates and yields to concentrations of lignin blockers and cellulase; the cellulose, lignin, and other component content of pretreated biomass; process conditions; and the use of other ingredients (e.g., supplemental beta-glucosidase). This research element will focus on improving the understanding of how adsorption and desorption of lignin blockers and cellulase are influenced by processing conditions and how they in turn affect the performance of hydrolysis systems and use that information to project pathways to further improve performance

**APPROACH:** Corn stover is the primary feedstock for this project because it represents a major biomass source; a reliable, controlled supply is available; and we have extensive experience with its pretreatment and enzymatic hydrolysis. In the first element of research, alternative lignin blockers will be rapidly screened using cellulose and pretreated stover to define a library of compounds beyond those we found initially that promise reduced cellulase loadings and costs. Cellulase and blocker adsorption and desorption will be measured in the second element for different lignin blocker and cellulase addition strategies and pretreatment conditions. These experiments will include characterization with cellulose, lignin, and pretreated stover and determining the influence of the order of ingredient addition and treatment conditions. We also plan to apply special inactive cellulases to better understand how lignin blockers and cellulase interact at hydrolysis temperatures. This effort will include evaluating how hydrolysis process variables affect capture of cellulase and lignin blockers. The third research element will define the impact of the most promising lignin blockers on enzymatic hydrolysis of pretreated cellulose. This portion will focus on how performance is influenced by amounts of lignin blockers and cellulase, cellulose and lignin content, temperature, pH, glucose accumulation, and ingredient addition strategies. Because cellulase is strongly inhibited by accumulation of glucose and particularly cellobiose, the enzymatic hydrolysis rate will be followed with changes in solids concentration and beta-glucosidase supplementation. A valuable part is to explore whether lignin blockers are particularly effective for enzymatic hydrolysis of pretreated biomass in continuous fermentations. A fourth research element will investigate the effect of the most promising lignin blockers on performance of the simultaneous saccharification and fermentation (SSF) system. Overall, many practitioners favor SSF for ethanol production because it eliminates equipment and enhances rates, yields, and concentrations of ethanol production despite requiring somewhat lower temperatures. Thus, we will also measure how SSF performance is influenced by amounts of lignin blockers and cellulase, cellulose and lignin concentrations, temperature, pH, glucose accumulation, beta-glucosidase supplementation, fermentative organism choice, ingredient addition strategies, and fermentation configuration. We will explore whether continuous SSF further enhances the benefits of lignin blockers. In the final element, we will model how lignin blockers, cellulase, and beta glucosidase interact with cellulose, lignin, and pretreated biomass to better understand what factors appear to govern their effects. We desire to relate hydrolysis performance to adsorption characteristics of enzymes and blockers to gain a better appreciation for operating conditions that will realize the greatest benefits. We also plan to develop models to describe the effect of blockers on cellulose hydrolysis for SSF with regular and cellobiose fermenting yeast.

**PROGRESS:** 2005/10 TO 2006/09

In this study, the interactions between cellulase enzyme and the different components of biomass were determined by developing adsorption data and calculating adsorption isotherms. Our results showed that

BSA treatment of dilute acid pretreated corn stover reduced cellulase adsorption by substrate. We also showed that this phenomenon is more evident when the substrate is treated at 50C than at 4C. Lignin showed a high adsorption capacity for cellulase. These results confirm that cellulase has a higher mass affinity than either  $\beta$ -glucosidase or BSA for Avicel cellulose, dilute acid pretreated corn stover, and corn stover lignin. It also proved that  $\beta$ -glucosidase and BSA show very little affinity for cellulose and higher affinity for pretreated corn stover and lignin, demonstrating their tendency to adsorb to the lignin fraction. In general, the adsorption of protein by the substrates increased with temperature. Tween 80 and BSA were both evaluated as additives for hydrolysis of pretreated corn stover on the basis of how much enzyme they could displace for the same extent of conversion. The results showed that BSA and Tween 80 both improved hydrolysis of dilute acid pretreated corn stover and that this benefit was most dramatic at low enzyme loadings. Specifically, the need for  $\beta$ -glucosidase supplementation could be significantly reduced by use of additives, reducing enzyme costs through significantly lower addition of  $\beta$ -glucosidase. For example, the most dramatic results were that an enzyme loading of just 5 FPU/g glucan was adequate to achieve a glucan conversion of as high as 85% in the presence of additives while three times that amount of cellulase (15 FPU/g glucan) was required without BSA. For AFEX pretreated corn stover, Tween 80 performed slightly better than acid pretreated corn stover although additional work is required to reveal the underlying mechanism. The conversion of glucan in pretreated corn stover at 120 hours by 5 FPU/g glucan of cellulase was improved by up to 20% by the presence of 10 mg/mL of either BSA or Tween 80. BSA treatment decreased adsorption of cellulase and  $\beta$ -glucosidase on pretreated corn stover, pointing out that BSA decreased adsorption of enzyme on the lignin fraction. Application of kinetic models to this project also support this mechanism. Both versions of the model used herein resulted in elevated values for the reaction rate constant for the conversion of cellobiose to glucose by  $\beta$ -glucosidase, confirming our last report that there is more  $\beta$ -glucosidase remaining in the liquid fraction of the hydrolysis mixture. In other words, there is less unproductively bound  $\beta$ -glucosidase. Our attention will now focus on evaluating the effect of lignin blockers on continuous SSF of pretreated corn stover, and a mathematical model is being developed to predict the performance of continuous SSF and point out opportunities to realize high ethanol yields at very low cost.

#### IMPACT: 2005/10 TO 2006/09

Cellulosic biomass must be pretreated to realize high sugar yields via enzymatic digestion and achieve competitive costs for production of large market fuels and commodity chemicals with powerful societal benefits. However, pretreatment is the most expensive step followed closely by the cost of enzymatic hydrolysis of pretreated substrate and costs of the enzymes. A better understanding of factors that control substrate-enzyme interactions is invaluable to identifying low cost paths. Addition of non catalytic proteins such as BSA has been shown to enhance cellulose hydrolysis by enzymes or lower the amount of enzyme required to realize a particular conversion, potentially lowering costs. Thus, we are determining interactions among substrate features, enzymes, and BSA to better understand mechanisms by which these additives influence hydrolysis and identify promising routes to reduce enzyme use and speed rates. Adsorption and desorption profiles were measured to better clarify the interaction of BSA, cellulase, and beta-glucosidase with cellulose, pretreated corn stover, and lignin from corn stover. This data indicates that BSA adsorbs much more strongly on lignin than cellulose, thus reducing non productive enzyme binding to lignin and enhancing performance. Thus, our results confirm that treatment of pretreated biomass with inexpensive protein would reduce costs significantly. In addition, application of a new restart protocol suggests that the slow down in rate with enzymatic digestion is due to changes in enzyme effectiveness and not cellulose reactivity.

#### PUBLICATIONS (not previously reported): 2005/10 TO 2006/09

1. Bin Yang and Charles E Wyman, Changes in the Enzymatic Reaction Rate of Cellulose with Conversion, *Biotechnology and Bioengineering* 94(6): 1120-1128, 2006.
2. Bin Yang and Charles E Wyman, BSA Treatment to Enhance Enzymatic Hydrolysis of Cellulose in Lignin Containing Substrates, *Biotechnology and Bioengineering* 94(4): 611-617, 2006.
3. Deidre M. Willies , Bin Yang, and Charles E. Wyman, Adsorption and Desorption of Cellulase, Beta-Glucosidase, and BSA Protein on Pretreated Corn Stover, Cellulose, and Lignin, presentation at the 2006 Annual AIChE Meeting, San Francisco, California, November 17, 2006.
4. Bin Yang, Deidre M. Willies, and Charles E. Wyman, Improving Ethanol Yields by Lignin Blockers, presentation at the The World Congress on Industrial Biotechnology and Bioprocessing, Toronto, Canada, July 11-14, 2006.

5. Bin Yang, Deidre M. Willies, and Charles E. Wyman, Changes in the Enzymatic Digestion Rate of Cellulose with Conversion, presentation at the The World Congress on Industrial Biotechnology and Bioprocessing, Toronto, Canada, July 11-14, 2006.
6. Deidre Willies, Bin Yang, and Charles E. Wyman, Adsorption and Desorption of Cellulase, Beta-Glucosidase, and BSA Protein on Pretreated Corn Stover, Cellulose, and Lignin, presentation at the 28th Symposium on Biotechnology for Fuels and Chemicals, Nashville, TN, April 30 - May 3, 2006.
7. Bin Yang, Deidre Willies, and Charles E. Wyman, Protein Treatment to Reduce Non-Productive Cellulase Adsorption, presentation at the 14th European Biomass Conference and Exhibition, Paris, France, October 17, 2005.

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Item No. 35 of 59

ACCESSION NO: 0186451 SUBFILE: CRIS  
 PROJ NO: NHW-2000-04726 AGENCY: CSREES NH.W  
 PROJ TYPE: OTHER GRANTS PROJ STATUS: EXTENDED  
 CONTRACT/GRANT/AGREEMENT NO: 00-52104-9663 PROPOSAL NO: 2000-04726  
 START: 15 SEP 2000 TERM: 30 SEP 2004 FY: 2003 GRANT YR: 2000  
 GRANT AMT: \$1,200,000

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**COORDINATED DEVELOPMENT OF LEADING BIOMASS PRETREATMENT TECHNOLOGIES**

**NON-TECHNICAL SUMMARY:** Leading technologies will be applied to prepare low cost lignocellulosic biomass for conversion to a variety of products that would open up major new markets for agricultural feedstocks. The effort will be performed by a Biomass Refining Consortium among Auburn Univ, Dartmouth College, Michigan State Univ, the National Renewable Energy Lab, Purdue Univ, and Texas A&M Univ. Optimum pretreatment conditions will be defined for ammonia explosion, aqueous ammonia recycle, controlled pH, dilute acid, lime, and uncatalyzed technologies based on the extensive experience of this team. The resulting fluid and solid streams will be fully characterized, and the data will be used to accurately close material balances. In addition, energy balances will be estimated. The fermentability of the liquids and digestibility of the solids by cellulase enzyme will be assessed and used to guide definition of pretreatment conditions. Thermochemical hydrolysis of the cellulose rich solids will also be evaluated to provide data on this optional approach to cellulose use. Economic assessments will be applied to estimate the cost of pretreatment by each approach on a consistent basis. Priority will be given to insuring accurate data is developed for corn stover, but a hardwood and switchgrass will also be included to the extent possible to apply accurate analysis. The comparative studies will be guided by an agricultural and industrial advisory board, and the results widely disseminated.

**OBJECTIVES:** The overall goal of the proposed project is to develop comparative information on leading pretreatment operations for production of sugars from the hemicellulose and cellulose fractions of biomass for fermentation or chemical reaction to a wide range of high volume commodity products. In particular, corn stover will be used initially as a representative feedstock, and material balances will be accurately closed to describe the fate of the key biomass constituents for each pretreatment approach. Comprehensive analysis will be made of the biomass source and liquid and solid products from pretreatment to support closing of material balances and characterization of the key reactions. The cellulose rich solids from each

will also be processed to glucose, and the liquid hydrolyzate fermented to provide important data for commercial use and to assess the relationship among pretreatment system, conditions, effects on the biomass substrate, and subsequent downstream processing. Similar data will be gathered subsequently on a hardwood energy crop and switchgrass, as time permits gathering the comprehensive data vital to the project. The overall results will improve these pretreatment technologies further, provide valuable comparative data to industry on each technology, provide information to accelerate near-term scale-up and application by reducing risk, and develop new insight into biomass hydrolysis that will help define advanced processes that further reduce costs. The following specific objectives have been defined for the proposed work: Objective 1: Apply each of the leading pretreatment technologies to recover hemicellulose sugars and prepare biomass for cellulose hydrolysis. Objective 2: Monitor the recovery, reactions, and fate of lignin, hemicellulose, cellulose, and protein for each of these pretreatment technologies, and gather comprehensive data to characterize these components. Objective 3: Develop and accurately close material balances for each of the pretreatments and calculate energy balances for each. Objective 4: Hydrolize pretreated solids with enzyme and acid and evaluate the fermentability of liquid hydrolyzate for the most promising conditions for each pretreatment technology. Objective 5: Compare performance among systems on a consistent basis and publish and otherwise widely disseminate the results. Also, work with individuals, groups, and firms to apply these results commercially.

**APPROACH:** This effort will be a cooperative project among Auburn University, Dartmouth College, Michigan State University, Purdue University, and Texas A&M University, along with non-reimbursed participation by the National Renewable Energy Laboratory (NREL). Each of the academic institutions will be responsible for pretreating biomass by technologies for which they have substantial development experience and capabilities. In addition, each of these laboratories will apply established analytical methodologies to capitalize on existing capabilities and insure results on a consistent basis. NREL will provide facilities and guidance and help in the assessment and application of the results. The first priority will be to use corn stover for all tests to provide a common basis for comparison followed by a hardwood and switchgrass, as possible, while meeting the comprehensive data gathering vital to this project. Furthermore, a panel of industrial and agricultural experts will meet regularly with the team to guide the project and serve as extension agents. In the first element of the project, each team will pretreat biomass to recover sugars and prepare cellulose for subsequent hydrolysis. Auburn University will apply liquid ammonia recycled percolation (ARP); Dartmouth College will employ acid catalyzed and uncatalyzed technologies; Michigan State University will utilize ammonia fiber extrusion (FIBEX); Purdue University will run controlled pH pretreatments; and Texas A&M University will work with lime based processes. Each team will apply conditions based on their extensive experience. To meet the second objective, each of the collaborators will be responsible for specific evaluations using available instrumentation. Particular attention will be given to the effects of the various pretreatments on hemicellulose, cellulose, lignin, and protein. A key component of objective 3 is to accurately determine the fate of key constituents for each pretreatment technology. Material balances are challenging for biomass systems because of the heterogeneity of the material, its complex structure, and side reactions. However, because high yields of sugars are central to product revenues, it is critical to determine yields accurately, and substantial effort will be devoted to this objective. A key measurement is the determination of the yield of glucose from cellulose for objective 4 because this, together with hemicellulose sugar recovery, is central to obtaining revenues in a commercial context. Thus, enzymatic digestibility will be evaluated for each pretreatment based on established procedures. The fermentability of the liquid hydrolyzates to ethanol will also be determined to allow comparison of technologies. In addition, the digestibility of cellulose from each pretreatment will be determined with dilute sulfuric acid.

**PROGRESS: 2002/10 TO 2003/09**

The project is on schedule. The Agricultural and Industrial Advisory Board was expanded some to 16 members, and the Team met twice with them to obtain feedback. The Team held conference calls to coordinate throughout the year. Corn stover was used as the feedstock for all tests. Auburn University reduced liquid rates to 3.3 mL/g of stover for Ammonia Recycled Percolation (ARP) pretreatment. Auburn also developed a new SAA pretreatment method at moderate conditions of <100C and atmospheric pressure. Advantages are the process is simple, most hemicellulose is retained, and process energy and equipment costs are low. It was also proven that recombinant E. coli can efficiently utilize both the glucan and the xylan in treated corn stover. Dartmouth College achieved 90% total sugar yields for batch dilute acid pretreatment followed by enzymatic hydrolysis at high loadings. The optimum conditions for these steps were not the same, and enzymes enhanced xylose recovery. Models were devised to predict high

temperature pH and describe oligomer and monomer release. Hemicellulose removal increased significantly with water flow through biomass, contrary to customary predictions, and possible mechanisms were developed. A novel periodic-flow was developed to reduce water use but enhance performance. Michigan State University optimized ammonia fiber explosion (AFEX) to convert cellulose and hemicellulose to glucose and xylose and realized near theoretical yields of glucose and about 80% yields of xylose. Over 90% yields of glucose resulted at lower enzyme loadings of 7.5 IU/gram glucan. MSU also provided infrared, fluorescence, and X ray diffraction analysis for all team members. MBI International is pursuing scale up and commercialization of AFEX with interested parties. Purdue University optimized their controlled pH process at 190C with pH control at 4-7 through liquid buffer capacity to minimize monosaccharides and avoid their degradation to inhibitors that affect fermentation. Controlled pH pretreatment of stover resulted in 87% of glucan and 78% of xylan being hydrolyzed at a cellulase loading of 15 FPU/g pretreated corn stover, and 88% of the glucose and xylose was converted to ethanol by a recombinant yeast developed at Purdue. Texas A&M University treated corn stover with lime and air at 25-55C for up to 16 weeks. The optimal conditions were 4 weeks with 0.1 g of lime/g biomass at 55C. At an enzyme loading of 15 FPU/g glucan, 92.4% of glucan and 78.4% of xylan were hydrolyzed. At an enzyme loading of 60 FPU/g glucan, 97.1% of glucan and 81.0% of xylan were hydrolyzed. This lime/air treatment has been licensed to Terrabon, LLC who is raising \$2 million to construct a demonstration plant. The National Renewable Energy Laboratory (NREL) participated through Department of Energy funding and continued to store and supply corn stover and cellulase. Process and economic models were also updated for each pretreatment with performance and digestibility data from each researcher. In addition, NREL conducted comparative simultaneous saccharification and fermentation studies on samples from each pretreatment process.

#### IMPACT: 2002/10 TO 2003/09

Cellulosic biomass is a unique sustainable resource for making organic fuels and chemicals. Very low greenhouse gas emissions is a powerful attribute, but cellulosic biomass use would also enhance energy security, reduce trade deficits, create rural employment, and dispose of waste. Cost and availability of cellulose are attractive, and the primary need is to reduce processing costs. Pretreatment is essential for biological conversion, and the project is developing comparable information on leading pretreatments that would open up major new agricultural markets. Data and projected costs are compared and widely disseminated, and opportunities are sought to accelerate commercial applications. An Agricultural and Industrial Advisory Board gains insight and provides guidance in regular meetings. The project gives significant momentum to biomass processing as well as important educational benefits. Key findings are emerging through this project. First, each pretreatment provides highly digestible cellulose, with about 90% of the cellulose converted to glucose. The project also shows that hemicellulase activity in enzyme increases hemicellulose sugar yields, particularly for high pH pretreatment technologies. The initial economic analysis has projected similar costs for all processes, but further integration and optimization is ongoing to more fully capture the unique features of each pretreatment. A number of papers, patent applications, and presentations resulted, and several companies are working with participants to commercially apply pretreatment technologies.

#### PUBLICATIONS (not previously reported): 2002/10 TO 2003/09

1. Mosier N, Wyman CE, Dale BE, Elander RT, Lee YY, Holtzapple M, Ladisch MR. 2003. "Features of promising technologies for pretreatment of lignocellulosic biomass," *Bioresource Technology* (submitted).
2. Kim TH, Lee YY. 2004. "Fractionation of corn stover by hot-water and aqueous ammonia treatment," *Bioresource Technology* (submitted).
3. Liu C, Wyman CE. 2004. "The effect of flow rate of very dilute sulfuric acid on xylan, lignin, and total mass removal from corn stover," *Industrial Engineering Chemistry Research* (accepted).
4. Liu C, Wyman CE. 2004. "Impact of fluid velocity on hot water pretreatment of corn stover in a flowthrough reactor," *Applied Biochemistry and Biotechnology* (Proceedings of the 25th Symposium on Biotechnology for Fuels and Chemicals), (in press).
5. Lloyd TA, Wyman CE. 2004. "Predicted effects of mineral neutralization and bisulfate formation on hydrogen ion concentration for dilute sulfuric acid pretreatment," *Applied Biochemistry and Biotechnology* (Proceedings of the 25th Symposium on Biotechnology for Fuels and Chemicals), (in press).
6. Kim TH, Sunwoo C, Lee YY. 2003. "Pretreatment of corn stover by aqueous ammonia," *Bioresource Technology* 90: 39-47.
7. Lee YY, Kim TH. 2003. "Low-temperature treatment of lignocellulosic biomass with aqueous ammonia for improvement of enzymatic digestibility," *US Provisional Patent Application 60/459,670*, April 20.

8. Lloyd TA, Wyman CE. 2003. "Application of a depolymerization model for predicting thermochemical hemicellulose hydrolysis," *Applied Biochemistry and Biotechnology (Proceedings of the 24th Symposium on Biotechnology for Fuels and Chemicals)* 105-108: 53-67.
9. Eggeman T, Elander R, Ibson K. 2003. "Logistical support and modeling efforts in pretreatment research," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
10. Kim S, Thanakoses P, Holtzapple MT. 2003. "Lime pretreatment," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
11. Kim TH, Lee YY. 2003. "Pretreatment of corn stover by soaking in aqueous ammonia," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
12. Laureno-Perez L, Teymouri F, Dale B, Alizadeh H. 2003. "Understanding factors that limit enzymatic hydrolysis of biomass: Characterization of pretreated corn stover," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
13. Liu C, Wyman CE. 2003. "Comparison of batch, stop-flow-stop, and flowthrough pretreatment of corn stover," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
14. Lloyd TA, Wyman CE. 2003. "Overall sugar yields from corn stover via thermochemical hemicellulose hydrolysis followed by enzymatic hydrolysis," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
15. Mosier N, Hendrickson R, Kim Y, Zeng M, Dien B, Welch G, Wyman CE, Ladisch MR. 2003. "Optimization of controlled pH liquid hot water pretreatment of corn fiber and stover," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
16. Teymouri F, Laureano-Perez L, Dale B, Alizadeh H. 2003. "Ammonia fiber explosion (afex) for pretreatment of corn stover: recent research results," AICHE Annual Meeting, San Francisco, CA, November (proceedings and oral presentation).
17. Wyman CE, Dale B, Eggeman T, Elander R, Holtzapple M, Ladisch M, Lee YY. 2003. "Comparison of selected results for application of leading pretreatment technologies to corn stover," AICHE Annual Meeting, San Francisco, CA, November (oral presentation).
18. Wyman CE, Eggeman T. 2003. "Pretreatment of lignocellulosic biomass: update on biomass refining cafi studies," AICHE Annual Meeting, San Francisco, CA, November (oral presentation).
19. Dale BE, Elander RT, Holtzapple M, Ladisch MR, Lee YY, Eggeman T, Wyman CE. 2003. "Comparative data from application of leading pretreatment technologies to corn stover," 25th Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO, May (oral presentation).
20. Hendrickson R, Mosier NS, Ladisch MR. 2003. "Generation of coproducts derived from a modified hot water pretreatment of corn stover," 25th Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO, May (poster).
21. Kim TH, Lee YY. 2003. "Pretreatment of corn stover by low-liquid ammonia percolation process," 25th Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO, May (poster).
22. Kim TH, Lee YY. 2003. "Effect of lignin on enzymatic hydrolysis of cellulose," 25th Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO, May (poster).
23. Liu C, Wyman CE. 2003. "Impact of fluid velocity and contact time on corn stover pretreatment in a flowthrough reactor," 25th Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, Colorado, May 5 (poster).
24. Kim YM, Mosier NS, Hendrickson R, Goetz J, Ladisch MR. 2003. "Hydrolysis of oligosaccharides using strong cation exchange catalyst and cellulase enzymes," ACS National Meeting, New Orleans, March 25 (poster).
25. Dale B, Wyman CE, Elander RT, Holtzapple MT, Ladisch MR, Lee YY. 2002. "Recent activities of the Consortium for Applied Fundamentals and Innovation," AICHE Annual Meeting, Indianapolis, IN, November 4 (presentation).
26. Kim TH, Sunwoo C, Lee YY. 2002. "Pretreatment and fractionation of corn stover by aqueous ammonia," AICHE Annual Meeting, Indianapolis, IN, November (proceedings and oral presentation).
27. Liu C, Wyman CE. 2002. "Evaluation of a flowthrough reactor for corn stover pretreatment," AICHE Annual Meeting, Indianapolis, IN, November (proceedings and oral presentation).
28. Mosier NS, Hendrickson R, Welch G, Ladisch CM, Ladisch MR. 2002. "Design and scale-up of corn fiber and corn stover pretreatment for fuel ethanol production," AICHE Annual Meeting, Indianapolis, IN, November.
29. Liu C, Wyman CE. 2002. "Comparison of batch and flowthrough biomass pretreatment systems for biological production of fuels and chemicals," 12th European Biomass Conference and Exhibition, Amsterdam, The Netherlands, June (poster and proceedings paper).

30. Dale BE, Laureano-Perez L. 2002. "Spectroscopic characterization of pretreated corn stover," 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, April (poster).
31. Kim TH, Lee YY. 2002. "Fractionation of corn stover by a two-stage percolation process," 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN (poster).
32. Liu C, Wyman CE. 2002. "Effect of flow rate on the dissolution of hemicellulose, lignin, and total mass for pretreatment of corn stover in a flowthrough reactor," 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May (poster).
33. Lloyd TA, Wyman CE. 2002. "Application of a depolymerization model for predicting thermochemical hemicellulose hydrolysis," 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May (presentation).
34. Teymouri F, Dale BE. 2002. "Effects of pretreatment on the activity of enzymes in plants: cellulase enzymes and ribulose diphosphate carboxylase," 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May (presentation).

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ACCESSION NO: 0193616 SUBFILE: CRIS  
 PROJ NO: NYC-143346 AGENCY: SAES NY.C  
 PROJ TYPE: STATE PROJ STATUS: EXTENDED  
 START: 01 OCT 2002 TERM: 30 SEP 2012 FY: 2006

INVESTIGATOR: Brady, J. W.

PERFORMING INSTITUTION:  
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#### USE OF COMPUTER MODELING AND MD SIMULATIONS

**NON-TECHNICAL SUMMARY:** The objective of this project is to develop a systematic understanding of how water affects the properties of biological molecules, and also of how such solutes affect the behavior of water. The project will use computer simulations to determine information which cannot be gained by other means, and where possible, the simulations will be tested by direct comparison with experimental values.

**OBJECTIVES:** The objectives of this project are to characterize the way in which biopolymer structure and conformation determine function. A major goal is to understand the way in which biological solutes affect the properties of solvent water and also the way in which aqueous solvent influences the conformation and functional properties of biological solutes. The major focus of the studies will be on proteins, including cellulases; carbohydrates, including cellulose; lipids; and nucleotides. The detailed structuring which biological solutes impose on solvent water will be characterized from MD simulations, and this structuring will then be correlated with the specific structural features of the solute molecule, in an effort to develop a general model of how particular molecules will affect solvent and in turn be affected by solvation. Another goal will be to characterize the accuracy of the simulations by comparing the calculated results to data obtained from various experiments, including NMR and neutron diffraction experiments.

**APPROACH:** In this project molecular mechanics calculations will be used to model the conformational behavior and aqueous solvation of a series of biological molecules. Conformational energy calculations and molecular graphics methods will be used to study the preferred structures and conformations of a variety of biological molecules and biopolymers. Molecular Dynamics simulations will be used to model the way in which atoms and molecules respond to assumed forces arising from empirical force fields by solving the

classical Newtonian equations of motion for the systems. The trajectories produced from such computer simulations can then be analyzed to compute observable properties as the appropriate average over the time series of atomic coordinates. A particular focus of this project will be to calculate solvent density around biological solutes and to examine the effects of solvation on biopolymer conformation. Various experimental techniques will also be used to subject the calculated properties to experimental verification. The most important of these will be first difference neutron diffraction experiments on specially synthesized subject molecules which are specifically labeled by isotopic substitution at particular sites.

**PROGRESS: 2006/01 TO 2006/12**

Our large-scale molecular dynamics simulations of cellulase enzymes interacting with cellulosic substrate have been continued and extended during this reporting period. We have focused on the CBH I cellulase from *Trichoderma reesei*, a quite complex multi-domain molecular machine. In addition, simulations have been conducted on a system consisting of just the cellulose binding domain (CBD) of the CBH I cellulase bound to cellulose. Another simulation which has been initiated consists of the entire CBH I molecular complex docked onto a crystalline cellulose substrate as before, but with one of the cellulose chains broken and fed into the active site binding tunnel to determine what effect the presence of the substrate in the active site has on the dynamics of the system. Since the microfibril models used in our previous simulations are actually too large, we have also built and equilibrated new smaller microfibrils with more realistic dimensions to use as substrates in these simulations. All of these simulations are still proceeding.

**IMPACT: 2006/01 TO 2006/12**

The impact of this work will be in helping to improve the industrial conversion of cellulose into monosaccharides for use as a feedstock in the production of ethanol for fuel. Bio9mass conversion to reduce the US's dependence on imported fuels is a major national goal and has been mentioned in the State of the Union address twice in a row. The limiting factor in cellulose hydrolysis is the insolubility of the substrate, and understanding the interaction of water with this substrate and how to disrupt the microcrystalline structure would be of great significance in optimizing the process. In addition, developing an understanding of the enzymatic mechanism would also be of great use in designing improved activity in mutants through site-directed mutagenesis.

**PUBLICATIONS (not previously reported): 2006/01 TO 2006/12**

Matthews, J.F., C.E. Skopec, P.E. Mason, P. Zuccato, R.W. Torget, J. Sugiyama, M.E. Himmel and J.W. Brady. 2006. Computer Simulation Studies of Microcrystalline Cellulose IB. *Carbohydr. Res.* 341, 138(2006).

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Item No. 37 of 59

ACCESSION NO: 0211017 SUBFILE: CRIS

PROJ NO: NYZ-2340-02-005 AGENCY: CSREES NY.Z

PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: NEW

CONTRACT/GRANT/AGREEMENT NO: 2007-35504-18341 PROPOSAL NO: 2007-02176

START: 01 SEP 2007 TERM: 31 AUG 2010 GRANT YR: 2007

GRANT AMT: \$499,299

INVESTIGATOR: Stipanovic, A. J.; Winter, W. T.; Driscoll, M. S.

PERFORMING INSTITUTION:

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## ELECTRON BEAM & X-RAY IRRADIATION OF LIGNOCELLULOSIC BIOMASS - SYNERGIES W/ BIODELIGNIFICATION & HEMICELLULOSE REMOVAL IN REDUCING RECALCI.

**NON-TECHNICAL SUMMARY:** It is well established that the production of biobased fuels and chemicals from lignocellulosic biomass will require the application of a pretreatment technology to reduce the recalcitrance of the composite cellular structure of woody plants. In this study, we will demonstrate the utility of commercially available electron beam generators in loosening up the solid state structure of woody biomass to enhance the rate of conversion to sugars, ethanol and other bioproducts. The purpose of this study is to evaluate the impact of electron beams as a pretreatment to make lignocellulosic biomass easier to convert to biobased products.

**OBJECTIVES:** Objective 1- Biomass Selection: A group of potential feedstocks suitable for a lignocellulosic-based biorefinery will be procured, dried and ground into chips. A sub-sample will be subjected to a sequential biodelignification / hot water hemicellulose extraction protocol using pilot-scale facilities following prior work at SUNY-ESF. Feedstocks will include a northeastern hardwood, fast-growing plantation grown willow (also a hardwood), a common softwood species used for papermaking, corn stover, and switchgrass. In addition, we will evaluate cellulosic resources such as recycled paper pulp and paper mill fines or sludge as feedstocks without biodelignification and hemicellulose extraction, since these represent model systems for cellulose itself. The chemical composition of these feedstocks will be determined by thermogravimetric analysis (TGA; percent hemicellulose, cellulose, lignin and ash), Nuclear Magnetic Resonance Spectroscopy (NMR) and standard TAPPI methods for lignin. Objective 2 - High Energy Radiation Treatment: In collaboration with our industrial partner, Radiation Dynamics Inc. (RDI; member of the IBA Group), we will design an experimental protocol to optimize the impact of high energy radiation treatment on the solid state morphology of woody biomass in an effort to reduce the recalcitrance of these substrates. Adjustable parameters will include the type of radiation (electron beam or x-ray), radiation intensity and flux, duration of irradiation, total dose, etc. Other potential variables include irradiation in the dry state, oxygenated atmospheres, or irradiation of biomass slurries in water. Each woody biomass feedstock will be irradiated in the un-pretreated control state and after the biodelignification / hemicellulose extraction pretreatment sequence described above. We will also, perform preliminary process economics calculations based on an optimum radiation dose. Objective 3. Biomass Characterization: Before and after radiation treatment, each biomass and cellulose substrate will be characterized to determine the impact of irradiation on the composition, solid state morphology and potential processability to biobased products. In addition to the compositional analysis mentioned above, other measurements will include: solid-state crystallinity by x-ray diffraction and CP/MAS <sup>13</sup>C NMR, available surface area, and potential degree of conversion to reducing sugars and ethanol by using standard NREL methods. In addition, the cellulose samples will be subjected to molecular weight analysis by Size Exclusion Chromatography in a novel cellulose solvent system to determine the extent of depolymerization associated with the radiation treatment.

**APPROACH:** In this study, we propose to use high energy electrons and x-rays to partially depolymerize and decrystallize lignocellulosic biomass thereby reducing its recalcitrance. Samples will be exposed to an electron beam with doses from 1 to 1000 kGy with and without additional treatments such as a high oxygen environment to facilitate degradation. Further, exposure profiles will include a high dose rate electron beam and a lower dose rate x-ray beam to determine if this parameter has an effect on the degradation of the cellulose. Electron energies will also be varied from about 500 keV to 3 MeV with the possibility of going as high as 10 MeV if there appears to be a strong energy response. RDI will also provide Monte Carlo calculations to estimate the electron energy and beam power required for both the experimental irradiation and for high throughput industrial processing. In the later phases of the study we hope to evaluate a continuous feedstock supply system involving a conveyor belt or a pumped slurry configuration where the biomass is suspended in water. The impact of electron beams will be studied with and without other biomass pretreatments such as biodelignification and hot water extraction of hemicellulose to determine if these approaches are synergistic in reducing recalcitrance.

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ACCESSION NO: 0406585 SUBFILE: CRIS

PROJ NO: 5445-21000-008-04R AGENCY: ARS 5445

PROJ TYPE: USDA INHOUSE PROJ STATUS: TERMINATED

START: 01 AUG 2002 TERM: 31 AUG 2005 FY: 2004

INVESTIGATOR: HANSON J D; BERDAHL J D; KRUPINSKY J M; LIEBIG M A; FRANK A B

PERFORMING INSTITUTION:

AGRICULTURAL RESEARCH SERVICE

MANDAN, NORTH DAKOTA 58554

#### BIOFUEL FEEDSTOCK DEVELOPMENT

**OBJECTIVES:** The objectives for this project are as follows: 1) To compare and characterize liquid fuels biomass production potential of switchgrass monocultures to native warm-season grass mixtures from western Minnesota to central North and South Dakota; and to identify most environmentally sustainable methods of production. 2) To identify the region in the Northern Plains most ripe for profitable production of native grasses for use in cellulosic liquid fuels conversion.

**APPROACH:** The primary purpose of this research is to compare liquid fuel biomass production potential of switchgrass monocultures to native warm-season grass mixtures from western Minnesota into central North and South Dakota. Yield and feedstock quality data will be used to characterize the best management practices and cultivars, and also to help determine the geographic scope of a viable cellulosic bio-ethanol industry in the Northern Plains. Additional attention will be paid to evaluating changes in soil quality and carbon storage, habitat development and species density and other ecological concerns.

**PROGRESS:** 2002/08 TO 2005/08

4a What was the single most significant accomplishment this past year? This report serves to document research conducted under a reimbursable agreement between ARS and the Department of Energy involving biomass production, management practices, and chemical composition of biomass from monocultures and mixtures of three native warm-season grasses. This research is associated with parent CRIS 5445-211000-008-00D Integrated Forage, Crops, and Livestock Systems for the Northern Great Plains. Switchgrass is considered a valuable bioenergy crop with significant potential to sequester soil organic carbon. A project was conducted by ARS researchers at the Northern Great Plains Research Laboratory to evaluate soil carbon stocks within established switchgrass stands and nearby cultivated cropland on farms throughout the northern Great Plains and northern Cornbelt. Soil organic carbon was greater in switchgrass stands than cultivated cropland at soil depths of 0 to 2, 12 to 24, and 24 to 36 inches, and especially so at the deeper soil depths where treatment differences were 7.74 and 4.35 Mg/ha (or 6900 lbs/ac and 3900 lbs/ac) for the 12 to 24 and 24 to 36 inch depths, respectively. Consequently, switchgrass appears to be effective at storing soil organic carbon not just near the soil surface, but also at depths below 12 inches where carbon is less susceptible to loss. 4b List other significant accomplishments, if any. Understanding the impacts of mycorrhizial fungi and glomalin on the production of potential perennial biofuels crops such as switchgrass and big bluestem can help producers develop efficient management systems. The role of native and introduced mycorrhizial inoculums on switchgrass production under ambient and elevated CO<sub>2</sub> levels and the impact of nitrogen and drought stress on the above- and below-ground biomass and ethanol production potential in big bluestem and switchgrass are being evaluated. Information from these experiments will provide producers with management options for producing biofuel crops. Understanding potential yield reducing in switchgrass is important if its potential as a biofuel is to be realized. Scientists at Mandan, ND, Corvallis, OR, and Beltsville, MD collaborated in the identification of *Bipolaris oryzae*, a common fungal pathogen on rice, as the causal agent of a leaf-spot disease on switchgrass. This pathogen has the potential to reduce yields of switchgrass under intensive plantings for biomass production, particularly if susceptible varieties were seeded over a wide area. 4d Progress report. Some perennial grasses have the potential to be converted into ethanol providing an alternative energy source as well as economical and environmental benefits to agricultural producers. The objective of this research has been to identify cultivars adapted to the region and limitations to germination and establishment, evaluate the ability of switchgrass to preserve

the soil resource and store carbon, and identify other perennial grasses with ethanol production potential. From this research, Sunburst switchgrass was identified as the cultivar with the greatest biomass potential for the northern half of the Northern Great Plains, while Trailblazer was the most productive cultivar for southern half of this region. Optimum germination temperature is approximately 77F and optimum pH is 6.0. An evaluation of switchgrass stands and nearby croplands in the northern Great Plains and northern cornbelt, indicated switchgrass stands tended to store more carbon at depths below 12 inches where it is less susceptible to loss back into the atmosphere. The impact of native and introduced mycorrhizial fungi on biomass production under elevated and ambient CO<sub>2</sub> concentrations is currently being studied. Additional research suggested that big bluestem might have a higher ethanol producing potential than switchgrass. Herbaceous bioenergy crops may be an important component in integrated systems in the Northern Great Plains. This research provides producers with information to maximize the potential of bioenergy crops.

PUBLICATIONS (not previously reported): 2002/08 TO 2005/08  
No publications reported this period.

Item No. 39 of 59  
ACCESSION NO: 0211174 SUBFILE: CRIS  
PROJ NO: ND01463 AGENCY: CSREES ND.  
PROJ TYPE: HATCH PROJ STATUS: PENDING NEW  
START: 01 OCT 2007 TERM: 30 SEP 2012

INVESTIGATOR: Pryor, S. W.

PERFORMING INSTITUTION:  
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#### USE OF NORTHERN GREAT PLAINS AGRICULTURAL RESOURCES FOR BIOENERGY AND BIOPRODUCT DEVELOPMENT

**NON-TECHNICAL SUMMARY:** Economic, environmental, and political concerns regarding national petroleum usage has driven an increased interest in biobased fuels and other bioproducts. The USDA and USDOE have agreed to strongly support the increased use of biofuels, biopower, and bioproducts to reduce national dependence on oil imports in the coming decades. The purpose of this project is to increase the technical and economic viability of using Northern Great Plains agricultural resources for energy and high-value bioproducts. Specific areas to be explored include: alternative starch crops for integration with the corn ethanol industry, characterization and pretreatment of mixed feedstocks for cellulosic ethanol production, and utilization of canola meal for adhesives, plastics, and composites.

**OBJECTIVES:** The first project objective is to evaluate and increase the technical viability of bioenergy productions using agricultural residues, dedicated energy crops, and other biomass resources to produce sustainable and economically viable fuels for transportation, heating, or electrical generation. The second project objective is to increase the technical and economic viability of commercial and industrial bioproducts either independently or as coproducts of related bioenergy production processes. Accomplishments related to this objective are also expected to affect the first objective through the economic impacts of coproduct development on bioenergy processing.

**APPROACH:** Although bioenergy and bioproduct development could encompass a wider range of projects, the following procedures outline initial projects falling under these categories. Initial work in the area of bioenergy will include feedstock development for the starch ethanol industry and feedstock analysis and pretreatment for cellulosic ethanol production. Feedstock development for the starch ethanol industry will involve testing the technical feasibility of co-fermenting pea starch with corn in a dry-grind ethanol facility. Fermentation rates and yields will be examined when corn is replaced by pea starch at levels of 10, 30, and 50%. Initial work on cellulosic ethanol development will include CRP biomass characterization and optimization of pretreatment conditions for mixed feedstocks to maximize fermentable sugar production. All feedstock characterization will be completed using established NREL protocols for feedstock

preparation and determination of extractives, structural carbohydrates, and lignin. Grasses and agricultural residues will be pretreated for cellulosic ethanol production, hydrolyzed with cellulase enzymes, and measured for glucose and xylose content as a percentage of theoretical yields. These data will be used in conjunction with individual biomass species and biochemical compositional analysis to predict sugar yields from pretreated mixed feedstocks. Mixed biomass feedstocks will also be treated and analyzed as described above to test if sugar yields from pretreated mixed feedstock are equal to the sum of sugar yields from the pretreated individual single species biomass samples. Initial work in the bioproducts area will focus on the utilization of canola meal proteins for production of industrial products such as adhesives, plastics, or composite materials. Tasks falling under this objective include: protein separation, characterization, modification, and utilization. Canola oil will be extracted and canola meal proteins will be purified to varying degrees for characterization and use for industrial bioproducts. Canola meal and protein characterization will include analysis of protein, carbohydrate, fat, and fiber content of canola meal produced from various oil extraction techniques. Protein characterization will be based on electrophoretic pattern and amino acid composition. The fiber component will be characterized based on length-to-width ratio and strength properties. Protein functionality will be characterized in terms of solubility, viscosity, emulsification, and foaming properties and the relationship between these properties and product performance will be explored. Various techniques will be tested for protein denaturation and functional group modification to modify industrial properties of canola meal and or canola proteins. Among the most promising methods for protein modification for adhesive formulation are treatment with alkali, sodium dodecyl sulfate, and sodium dodecyl benzene sulfonate. Modifications will be carried out to determine their effects on product functionality described above.

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ACCESSION NO: 0187998 SUBFILE: CRIS  
 PROJ NO: NDW-20010045 AGENCY: CSREES ND.W  
 PROJ TYPE: OTHER GRANTS PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 00-38819-8989-R PROPOSAL NO: 2001-03154  
 START: 01 JUN 2000 TERM: 31 MAY 2002 FY: 2003 GRANT YR: 2001  
 GRANT AMT: \$241,891

INVESTIGATOR: Aulich, T. R.

PERFORMING INSTITUTION:  
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**NATIONAL ALTERNATIVE FUELS LABORATORY PHASE 11**

**NON-TECHNICAL SUMMARY:** A new high-performance, economical fuel is needed replace lead-containing aviation gasoline; new economic sources of octane are needed for the U.S. gasoline pool; and new easily biodegradable solvents are needed to replace hazardous chlorinated solvents. This project will 1) help commercialize AGE85 (an ethanol-based alternative to aviation gasoline) by developing an ASTM fuel specification for AGE85, and 2) demonstrate performance, environmental, and economic benefits of ethanol-based acid esters as octane-providing fuel additives and solvents.

**OBJECTIVES:** 2000-03900. Help commercialize aviation-grade E85 (AGE85), an EERC-formulated ethanol-based aviation fuel approved for use in certified aircraft by the U.S. Federal Aviation Administration (FAA), through 1) developing an American Society of Testing and Materials (ASTM) specification for AGE85, and 2) working with the University of North Dakota School of Aerospace Sciences (UND Aerospace), one of the two largest civilian pilot-training facilities in the U.S., to attain

FAA approval of AGE85 for the UND fleet of about 90 aircraft. Help increase commercial renewable fuels and chemicals production and utilization through establishment of partnerships with industry, agriculture, and environmental groups to 1) research and publicize beneficial emissions effects of ethanol-blended and other renewable-content fuels, 2) develop, evaluate, and help commercialize new fuel additives and fuel formulations, and 3) evaluate and help commercialize new biomass processing technologies and biobased products. Continue EERC leadership of the Red River Valley Clean Cities Coalition (RRV Coalition).

APPROACH: Commercialization of AGE85 will be advanced by 1) assembling an ASTM-approved task group for drafting an AGE85 fuel specification, and leading the task group through the democratic, iterative ASTM fuel specification development process, and 2) assisting UND Aerospace through setting up a safe, reliable, fuel storage and dispensing system that meets all materials compatibility requirements; ensuring that all aircraft fuel system components meet all materials compatibility requirements; development and performance of fuel analysis and property determination quality assurance procedures for bulk-delivered and on-site-stored AGE85; development of preflight fuel inspection and testing procedures; performance of analytical and experimental testing as required by FAA directives; and researching and reporting of fuel-related issues as required to meet FAA directives. To help commercialize renewable fuels and chemicals, partnerships like recent and ongoing collaborations with the Minnesota Corn Research and Promotional Council, South Dakota Corn Utilization Council, American Coalition for Ethanol, and American Lung Association of Minnesota will be established to 1) perform on-road emissions testing with systematically adjusted gasoline and diesel fuel formulations containing ethanol and other renewable fuels, 2) conduct and report laboratory and engine tests that demonstrate performance and emissions benefits of ethanol-based esters and higher-weight alcohols as gasoline octane providers, and 3) conduct and report laboratory tests to demonstrate performance, economic, and environmental advantages of using ethanol-based esters and other fermentation-derived chemicals as solvents, plasticizers, and polymer feedstocks. Leadership of the RRV Coalition will be provided by 1) coordinating alternative fuel (ethanol, biodiesel, natural gas, and others) vehicle acquisition efforts for regional public and private fleets, 2) continuing regular publication of the RRV Coalition newsletter, *The Valley Drive*, 3) maintaining, improving, and updating the RRV Coalition Website, 4) coordinating establishment of alternative fuel infrastructure like E85 and biodiesel refueling facilities, 5) designing and promoting alternative fuels educational activities (including *Advancing the Choice* workshops) throughout the RRV Coalition region of eastern North Dakota, northwestern Minnesota, and southern Manitoba, Canada, and 6) providing technical assistance to local initiatives for alternative fuels commercialization, including the Fargo biodiesel initiative as well as the activities of the North Dakota Corn Growers Association geared toward increased ethanol production, distribution, and use.

#### PROGRESS: 2000/06 TO 2002/05

As a result of National Alternative Fuels Laboratory (NAFL) work on developing aviation ethanol (AvE), the U.S. Federal Aviation Administration (FAA) approved a multi-partner project to demonstrate the safety, performance, economic, and maintenance benefits of AvE versus lead-containing aviation gasoline. Industry partners include Phillips Petroleum and Textron Lycoming. The NAFL initiated work with Phillips to optimize the AvE formulation and develop, at FAA request, an AvE fuel specification that garners approval from the American Society of Testing and Materials. The NAFL-developed on-road, on-board-vehicle exhaust emissions analysis system was used in an ongoing partnership with the American Lung Association of Minnesota (ALAMN) to evaluate air quality effects of ethanol-blended gasolines based on emissions of total hydrocarbons, carbon monoxide, and oxides of nitrogen. Results of winter and summer tests were published on the ALAMN website at [www.alamn.org](http://www.alamn.org), and demonstrate the emissions benefits of ethanol and low sulfur content in gasoline. A project was conducted to optimize formulation of a blend of ethanol, biodiesel, and petroleum diesel based on performance, fuel economy, and emissions. Adding ethanol to diesel fuel is gaining prominence as a method to achieve significant reductions in exhaust emissions of particulates and oxides of nitrogen, but keeping ethanol and diesel together in solution requires an emulsifier or co-solvent. The NAFL is evaluating the use of biodiesel as a co-solvent for ethanol and diesel. The project showed the viability of a blend of 50% biodiesel-50% ethanol, which, when added to petroleum diesel at a concentration of 10%, ensures against ethanol phase separation at a temperature as low as 0 degrees F. Also being evaluated is the viability of the NAFL-developed dual fermentation (DFB) concept, which would split the sugar solution fed to either a corn- or biomass-based ethanol plant into two process streams: one for ethanol production and one for production of a carboxylic acid like lactic, propionic, butyric, or succinic. Each of these carboxylic acids can then be combined with ethanol, via an NAFL-developed direct esterification process based on the reaction used to produce

biodiesel, to yield ethyl esters with high value as industrial feedstocks, solvents, and gasoline octane providers. Based on work to date, application of the direct esterification approach to production of ethyl lactate appears to offer significant advantages over other high-profile approaches to recovery and purification of fermentation-derived lactic acid. The NAFL also initiated a project with a commercial biomass pyrolysis company to optimize a fast pyrolysis-based process for production of ethanol from cellulosic biomass. Key to the success of the effort will be maximizing pyrolysis yields of anhydrosugars, which can be converted to yeast-fermentable six-carbon sugars utilizing NAFL-developed hydrolysis techniques.

**IMPACT: 2000/06 TO 2002/05**

The National Alternative Fuels Laboratory (NAFL) program is working to develop and optimize processes to enable product diversification options for corn-based ethanol plants, and pyrolysis-based processes to enable economic production of ethanol from cellulosic biomass. Commercialization of these processes will provide product diversification and value-added opportunities for existing and future ethanol plants, and help make lower-cost biomass-based ethanol a reality. The NAFL is also working to assess and demonstrate the commercial viability, performance, environmental benefits, and safety of 1) ethanol-based, biodiesel-containing aviation ethanol, 2) ethanol-blended, low sulfur-content gasoline, 3) oxygenated diesel fuel that utilizes biodiesel as a co-solvent for ethanol, and 5) ethyl esters for use as solvents, industrial chemical feedstocks, and gasoline octane providers. Commercialization of these fuels and fuel additives will 1) eliminate the last commercial fuel still permitted by the U.S. Environmental Protection Agency to contain toxic lead (aviation gasoline), 2) significantly expand ethanol and biodiesel demand, since the current general aviation fuel market is about 400 million gallons per year and rising (its historic high was about 700 million gallons in the early 1980s), and current U.S. diesel fuel consumption is about 40 billion gallons per year, 3) improve air quality, 4) reduce fuel costs, and 5) increase U.S. energy independence and national security.

**PUBLICATIONS (not previously reported): 2000/06 TO 2002/05**

1. Olson, E., Sharma, R., and Aulich, T. 2002. Ester Fuels and Chemicals from Biomass. Accepted for publication in: Proceedings of the 24th Symposium on Biotechnology for Fuels and Chemicals, April 28-May 1, 2002, hosted by Oak Ridge National Laboratory.
2. Olson, E., Sharma, R. 2001. Direct Esterification of Ammonium Carboxylates with Ethanol and Methanol. Provisional Patent Application, Serial No. 60/344,934. Filed with U.S. Patent Office December 31, 2001.
3. Helder, D., Behnken, J., and Aulich, T. 2000. Design of Ethanol-Based Fuels for Aviation. American Society of Automotive Engineers Paper No. 00GATC-38.

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Item No. 41 of 59

ACCESSION NO: 0191656 SUBFILE: CRIS  
 PROJ NO: NDW-2002-06205 AGENCY: CSREES ND.W  
 PROJ TYPE: OTHER GRANTS PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 2002-38819-01906 PROPOSAL NO: 2002-06205  
 START: 01 JUL 2002 TERM: 31 DEC 2003 FY: 2003 GRANT YR: 2002  
 GRANT AMT: \$275,184

INVESTIGATOR: Aulich, T. R.

PERFORMING INSTITUTION:  
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## NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 12

**NON-TECHNICAL SUMMARY:** Lower-cost methods are needed for production of ethanol from non-corn kernel "biomass" resources, and production of biodiesel from a wide variety of oil seed crops, used cooking oils, and tallow. New economic sources of octane are needed for the U.S. gasoline pool, cleaner diesel fuels are required to reduce air pollution, and new easily biodegradable solvents are needed to replace hazardous chlorinated solvents. This project will 1) pursue development of a low-cost thermal process for converting biomass (like corn stalks, wood waste, and wheat and rice straw) into viable ethanol feedstocks, 2) optimize a catalyst used to make biodiesel that will reduce or eliminate expensive water washing requirements, 3) investigate renewable gasoline and diesel fuel additives and formulations based on engine performance and exhaust emissions, and 4) pursue development of new processes that will provide product diversification and value-added opportunities for existing and future ethanol plants.

**OBJECTIVES:** Lower the cost of biomass ethanol production by developing a new thermal pyrolysis process to convert cellulose and hemicellulose to fermentable sugars without consumption of expensive acids, enzymes, or other chemical or biological agents. Lower the cost of biodiesel production by developing and optimizing a high-efficiency non-sodium hydroxide esterification catalyst that reduces or eliminates the need for washing sodium out of esterified fuel product. Continue leadership of the Red River (of the North) Valley Clean Cities (RRVCC) Coalition. Help increase commercial renewable fuels and chemicals production and utilization through establishment of partnerships with industry, agriculture, and environmental groups to 1) research and publicize beneficial emissions effects of ethanol- and other renewable-content fuels, 2) develop, evaluate, and help commercialize new fuel additives and fuel formulations, and 3) develop, evaluate, and help commercialize new biomass processing technologies and biobased products.

**APPROACH:** Development of a thermal pyrolysis process for hydrolysis of biomass to fermentable sugars will build on recent Energy & Environmental Research Center (EERC) work with effluents from commercial sugar beet pulp dryers, and work performed by Weyerhaeuser Corporation, Crown Zellerbach, and the University of Waterloo in Ontario, Canada. The process will utilize a low-pressure, high-flow-rate gas to effect rapid removal of "anhydrosugar" pyrolysis products from the heated zone, thereby preventing their destruction, and a solid acid catalyst for anhydrosugar hydrolysis, which will eliminate problems associated with neutralization and loss of liquid acids. A bench-scale pyrolysis reactor will be used in tests with up to five different biomass feedstocks. Development and optimization of a new catalyst for biodiesel production will be based on recent EERC work on sunflower oil esterification. Laboratory experiments will evaluate a series of systematically adjusted catalyst configurations based on reaction conditions required to effect complete conversion of triglycerides to methyl esters, while leaving a sufficiently small amount of catalyst residue to negate the need for water washing. Leadership of the RRVCC Coalition will be provided by 1) coordinating alternative fuel (ethanol, biodiesel, natural gas, and others) vehicle acquisition efforts for regional public and private fleets, 2) continuing regular publication of the RRVCC Coalition newsletter, The Valley Drive, 3) maintaining, improving, and updating the RRVCC Coalition Website, 4) coordinating establishment of alternative fuel infrastructure like E85 and biodiesel refueling facilities, 5) designing and promoting alternative fuels educational activities (including "Advancing the Choice" workshops) throughout the Coalition region of eastern North Dakota, northwestern Minnesota, and southern Manitoba, Canada, and 6) providing technical assistance to local initiatives for alternative fuels commercialization. To help commercialize renewable fuels, chemicals, and related processes, partnerships like recent and ongoing collaborations with the Minnesota Corn Research and Promotional Council, South Dakota Corn Utilization Council, North Dakota Soybean Council, American Coalition for Ethanol, and American Lung Association of Minnesota will be established to 1) perform on-road and engine-dynamometer testing to demonstrate performance and emissions benefits of new gasoline and diesel fuel formulations containing ethanol, biodiesel, and other renewable fuels (including an oxygenated diesel that uses biodiesel as a co-solvent for ethanol), 2) conduct and report laboratory tests on optimizing processes for production of ethanol-based "esters" for use as gasoline octane providers and as chemical and polymer feedstocks, and 3) conduct and report laboratory tests to demonstrate the viability of processes that can be integrated with commercial conventional and upcoming biomass ethanol production processes.

**PROGRESS:** 2002/07 TO 2003/12

In partnership with Ensyn Renewables, Inc., of Boston, the University of North Dakota Energy & Environmental Research Center (EERC) is working to develop a fast pyrolysis-based biorefinery (FPB)

concept. The FPB is based on the Ensyn-developed rapid thermal process (RTP), which is commercially employed at three plants in Wisconsin for fast pyrolysis conversion of woody biomass to a bio-oil for specialty chemical and fuel applications. The EERC is working with Ensyn to tailor the RTP for conversion of wood and other biomass resources to a bio-oil optimally suited as a biorefinery input, with maximized levels of anhydrosugars that can be converted to fermentable six-carbon sugars using an EERC-developed low-temperature catalytic hydrolysis process that does not require the use of liquid acids or enzymes. In recent optimization work with an anhydrosugar-rich Ensyn bio-oil fraction, the EERC process has been demonstrated to achieve near-100% conversions of anhydrosugars to glucose. In other work related to the FPB concept, EERC researchers developed a process for extraction (from fast pyrolysis bio-oil) of a specific compound and conversion of the compound to a high-value additive utilized as a dispersant in most latex paints produced today. Current project effort is being directed toward economic optimization and commercialization of both the anhydrosugar and paint dispersant precursor conversion processes. EERC researchers compared three major Twin Cities (Minneapolis-St. Paul) 10%-ethanol-blended (E10) gasoline brands based on predicted and actual tailpipe emissions and demonstrated that gasoline sulfur content has a significant impact on automobile exhaust emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen. The investigation utilized U.S. Environmental Protection Agency (EPA) MOBILE6.2 vehicle emission modeling software and average fuel chemistry data for Twin Cities 87-octane Holiday, BP, and SuperAmerica summer- and winter-blend fuels to predict exhaust emissions from a typical 2002 model-year car. Average fuel chemistry data inputs to the EPA model were based on analysis of E10 samples collected at the pump from randomly selected Twin Cities gasoline retailers. Actual emissions data were acquired in on-the-road tests utilizing an EERC-developed on-board-vehicle emissions analysis system. Both the predicted and actual emissions data illustrated the importance of reduced sulfur content to lower exhaust emissions. Reports on the National Alternative Fuels Laboratory-conducted Twin Cities gasoline surveys are accessible through the American Lung Association of Minnesota (ALAMN) Web site. A series of nonsodium-hydroxide catalysts were evaluated based on conversion of soybean oil triglycerides to fatty acid methyl ester (FAME) biodiesel. One of the catalysts consistently generated FAME yields of 99%. A precipitation-based method was evaluated for separation of FAME and residual catalyst. The method was consistently demonstrated to effect catalyst removal to a level of 40 parts per million.

**IMPACT: 2002/07 TO 2003/12**

A catalytic process was developed that enables producing fermentable sugars from a bio-oil generated via fast pyrolysis (heating under a deficiency of oxygen) of waste wood. Commercialization of the process will enable economic production of ethanol and other biobased products from cellulosic biomass. Progress was made on development of an alternative (to sodium hydroxide) and potentially lower-cost catalyst system for production of FAME biodiesel from vegetable oil triglycerides. Unlike biodiesel production with conventional sodium hydroxide catalyst, which requires water washing for excess catalyst removal from the biodiesel product, the alternative catalyst under development will be removable via precipitation and filtration. In a study conducted in partnership with the ALAMN, the impact of low-sulfur, 10%-ethanol-blended gasoline (E10) on reducing automobile tailpipe emissions was demonstrated. ALAMN is using the study findings to advocate for wider use of lower sulfur-content E10 as a viable strategy for improving air quality in the Minneapolis-St. Paul metropolitan region.

**PUBLICATIONS (not previously reported): 2002/07 TO 2003/12**

Olson, E., Aulich, T., Sharma, R., Timpe, R. 2003. Ester fuels and chemicals from biomass. *Appl. Biochem. Biotechnol.* 105-108:843-851.

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Item No. 42 of 59

ACCESSION NO: 0195206 SUBFILE: CRIS

PROJ NO: NDW-2003-06204 AGENCY: CSREES ND.W

PROJ TYPE: OTHER GRANTS PROJ STATUS: TERMINATED



CONTRACT/GRANT/AGREEMENT NO: 2003-38819-02014 PROPOSAL NO: 2003-06204  
START: 01 JUL 2003 TERM: 30 JUN 2004 FY: 2004 GRANT YR: 2003  
GRANT AMT: \$280,835

INVESTIGATOR: Aulich, T. R.

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#### NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 13

**NON-TECHNICAL SUMMARY:** Lower-cost methods are needed for production of ethanol from non-corn kernel biomass resources, and production of biodiesel (a diesel fuel additive or replacement made from vegetable oils or animal fats). A non-lead-containing, high performance aviation fuel is needed to help ensure long-term availability of fuel for the general aviation industry. New, domestically produced biobased fuels and products, along with economically viable methods for their production, are needed to ensure national security, improve our environment, and sustain economic growth. This project will 1) pursue development of new high-value products (including pharmaceutical building blocks) from bio-oils generated via high-temperature-processing of biomass feedstocks like corn stover, wheat straw, prairie grass, and waste wood and paper, 2) optimize a new, lower-cost process for producing biodiesel, 3) help commercialize an ethanol-based aviation fuel for piston engine aircraft via demonstrating fuel compatibility with aircraft fuel system materials of construction, 4) pursue development of fueling stations and increased fleet utilization of ethanol-based and biodiesel-containing fuels, and 5) work with ag and environmental groups to commercialize and increase utilization of biobased fuels and non-fuel products and biomass processing technologies.

**OBJECTIVES:** Develop new high-value products (including pharmaceutical building blocks) from "bio-oils" generated via fast pyrolysis of lignocellulose biomass resources like corn stover, wheat and barley straw, switch grass, waste wood and paper, and others. Optimize an innovative catalytic process to improve the efficiency and reduce the cost of producing biodiesel. Help commercialize aviation-grade ethanol (AGE), a high performance alternative to lead-containing aviation gasoline, through collaborating on a recently initiated effort to develop an American Society of Testing and Materials (ASTM) fuel specification for AGE. Increase renewable fuels and chemicals commercial production and utilization through establishment of partnerships with industry, agriculture, and environmental groups to develop new biobased fuels and products and biomass processing technologies. Continue leading the Red River Valley Clean Cities Coalition (RRVCC) in developing partnerships and region-wide initiatives to establish commercial E85 and biodiesel fuel stations and increase renewable fuels utilization.

**APPROACH:** Pyrolysis product development will focus on characterization of bio-oils generated from straw, stover, grass, and wood, identification of potential products, and development of effective and economic extraction and conversion technologies based on solid acid catalysis methods. Bio-oil samples will be generated by NAFL partner Ensyn Technologies, Inc., of Ottawa, Canada, using the Ensyn bench-scale fast pyrolysis reactor. Based on preliminary characterization of wood-generated bio-oils, product development efforts will focus on levoglucosan-derived pharmaceutical building blocks, sugar esters, furans, and non-fermentable sugars. Biodiesel process improvement efforts will utilize an NAFL-developed non-alcohol alkylating agent in a column reactor packed with a solid acid catalyst. Different reaction conditions and catalysts will be evaluated based on fatty acid methyl (or ethyl) ester yield, operational cost, and co-product purity and recovery. The effort to help commercialize AGE will focus on establishing AGE compatibility with materials used in general aviation fuel systems via tests conducted according to ASTM and Society of Automotive Engineers procedures. To help commercialize and increase utilization of renewable fuels, chemicals, and related biomass processing technologies, partnerships like recent and ongoing collaborations with the Minnesota Corn and Soybean Research and Promotion Councils, South Dakota Corn Utilization Council, American Coalition for Ethanol, and American Lung Association of Minnesota will be established to 1) perform on-road and engine dynamometer testing to demonstrate performance and emissions benefits of new gasoline and diesel fuel formulations containing ethanol, biodiesel, and other renewable fuels (including an oxygenated diesel that uses biodiesel as a co-solvent for

ethanol), 2) conduct and report laboratory tests on optimizing processes for production of ethanol-based esters for use as polymer feedstocks, chlorinated solvent replacements, and chemical intermediates, and 3) conduct and report laboratory tests to demonstrate the viability of process improvements that can be integrated with commercial conventional and upcoming biomass ethanol production processes. Leadership of the RRVCC Coalition will be provided by 1) coordinating alternative fuel (ethanol, biodiesel, and others) vehicle acquisition efforts for regional public and private fleets, 2) continuing regular publication of the RRVCC Coalition newsletter, *The Valley Drive*, 3) maintaining, improving, and updating the RRVCC Coalition Website, 4) coordinating establishment of alternative fuel infrastructure like E85 and biodiesel refueling facilities, 5) designing and promoting alternative fuels educational activities (including *Advancing the Choice* workshops) throughout the Coalition region of eastern North Dakota, northwestern Minnesota, and southern Manitoba, Canada, and 6) providing technical assistance to local initiatives for alternative fuels commercialization.

#### PROGRESS: 2003/07 TO 2004/06

In partnership with Ensyn Renewables, Inc., the Energy and Environmental Research Center (EERC) is developing a fast-pyrolysis biorefinery (FPB) concept. The FPB is based on the Ensyn pyrolysis process that is commercially employed at four plants in Wisconsin for conversion of biomass to a bio-oil for chemical and fuel applications. EERC has developed processes that enable 1) converting bio-oil anhydrosugars to fermentable 6- carbon sugars via a low temperature catalytic hydrolysis, and 2) converting bio-oil hydroxyacetaldehyde (HA) to high value chemicals. Using Ensyn bio-oil fractions, the EERC hydrolysis has achieved near 100 percent conversions of anhydrosugars to glucose, and a provisional patent was filed for the process. Using HA-rich bio oil fractions, EERC has developed a simple reaction sequence for producing large-market alkanolamines. EERC developed and demonstrated a transesterification process that enables utilization of soapstocks and other high free fatty acid-content vegetable oil processing coproducts and animal fats as biodiesel feedstocks. In tests with commercial vegetable oil coproducts, the process, which utilizes a non-alcohol alkylating agent and an acid catalyst, has been demonstrated to effect fatty acid conversions of up to 99 percent. EERC investigated the compatibility of aviation-grade ethanol (AGE) with a comprehensive array of materials used in piston engine aircraft fuel systems. The investigation utilized metals, elastomers, plastics, rubbers, composites, adhesives, and other materials to compare AGE to leaded aviation gasoline based on fuel immersion-generated impacts on corrosion, solubilization, swelling, shrinkage, flexibility, and shear strength. Results of the investigation, which showed a few possibly significant differences between AGE and aviation gasoline, were reported to an American Society of Testing and Materials (ASTM) task force working on development of an ASTM specification for AGE. EERC compared three major Minneapolis and St. Paul 10 percent ethanol gasoline (E10) brands, E85 (a blend of 85 percent ethanol and 15 percent gasoline), and nonoxygenated gasoline based on predicted and actual tailpipe emissions, and demonstrated that gasoline sulfur content has a significant impact on automobile exhaust emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen. The investigation utilized EPA MOBILE6.2 vehicle emission modeling software and average fuel chemistry data for 87-octane summer-blend fuels to predict exhaust emissions from a typical 2002 model year car. Average fuel chemistry data inputs to the EPA model were based on analysis of E10 samples collected at the pump from randomly selected Minneapolis and St. Paul gasoline retailers. Actual emissions data were acquired in tests utilizing a 2002 flexible-fuel Ford Taurus and a chassis dynamometer. Both the predicted and actual emissions data illustrated the importance of reduced sulfur content to lower exhaust emissions. Of the five fuels evaluated in the dynamometer testing, the E85 generated the lowest grams-per-mile tailpipe emission of carbon dioxide.

#### IMPACT: 2003/07 TO 2004/06

A catalytic process was developed for producing alkanolamines from bio-oil. Because alkanolamines are derived from petroleum and natural gas and represent an annual market of 3.3 billion pounds, commercialization of the process will enable replacement of oil with biomass in chemical markets and improve biorefining economics. Progress was made on an economic process for producing methyl esters from low value feedstocks high in free fatty acids. Commercialization of the process will result in improved biodiesel economics. Some of the most critical questions on replacing leaded aviation gasoline with aviation-grade ethanol (AGE) derive from materials compatibility concerns. The EERC investigation on AGE materials compatibility provides definitive empirical evidence regarding how key aircraft material properties are impacted by AGE immersion. The EERC report on the investigation will help expedite prosecution of an American Society of Testing and Materials specification for AGE, which was requested by the U.S. Federal Aviation Administration. In a study conducted with the American Lung Association of

Minnesota (ALAMN), the impact of low sulfur, 10 percent ethanol gasoline (E10) on reducing automobile tailpipe emissions was demonstrated, as was the impact of E85 (85 percent ethanol and 15 percent gasoline) on reducing tailpipe carbon dioxide emissions. ALAMN is using the study findings to advocate wider use of lower sulfur content E10 and E85 as a viable strategy for improving air quality in the Minneapolis and St. Paul metropolitan region.

PUBLICATIONS (not previously reported): 2003/07 TO 2004/06

1. Olson, E.S.; Sharma, R.K.; Aulich, T.R. 2004. The Higher-Alcohols Biorefinery: Improvement of the Catalyst for Ethanol Conversion. *Appl. Biochem. Biotechnol.* 113-116, 913-932.
2. Olson, E.S.; Sharma, R.K.; Aulich, T.R. 2004. The Higher Alcohols Biorefinery II: Conversion of Ethanol to High Cetane Diesel Additives. In proceedings of the 26th Symposium on Biotechnology for Fuels and Chemicals, Chattanooga, TN, May 9-12, 2004.
3. Aulich, T.R. 2003. Hydrogen, Ethanol, and Energy Security. *Ethanol Today*, November 2003.

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Item No. 43 of 59

ACCESSION NO: 0199475 SUBFILE: CRIS  
 PROJ NO: NDW-2004-06202 AGENCY: CSREES ND.W  
 PROJ TYPE: OTHER GRANTS PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 2004-38819-02182 PROPOSAL NO: 2004-06202  
 START: 01 JUL 2004 TERM: 30 JUN 2005 FY: 2005 GRANT YR: 2004  
 GRANT AMT: \$251,229

INVESTIGATOR: Aulich, T. R.

PERFORMING INSTITUTION:  
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NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 14

NON-TECHNICAL SUMMARY: Lower-cost methods are needed for production of fuel and chemical intermediates from lignocellulosic biomass. Lower cost biodiesel feedstocks and methods for their conversion to biodiesel are needed. Better methods for extracting value from wind energy and utilization of ethanol plant-generated carbon dioxide are needed. This project will 1) optimize and evaluate methods for production of chemical intermediates from bio-oil generated by pyrolysis of biomass, 2) optimize a non-alcohol-based esterification process for producing biodiesel from low-value vegetable oil coproducts known as soapstocks, and 3) optimize and evaluate a process that utilizes electricity and carbon dioxide for production of urea fertilizer.

OBJECTIVES: The first objective is to develop new high-value products from bio-oils generated via fast pyrolysis of wood, corn stover, wheat and barley straw, switch grass, and other lignocellulose biomass resources. The second objective is to optimize a non-alcohol-based esterification process for production of fatty acid methyl esters from low-value, high free fatty acid-content vegetable oil refining coproducts known as soapstocks. The third objective is to optimize and evaluate the economics of a low-severity (ambient temperature and pressure) electrochemical synthesis-based process for production of urea fertilizer from wind-generated electricity and ethanol plant-generated carbon dioxide.

APPROACH: Pyrolysis product development will focus on development of processes for producing chemical intermediates from wood- and switch grass-derived bio-oil fractions rich in hydroxyacetaldehyde.

Bio-oil samples will be generated by project partner Ensyn Renewables, Inc., of Boston, using the Ensyn bench-scale fast pyrolysis reactor. Biodiesel-from-soapstock process development will optimize the non-alcohol-based esterification process based on catalyst type and configuration, reaction temperature and pressure, and reactor residence time. Work will also include development of waste water-minimization methods, and methods for removal of soapstock-contributed contaminants. The urea production process development effort will comprise laboratory-scale work to improve the efficiency of the electrochemical synthesis by utilizing new cathode materials and solid-polymer electrolyte technologies.

#### PROGRESS: 2004/07 TO 2005/06

The National Alternative Fuels Laboratory (NAFL) at the University of North Dakota Energy & Environmental Research Center is optimizing a low-temperature electrochemical process for producing urea fertilizer from ethanol coproduct carbon dioxide (CO<sub>2</sub>), coal combustion emissions of nitrogen oxides (NO<sub>x</sub>), and electricity. NAFL researchers designed and fabricated an electrochemical cell and used it to produce urea from reagent-grade feedstocks. Project activities are currently focused on electrode catalytic optimization for improved process efficiency. In partnership with Ensyn Renewables, Inc., the NAFL is developing the fast-pyrolysis biorefinery based on the commercial Ensyn process for conversion of biomass to bio-oil. The NAFL developed processes for low-temperature catalytic hydrolysis of bio-oil anhydrosugars to fermentable 6-carbon sugars, and converting bio-oil hydroxyacetaldehyde (HA) to high value alkanolamines. A glucose stream generated from bio-oil via the hydrolysis process was submitted to the University of Minnesota Biotechnology Institute for evaluation as fermentation ethanol feedstock. Using HA-rich bio oil fractions, the NAFL developed a simple reaction sequence for producing large-market alkanolamines. In response to a request from a major chemical manufacturer, the NAFL is working with Ensyn to evaluate the life cycle economics of an alkanolamines process based on utilization of the HA-based reaction sequence. The NAFL developed and demonstrated a low-temperature, solid acid-catalyzed transesterification process that enables utilization of unrefined vegetable oil and other lower-value materials as biodiesel feedstocks. In tests with crude soybean oil, the process consistently achieved 100% conversion of fatty acids to methyl esters. Current research is focused on catalyst optimization to reduce residence time, pressure, and methanol-to-fatty acid molar ratio requirements. As a component of an ongoing effort to commercialize aviation-grade ethanol (AGE) as an alternative to leaded aviation gasoline, the NAFL initiated long-term soak tests to evaluate a series of corrosion inhibitors for performance with aircraft-grade aluminum alloys. Results will be presented to the American Society of Testing and Materials (ASTM) Ethanol Aviation Fuel Development Task Force at the December 2005 ASTM meeting. In collaboration with the American Lung Association of Minnesota, the NAFL assessed the greenhouse gas reduction potential of E85. The assessment comprised measurement of tailpipe emissions from a 2004 E85-capable Ford Explorer Sport Trac running on E85 and gasoline, and analysis of fuel life cycle CO<sub>2</sub> emissions data reported by Argonne National Laboratory. The investigation showed that if the approximately 5 million E85-capable vehicles on the road today were to burn corn-based E85 instead of gasoline, this would effect a CO<sub>2</sub> emission reduction of 20 million tons per year. With lignocellulosic biomass-based E85, the reduction would be 31 million tons per year. To put these potential impacts in perspective, a typical 500-megawatt coal-fired power plant generates about 3.8 million tons of CO<sub>2</sub> per year.

#### IMPACT: 2004/07 TO 2005/06

Commercialization of the NAFL electrochemical urea synthesis would result in cheaper fertilizer, provide a market for ethanol plant-generated CO<sub>2</sub>, and turn power plant NO<sub>x</sub> emissions into a revenue stream. Operating the process with wind-generated electricity would enable extracting value from wind energy without the need for additional transmission capacity, and promote rural economic development on Great Plains. Because petroleum-derived alkanolamines are an annual market of 3.3 billion pounds, commercialization of the NAFL HA-to-alkanolamines process will enable replacement of oil with biomass in chemical markets and improve biorefining economics. Commercialization of the NAFL biodiesel process will enable utilization of unrefined vegetable oils and other cheaper feedstocks, which will improve biodiesel economics. Concern has been raised regarding the possibility of aluminum corrosion due to long-term AGE exposure. The NAFL soak tests will assess the corrosion potential of AGE and evaluate the effectiveness of commercial corrosion inhibitors. Resolving the aluminum corrosion issue is critical to achieving an ASTM specification for AGE, and, as stipulated by the U.S. Federal Aviation Administration, an ASTM specification is critical to AGE commercialization. NAFL data on the greenhouse gas emission reduction impact of E85 are being publicized by ALAMN to promote E85 and, in conjunction with higher

gasoline prices, have contributed to increasing Minnesota E85 consumption from 705,000 gallons in 2001 to 4.3 million gallons for the first 8 months of 2005.

PUBLICATIONS (not previously reported): 2004/07 TO 2005/06

1. Olson, E.S., Sharma, R.K., Timpe, R.C. and Aulich, T.R. 2005. T.R. High-Cetane Diesel Fuels from Biomass. Appl. Biochem. Biotechnol. In review.
2. Olson, E.S. Parallel Processing Biorefineries. 2005. Prepr. Pap. Am. Chem. Soc., Div. Fuel Chem. 50 (2), 681-682.
3. Olson, E.S., Sharma, R.K., Timpe, R.C. and Aulich, T.R. 2005. High-Cetane Diesel Fuels from Biomass. In Proceedings of the 27th Symposium on Biotechnology for Fuels and Chemicals.

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ACCESSION NO: 0206950 SUBFILE: CRIS

PROJ NO: NDW-2006-06229 AGENCY: CSREES ND.W

PROJ TYPE: OTHER GRANTS PROJ STATUS: TERMINATED

CONTRACT/GRANT/AGREEMENT NO: 2006-38819-03470 PROPOSAL NO: 2006-06229

START: 01 JUN 2006 TERM: 31 MAY 2007 GRANT YR: 2006

GRANT AMT: \$261,313

INVESTIGATOR: Aulich, T. R.

PERFORMING INSTITUTION:

ENERGY & ENVIRONMENTAL RES CTR

UNIV OF NORTH DAKOTA

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NATIONAL ALTERNATIVE FUELS LABORATORY - PHASE 16

NON-TECHNICAL SUMMARY: To reduce U.S. dependence on oil and reduce carbon dioxide emissions, lower-energy and lower-cost methods are needed for production of ethanol from corn and lignocellulosic biomass, and economically competitive methods are needed to produce polymers from lignocellulosic biomass. In addition to its use as a fuel, ethanol has potentially higher value as a chemical intermediate that could be used to produce products normally derived from petroleum. Methods are needed for extracting value from carbon dioxide generated as an ethanol coproduct, and better methods are needed for extracting value from wind energy and for producing urea fertilizer, the cost of which is primarily dependent on the increasing cost of natural gas. This project will optimize and evaluate 1) methods for improving the energy efficiency of ethanol production from corn and lignocellulosic biomass, 2) processes for producing polymers from bio-oil generated by heating lignocellulosic biomass in a deficiency of oxygen, 3) a process for converting ethanol to butanol and other chemical intermediates that is compatible with integration at corn- and lignocellulose-based ethanol production facilities, and 4) a process that uses electricity (ideally generated from wind) and ethanol coproduct carbon dioxide to produce urea fertilizer.

OBJECTIVES: The objectives are to are to optimize and evaluate 1) improved energy efficiency technologies for ethanol production from starch and lignocellulosic feedstocks based on the use of self-flocculating yeast and an innovative bioreactor design, 2) methods for utilizing hydroxyacetaldehyde extracted from bio-oils (generated via biomass pyrolysis) as feedstock for producing polyesters, polyurethanes, and polyamides, 3) a low-temperature, low-pressure process for converting ethanol to butanol and other higher alcohols that is compatible with integration at corn- and lignocellulose-based ethanol production facilities, and 4) an electrochemical synthesis that utilizes ethanol coproduct carbon dioxide, nitric oxide, and electricity (ideally generated from wind) to produce urea fertilizer.

**APPROACH:** Ethanol process efficiency improvement will focus on generating a clear beer, optimizing a membrane-based pervaporation process for dehydration of the clear beer, and increasing the ethanol concentration in lignocellulose feedstock-derived fermentation broth via beer recycle. Polymer process development will focus on utilization of hydroxyacetaldehyde in reactions similar to those employed in production of polyesters, polyurethanes, and nylon. Ethanol-to-higher alcohols process development will focus on optimization of a catalyst system based on yield, durability, and reaction temperature, all of which will impact operational cost. Urea process development will utilize a recently designed and fabricated electrochemical reactor system to optimize the urea synthesis using 1) reagent-grade carbon dioxide, and 2) carbon dioxide recovered from an ethanol plant.

**PROGRESS: 2006/06 TO 2007/05**

The National Alternative Fuels Laboratory (NAFL) at the University of North Dakota Energy & Environmental Research Center developed and is optimizing electrochemical processes for producing nitrogen-based fertilizers from nitric oxide (NO), carbon dioxide, hydrogen, and electricity. An electrochemical cell was designed, fabricated, and used to produce ammonium nitrate (AN), ammonia, and urea from reagent-grade feedstocks. Data from these lab-scale experiments were utilized to assess the economics of the processes based on the use of NO recovered from electric utility coal combustion emissions and carbon dioxide generated as a coproduct of fuel ethanol production. The economic assessment indicated good potential economic viability for the AN process, primarily because of its low hydrogen input requirement. Ongoing AN process optimization work is focused on improving the catalytic activity of the electrodes utilized to drive the process. NAFL developed and is optimizing a catalyst system for converting ethanol to butanol and other alcohols via a low-severity process that is compatible with integration at current and new ethanol production facilities. Using a carbon-based catalyst, a 40% conversion of ethanol to butanol was achieved. NAFL developed new synthetic methods for producing polymer products by substituting petroleum-derived ethylene oxide with hydroxyacetaldehyde (HA), a constituent of bio-oil generated via fast pyrolysis of lignocellulose. NAFL experiments indicated that HA can undergo a variety of reactions at its hydroxyl and aldehyde functionalities to yield large-market polyglycolamine products including latex paint dispersants and polymer-flood enhanced oil recovery agents. NAFL pursued development of a low-energy ethanol production route based on a continuous fermentation process that uses self-flocculating yeast and a specially designed suspended-bed airlift bioreactor (SBAB). A self-flocculating yeast strain was selected and acquired from the USDA Culture Collection, and two SBAB fermenters for ethanol continuous fermentation were designed and constructed. Fermentation study was focused on cellulosic ethanol, with emphasis on development of a beer recycle process. Beer recycle is crucial for improved cellulosic ethanol economics because the low density of cellulosic biomass typically translates to a low-concentration sugar solution and subsequent low-ethanol titer, which results in a high per-gallon ethanol dehydration cost. Typical ethanol concentration in a cellulose fermentation broth is about 4%, versus starch-based ethanol titers that can range from 12%-17%. Initial testing utilized purchased cellulose and cellulase enzyme to yield an 8.5% glucose concentration hydrolysate, which was fermented to yield a clear beer with an ethanol concentration of 4%. This clear beer was recycled through a second hydrolysis to yield an ethanol concentration of 8%. Attempts to achieve a third recycle were unsuccessful because of a reduction of cellulase activity by ethanol. During this project, an invention was conceived that comprises a method for the electrochemical production of ammonium nitrate from nitric oxide.

**IMPACT: 2006/06 TO 2007/05**

Commercialization of the NAFL electrochemical ammonium nitrate synthesis would result in cheaper fertilizer and turn coal-fired power plant NO<sub>x</sub> emissions into a revenue stream. Operating the process with wind-generated electricity would enable extracting value from wind energy without the need for additional transmission capacity and would promote rural economic development on the Great Plains. Because butanol is an excellent gasoline oxygenate with fuel properties that complement (rather than compete with) those of ethanol, commercialization of the NAFL low-severity process for conversion of ethanol to butanol represents a valuable product diversification option for current corn-based and future cellulosic ethanol plants. Because petroleum-derived ethylene oxide-based polymer production processes encompass large markets, commercialization of HA-based processes to produce these polymers will enable the replacement of oil with biomass in chemical markets and improve biorefining economics. The commercial viability of the HA-based processes will depend to a large extent on the cost of lignocellulosic pyrolysis-based HA

production and, ultimately, how this cost compares with the cost of ethylene oxide. Thus, HA-based products with the best potential viability are likely to be those with a sales price of greater than \$0.50/lb.

PUBLICATIONS (not previously reported): 2006/06 TO 2007/05

Liu, C.; Hu, B.; Chen, S.; Glass, R.W. Utilization of Condensed Distillers Solubles as Nutrient Supplement for Production of Nisin and Lactic Acid from Whey. *Appl. Biochem. Biotechnol.* 2007, 137-140 (1), 875-884.

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Item No. 45 of 59

ACCESSION NO: 0188159 SUBFILE: CRIS

PROJ NO: OKL02461 AGENCY: CSREES OKL

PROJ TYPE: SPECIAL GRANT PROJ STATUS: TERMINATED

CONTRACT/GRANT/AGREEMENT NO: 2001-34447-10302 PROPOSAL NO: 2001-03143

START: 01 JUL 2001 TERM: 30 JUN 2003 FY: 2003 GRANT YR: 2001

GRANT AMT: \$841,883

INVESTIGATOR: Huhnke, R. L.; Bellmer, D. D.; Bowser, T. J.; Epplin, F. M.; Lalman, J. A.; Taliaferro, C. M.

**PERFORMING INSTITUTION:**

AGRI ENGINEERING

OKLAHOMA STATE UNIVERSITY

STILLWATER, OKLAHOMA 74078

**BIOMASS-BASED ENERGY RESEARCH**

**NON-TECHNICAL SUMMARY:** Development of advanced alternative liquid transportation fuels, especially ethanol, will continue to be a national priority for the foreseeable future. This project involves the integrated activities of the Oklahoma/Mississippi Consortium (Oklahoma State University, The University of Oklahoma and Mississippi State University) in addressing most important issues in the conversion of biomass to liquid fuel utilizing a unique bioconversion process. Research conducted by this Consortium is reflected through five primary research projects: Feedstock Development, Biomass Gasification and Syngas Conditioning, Syngas Fermentation, Microbial Catalyst Development, and Economics.

**OBJECTIVES:** Determine optimal procedures for stand establishment and sustained biomass production for selected species with potential as dedicated feedstock crops. Develop and optimize gasification technology for syngas production through improved mass and energy balance measurement systems and techniques. Assess the impact of syngas composition on chemical productivity and cell growth within bench-scale fermenters. Determine the effect of medium components on the fermentation of syngas to ethanol. Examine the enzyme activities responsible for ethanol production. Determine the cost of system components (production, harvest, storage, transportation, processing, gasification, bioconversion, and ash disposal) for one or more potential feedstocks. Evaluate the potential demand for anticipated products (i.e. ethanol, ash, and change in air quality).

**APPROACH:** For selected species and varieties with a use history, studies will be initiated to determine the effects of fertilization (kind, rate, and date) and harvest (frequency, timing, cutting height) variables on biomass yield and chemical compositions. Operating conditions of gasifier at OSU will be optimized to produce desired syngas products with minimum waste. CO, H<sub>2</sub>, CO<sub>2</sub> and CH<sub>4</sub> production will be maximized while O<sub>2</sub>, tar, and ash content are minimized. Gasification system optimization involves

changing the physical and operational parameters of the equipment, based on results of gasification experiments, researchers' experience and knowledge obtained from the literature. Studies will be initiated that will use syngas compositions of various constituents and relative concentrations. Kinetic parameters will be measured that include the CO, CO<sub>2</sub>, and H<sub>2</sub> uptake rates, cell growth rate and concentration, ethanol/acetic acid ratio, yield of products relative to CO consumption, and the production rates of ethanol, acetic acid, butanol, and CO<sub>2</sub>. Manipulation of medium components to improve the conversion of syngas to ethanol will be examined. Primary measurements of organic acids and alcohols will be by gas chromatography, while ethanol concentrations will be confirmed using an alcohol dehydrogenase assay. Production coefficients will be developed after consultation with production scientists and used to develop input-output coefficients, while enterprise budgets will be used to determine production costs of dedicated agricultural biomass production activities. Historical data on product quantities and prices will be used to construct demand models representing the markets for the various products produced by the gasification process.

#### PROGRESS: 2001/07 TO 2003/06

**Feedstock Development:** Differences were detected in concentrations of chemical constituents in biomass samples of Kanlow switchgrass either harvested at 30-day intervals during winter (standing cured biomass) or at different maturity stages (preboot, full heading, end-of-season) during the growing season. One notable difference was significantly ( $P < 0.05$ ) lower levels of K in mature (heading stage and later), relative to immature, biomass because of the potential positive impact of lower K concentration when switchgrass feedstock is gasified or used in co-firing. Breeder and Foundation class plantings were made of bermudagrass breeding line LCB84X 16-66 in preparation for its release as a commercial cultivar.

**Gasification:** Switchgrass has consistently been gasified to produce 14 - 19% CO, 3 - 5% H<sub>2</sub>, 4-5% CH<sub>4</sub>, 15 - 18% CO<sub>2</sub> and 50-60% N<sub>2</sub>, and trace components (dry basis values). These values were obtained at a gasifier temperature of 650 to 800 degrees C and a biomass-to-air ratio of 0.27 to 0.29. A mass balance of the system has been successfully conducted. 5 to 7% of the biomass feedstock is removed from the system as ash. The ash contains about 50% carbon. Using a pilot-scale fluidization chamber, biomass fluidization studies were conducted to characterize behavior of the biomass in the gasifier. Results showed that both minimum and complete fluidization velocities were more sensitive to sand particle size as compared to the percent biomass level in a sand-biomass mixture. It was demonstrated that clean syngas could be produced and then stored at 100 psig with oxygen content of less than 1200 ppm. **Fermentation:** Syngas generated from biomass has been fermented. The bacteria were initially grown on compressed gases with similar composition as the generated gas. The gas source was then switched to the generated gas once the cell concentration remained at steady state for at least one day. The introduction of producer gas does not kill the cells. Cell growth stops. The cell decline observed in the chemostat agrees very well with a model suggesting no growth and loss of non-growing cells from the exit stream of the bioreactor. These results demonstrate that cell recycle is necessary. **Microbial Catalysts:** *Clostridium carboxidovorans* (P7) and *Clostridium ragsdalei* (P11) were deposited with the American Type Culture Collection and the Deutsche Sammlung von Mikroorganismen und Zellkulturen. Both P7 and P11 produce ethanol from CO in ammonium-free medium, eliminating a major medium cost. Hydrogenase, carbon monoxide dehydrogenase, formate dehydrogenase, and alcohol dehydrogenase are important enzymes for the conversion of CO to ethanol. The ability to measure these enzyme activities in whole cells is useful for monitoring fermentations and determining possible conversion bottlenecks.

#### IMPACT: 2001/07 TO 2003/06

The ultimate goal of our research is to move our unique bioconversion process to commercialization. Feedstocks for this process will include low-cost perennial grasses and crop residues, resulting in another possible source of farm income.

#### PUBLICATIONS (not previously reported): 2001/07 TO 2003/06

1. Tanner, R.S. 2003. *Clostridium ragsdalei* (P11) was deposited as ATCC BAA-622 and DSMZ 15248 (American Type Culture Collection and Deutsche Sammlung von Mikroorganismen und Zellkulturen). *Clostridium carboxidovorans* (P7) was deposited as ATCC BAA-624 and DSM 15243.
2. Das, M.K., Fuentes, R.G., and Taliaferro, C.M. 2003. Genetic variability and trait relationship in switchgrass. *Crop Sci.* (In Press).
3. Datar, R., Shenkman, R., Cateni, B.G., Huhnke, R.L., and Lewis, R.S. 2003. Ethanol from Biomass-generated producer gas. Proceedings of the Annual AIChE Meeting, San Francisco, CA.



4. Fuentes, R. G. and Taliaferro, C. M. 2002. Biomass yield stability of switchgrass (*Panicum virgatum* L.) cultivars. p. 276-282. IN J. Janick & A. Whipkey (eds.). Trends in New Crops and New Uses. Proceedings 5th Natl. Symposium on New Crops and New Uses, Strength in Diversity, 10-13 Nov. 2001, Atlanta, GA. ASHS Press, Alexandria, VA. USA.
5. Krushna, P., Bowser, T.J., Bellmer, D.D., and Huhnke, R.L. 2003. Fluidization characteristics of sand and mixtures of chopped switchgrass and sand. ASAE 036084. American Society of Agricultural Engineers, St. Joseph, MI.
6. Rajagopalan, S., Datar, R.P., and Lewis, R.S. 2002. Formation of ethanol from carbon monoxide via a new microbial catalyst, *Biomass and Bioenergy*, 23: 487-493.

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Item No. 46 of 59

ACCESSION NO: 0207135 SUBFILE: CRIS  
 PROJ NO: OKL02593 AGENCY: CSREES OKL  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 OCT 2006 TERM: 30 SEP 2011

INVESTIGATOR: Wilkins, M. R.

**PERFORMING INSTITUTION:**

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**RENEWABLE FUELS FROM OKLAHOMA BIOMASS**

**NON-TECHNICAL SUMMARY:** The United States imports over 50% of its petroleum from foreign sources, which threatens the nation's energy security. This project seeks to develop and improve processes to utilize cellulosic biomass grown in Oklahoma to produce fuel ethanol. Ethanol is a renewable, locally-produced fuel that can help reduce imports of petroleum from foreign sources.

**OBJECTIVES:** The overall objective is to identify technologies and process conditions that will most efficiently convert feedstocks that can be grown in Oklahoma into sugars that can be used to produce fuel ethanol. Individual objectives are to: (1) identify pretreatments that maximize ethanol production from an enzymatic hydrolysis process using lignocellulosic feedstocks; (2) evaluate thermotolerant microorganisms for ethanol production using SSF and lignocellulosic materials; and (3) evaluate non-senescent sorghum as a feedstock for ethanol production in Oklahoma.

**APPROACH:** Switchgrass and sorghum bagasse will be tested as feedstocks for ethanol production. Three pretreatments, liquid hot water, steam explosion, and alkaline, will be used to determine the best pretreatment for increasing cellulose reactivity while reducing yeast inhibition. Five thermotolerant *Kluyveromyces marxianus* yeast strains will be tested to determine their suitability for use in an ethanol process using switchgrass and/or sorghum bagasse. These yeasts will be tested at temperatures ranging from 40-45 degrees C. These temperatures are closer to the optimal temperatures for cellulase enzymes than temperatures generally used for ethanol fermentation (30-37 degrees C), allowing for faster hydrolysis times and/or lower enzyme loadings. Additionally, non-senescent sorghum, a variety of sorghum that delays senescence after grain production allowing the plant to store sugars such as glucose and sucrose in the stalk, will be grown and harvested on test plots in Bixby, OK. The grain will be harvested and starch in the grain will be hydrolyzed to glucose using alpha-amylase and gluco-amylase enzymes. Also, the stalks will be pressed to express a juice containing glucose, sucrose, and other sugars. Both the hydrolyzed starch and juice will be fermented using *Saccharomyces cerevisiae*, the *K. marxianus* strains previously

mentioned, and *Zymomonas mobilis*. Several temperatures and pH values will be tested to evaluate the best microorganism and fermentation conditions for maximum ethanol production.

**PROGRESS: 2006/10 TO 2007/09**

**OUTPUTS:** Experiments were conducted to evaluate hydrothermolysis as a pretreatment for preparation of switchgrass for enzymatic hydrolysis. Hydrothermolysis involves heating a slurry of biomass and water under pressure to keep the water in liquid form. Three temperatures (190, 200 and 210 degrees C) and three hold times (10, 15 and 20 minutes) were evaluated. After pretreatment, the remaining insoluble solids were recovered by filtration and hydrolyzed by a cellulase preparation to glucose. A thermotolerant yeast (*Kluyveromyces marxianus* IMB4) was added at the same time to ferment glucose to ethanol in a process known as simultaneous saccharification and fermentation (SSF). The temperature for SSF was 45 degrees C. In a subsequent experiment, *K. marxianus* IMB4 was evaluated at 37, 41 and 45 degrees C and compared to a control of *Saccharomyces cerevisiae* D5A at 37 degrees C. Switchgrass was prepared by hydrothermolysis at 200 degrees C and 10 minutes. SSF was initially conducted at pH 4.8. Due to a premature end to fermentation at pH 4.8 and 45 degrees C, an experiment was also done at initial pH 5.5 using *K. marxianus* IMB4 at 45 degrees C. *K. marxianus* IMB4 is of great interest because it can ferment sugars at 45 degrees C, which is an ideal temperature for cellulase hydrolysis. Other yeasts cannot survive at this temperature, so lower temperatures must be used during SSF. This results in a slower hydrolysis and fermentation. Results have been disseminated through a conference presentation and paper to the American Association of Agricultural and Biological Engineers Meeting and through a poster at the Oklahoma GROW Conference. **PARTICIPANTS:** Collaborators: Danielle D. Bellmer, OSU, Raymond L. Huhnke, OSU, Andrew Mort, OSU, Niels O. Maness, OSU and Ibrahim M. Banat, University of Ulster, United Kingdom. **TARGET AUDIENCES:** The target audiences are ethanol producers, government officials involved in bioenergy policy, enzyme producers, farmers and ranchers that may be involved in biomass production, undergraduate and graduate students interested in biofuels, and other biofuels researchers. Educational efforts to inform target audiences of the outputs of this project included a poster at the Oklahoma GROW Conference, a gathering of biofuels industry officials, Oklahoma farmers and ranchers, government officials, and academic researchers interested in biofuels. Also, a new course has been implemented at Oklahoma State University on renewable energy with several lectures focusing on activities and subjects related to this project.

**IMPACT: 2006/10 TO 2007/09**

Hydrothermolysis was determined to be a suitable pretreatment for hydrolysis of cellulose in switchgrass to glucose by cellulase. As temperature and hold time increased, more glucose was released through hydrolysis and more ethanol was produced. The conditions of 200 degrees C and 10 minutes were determined to be the best conditions for ethanol production. Also, *K. marxianus* IMB4 was found to be a promising candidate for use in SSF of biomass. *K. marxianus* IMB4 at 41 and 45 degrees C produced more ethanol than the control at 72 hours, but they ceased fermentation after 96 and 72 hours, respectively, while the control continued fermentation for 168 hours. Increasing pH to 5.5 resulted in greater ethanol productivity and fermentation continued for 96 h as opposed to 72 h at pH 4.8. SSF using *K. marxianus* IMB4 at 45 degrees C resulted in faster cellulose hydrolysis and faster ethanol production as compared to the most commonly used ethanol-producing yeast, *S. cerevisiae* D5A. The implementation of numerous standard procedures developed for analyzing biomass composition, enzymatic hydrolyses, and fermentations have been implemented as a result of this project. Three graduate students and the primary investigator have been trained in these methods, which has greatly expanded the capability of the biofuels program at Oklahoma State University (OSU). These procedures are commonly used in the biofuels industry and will make students trained during this project more marketable to employers. Also, more experienced graduate students have passed on their knowledge regarding enzymatic hydrolysis techniques and analysis procedures to new students, ensuring continuity of procedures and the ability to compare results over the course of the project.

**PUBLICATIONS (not previously reported): 2006/10 TO 2007/09**

Suryawati, L., M.R. Wilkins, D.D. Bellmer, R.L. Huhnke, N.O. Maness, and I.M. Banat. 2007. Effect of hydrothermolysis on ethanol yield from Alamo switchgrass using a thermotolerant yeast. Paper No. 077071. 2007 ASABE Annual Meeting. June 17-20, 2007.

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Item No. 47 of 59

ACCESSION NO: 0409037 SUBFILE: CRIS  
 PROJ NO: 1935-41000-072-00D AGENCY: ARS 1935  
 PROJ TYPE: USDA INHOUSE PROJ STATUS: NEW  
 START: 29 OCT 2004 TERM: 28 OCT 2009 FY: 2006

INVESTIGATOR: HICKS K B; TAYLOR F; BOATENG A A; MOREAU R A; MCALOON A J;  
 FISHMAN M L

PERFORMING INSTITUTION:  
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#### ECONOMIC COMPETITIVENESS OF RENEWABLE FUELS DERIVED FROM GRAINS AND RELATED BIOMASS

**OBJECTIVES:** Lower the cost of fuel ethanol production from corn and barley through improved dry grind and dry milling fractionation techniques, including a new 'ammoniation' process. Develop more efficient processes for converting hulled and hullless barley to fuel ethanol and improved, beta-glucan-free, feed coproducts. Through research assist in creation of a new hullless barley-to-ethanol industry in corn deficient regions, particularly the Mid Atlantic States and the North Western U.S. Use the low-starch ('low carb') and high-fiber, high-oil, and high-protein fractions recovered from corn and barley prior to ethanol fermentation to produce health-promoting food ingredients, functional foods, and extruded snacks. Develop improved processes to convert low valued crop-related biomass, byproducts and energy crops being researched in the ARS energy crop program into renewable hydrogen or liquid fuels and conduct economic feasibility studies for integrating this technology into co-located dry grind ethanol plants. Develop small-scale thermochemical technologies that economically, efficiently, and sustainably produce hydrogen and coproducts from agricultural materials.

**APPROACH:** Develop a continuous corn ammoniator for improving the conversion of corn to fuel ethanol. Conduct research to develop new dry de-germinators, roller mills, and associated fractionation devices with and without 'ammoniation' as a 'front end' to the traditional dry grind ethanol process. Use these techniques on corn and hulled barley to produce high-starch fractions for more efficient fermentations, and low-starch fractions that can be used as value added health-promoting 'low-carb' food ingredients, healthy edible oils and nutraceuticals. Use newly developed hullless barley cultivars and develop new beta-glucan-degrading enzyme technology to reduce fermentation viscosity and improve the production of ethanol from barley. Prepare hullless barley DDGS from beta-glucanase treated fermentations and examine as high-valued feeds for non-ruminants and aquaculture. Low-valued barley hulls and corn bran from corn and barley ethanol processing and energy crops and residues like switch grass, Eastern gama grass, reed canary grass, alfalfa, and corn stover will be studied as substrates for conversion to hydrogen and related liquid and gaseous fuels by thermochemical processes in a pyrolyzer (pyroprobe) coupled to a gas chromatograph/mass-spectrometer (PY-GC/MS) to analyze gasification products. Promising substrates will be converted in a 2-inch bench-top fluidized-bed reactor to test selected feedstock for yields of H<sub>2</sub>, syngas, char and pyrolytic oil. Process modeling and economic analysis will be conducted on all the technologies studied, to help direct research toward the most fruitful and commercially feasible areas.

**PROGRESS:** 2005/10 TO 2006/09

Progress Report 1. What major problem or issue is being resolved and how are you resolving it (summarize project aims and objectives)? How serious is the problem? Why does it matter? Agriculturally-derived renewable fuels have the potential to provide three major benefits to the United States: Energy independence; Economic opportunities for U.S. farmers and rural businesses; and Environmental improvements by cleaning the air and reducing greenhouse gas emissions. The demand for fuel ethanol in the U.S. is expected to at least double over the next several years due to federal mandates and the phase-out

of Methyl tert-Butyl Ether (MTBE). Technological advances are still needed, however, to enhance the economic competitiveness of domestically produced renewable fuels, such as fuel ethanol, so they can compete in the marketplace with lower-priced fossil fuels. Especially needed are new and improved dry grind ethanol processes for corn that can produce cheaper ethanol while producing revenue-generating coproducts more valuable than traditional Distillers Dried Grains with Solubles (DDGS). Research in this area is critically needed to continue to decrease the cost and the energy required for producing fuel ethanol. There is now a major need for ethanol plants on the East and West Coasts, to satisfy growing local ethanol markets, especially in the North East and in California. Since most of these states are corn deficit, ethanol plants located there would need to either import higher-priced corn from the Midwest or develop an alternative grain more easily grown locally. Groups of East Coast, Pacific Northwest, and Upper Midwest farmers, farmer groups, trade associations, and University small grain breeders have identified barley, and specifically, hullless barley as such a crop. Similar interest in barley is being seen in other corn deficit states around the U.S. Research is needed however, to assist barley breeders in selecting varieties that are optimal for ethanol and coproduct production. Research is also needed to solve technical problems related to milling and fermentation of barley as well as expanding the feed applications for barley DDGS. Finally, major Federal initiatives are in place to create a future Hydrogen Economy. For this effort to be successful, hydrogen should be produced locally from renewable resources through improved gasification processes. The ARS has a growing energy crop program to produce energy crops for various regions of the country. The initial goal was to develop processes to convert these crops to ethanol, through hydrolysis and fermentation. No program on gasification of these crops to form hydrogen, syngas, and liquid fuels is available in ARS. The present research project will fill this void by conducting gasification research on these specific energy crops as well as crop residues and fibrous ethanol plant byproducts. Research leading to cost-effective, integrated fuel ethanol/ biomass hydrogen facilities using grain and energy crops plus crop-derived biomass would greatly benefit the hydrogen initiative. Development of new technology that integrates feedstock pretreatment, biological conversion and product recovery processes, as well as fundamental knowledge regarding fermentation, milling and separations resulting in additional income and reductions in capital and processing costs associated with biofuel production contributes to ARS National Program goals. This project responds directly to the "Ethanol" problem area of NP 307 Action Plan's Component I, Ethanol specifically by developing new Process Efficiencies (Ammoniation process, continuous fermentation, dry mill pre-treatments to remove non-fermentable kernel components, increasing the fermentability and ethanol yields from barley and hullless barley) and by conducting new CoProduct Development (hydrogen, premium high-protein feeds, high-protein, low carbohydrate food ingredients). The project also responds to the Action Plan's Component IV, Energy Crops in which conversion methods need to be further improved to reduce the cost of deriving fuels from biomass (Hydrogen from fibrous grain milling fractions and energy crops) and Crop residues such as corn stalks and wheat [barley] straw for biomass fuel production. Whereas there is no specific mention of hydrogen in the NP 307 Action Plan, National Program Staff gave approval for including hydrogen in NP 307 Research Goals in January 2004. The project also responds directly to NP306 action plan's Problem Area 2b - New Uses for Agricultural By-products and 2c - New and Improved Processes and Products).

2. List by year the currently approved milestones (indicators of research progress) FY 2005

- 1(a) To begin development of upstream dry grind and dry milling processes with potential to decrease the cost of fuel ethanol production from corn.
- 1(b) Begin to develop a continuous process to evenly ammoniate corn with potential to lower cost of fuel ethanol production.
- 1(c) To begin evaluation of the ammoniation of corn as a pretreatment of dry milling processes with potential to decrease the cost of fuel ethanol production from corn.
- 2(a) To begin development of upstream dry fractionation processes with potential to decrease the cost of fuel ethanol production from barley.
- 2(b) Begin development of b-glucanase and high-solids fermentation technology as a potential process to lower cost of fuel ethanol from barley
- 3(b) Begin to characterize phytonutrients in high-oil fractions such as those obtained by scarification with the goal of identifying new valuable coproducts for functional foods and ingredients.
- 4(a) To begin conducting Pyrolysis-GC/MS Studies to establish the thermo- chemical energy potential of grain milling byproducts and energy crops being developed and studied in the ARS bioenergy program

FY 2006

- 1(a) To continue development and testing of upstream dry grind and dry milling processes with potential to decrease the cost of fuel ethanol production from corn.
- 1(b) Continue to develop a continuous process to evenly ammoniate corn with potential to lower cost of fuel ethanol production.
- 1(c) To conclude the evaluation of ammoniation of corn as a pretreatment of dry milling processes with potential to decrease the cost of fuel ethanol production from corn.
- 1(d) Begin to determine the effects of fractionation and ammoniation on fermentation and coproducts.
- 1(e) Begin process modeling and economic analysis of fractionation and ammoniation to determine their economic benefit in fuel ethanol production.
- 2(a) Continue development of upstream dry fractionation processes with potential

to decrease the cost of fuel ethanol production from barley. 2(b) Continue development of b-glucanase and high-solids fermentation technology as a potential process to lower cost of fuel ethanol from barley 2(c) Begin process and economic analysis for new barley process: develop base case barley to ethanol model. 3(a) Begin characterization of fractionated streams, from corn and barley, resulting from upstream ethanol processes and combine them to make potential low carb flour replacements and provide to collaborators for evaluations. 3(b) Continue to characterize phytonutrients in high-oil fractions such as those obtained by scarification with the goal of identifying new valuable coproducts for functional foods and ingredients. Identify and provide high-oil samples to potential industry partners. 3(c) To begin evaluation of low carb extruded snacks and related products using low starch corn and barley fractions resulting from "upstream" ethanol processes 3(d) Begin economic analysis for feasibility of products in this objective. 4(a) Continue conducting Pyrolysis -GC/MS Studies to establish the thermo-chemical energy potential of grain milling byproducts and energy crops being developed and studied in the ARS bioenergy program. 4(b) To begin construction of a bench-top gasifier and conduct studies to determine the potential of grain byproducts and energy crops as feedstock for production of syn gas. 4(c) Begin initial process/cost simulation modeling for co-located fuel ethanol and thermochemical conversion plants. FY 2007 1(a) To complete development of "upstream" dry grind and dry milling processes with potential to decrease the cost of fuel ethanol production from corn. 1(b) Complete the development of a continuous process to evenly ammoniate corn with potential to lower cost of fuel ethanol production. 1(d) Continue to determine the effects of fractionation and ammoniation on fermentation and coproducts. 1(e) Continue process modeling and economic analysis of fractionation and ammoniation to determine their economic benefit in fuel ethanol production. 2(a) Complete development of upstream dry fractionation processes with potential to decrease the cost of fuel ethanol production from barley. 2(b) Complete development of b-glucanase and high-solids fermentation technology as a potential process to lower cost of fuel ethanol from barley 2(c) Continue process and economic analysis for barley processes: develop hullless barley to ethanol model. 2(d) Begin Scale up of barley dry fractionation and fermentation processes to prepare quantities for feed studies (if feasibility studies warrant). 3(a) Continue characterization of fractionated streams, from corn and barley, resulting from upstream ethanol processes and combine to make potential low carb flour replacements and provide to collaborators for evaluations. 3b) Complete the characterization of phytonutrients in high-oil fractions such as those obtained by scarification and determine their potential value as coproducts with functional food applications. 3(c) To begin development of potential low carb extruded snacks and related products using low starch corn and barley fractions resulting from upstream ethanol processes. 3(d) Continue economic analysis for feasibility of low carb extruded snacks. 4(a) To complete Pyrolysis-GC/MS studies and establish the thermo- chemical energy potential of grain milling byproducts and energy crops being developed and studied in the ARS bioenergy program. 4(b) To complete construction and testing of the gasifier and begin conducting studies to determine the potential of grain byproducts and energy crops as feedstock for production of syn gas. 4(c) To conduct process/cost simulation modeling for co-located fuel ethanol and thermochemical conversion plants to determine the economic feasibility of direct firing/co-firing of grain byproducts and energy crop biomass in such plants. FY 2008 1(d) Complete determination of the effects of fractionation and ammoniation on fermentation and coproducts. 1(e) Continue process modeling and economic analysis of fractionation and ammoniation to determine their economic benefit in fuel ethanol production 2(c) Continue process and economic analysis for fuel ethanol from barley processes: develop barley to ethanol model modified for feedstock from barley fractionation. 2(d) Continue scale-up barley dry fractionation and fermentation processes to prepare quantities for feed studies (if feasibility studies warrant). 3(a) Conclude low carb flour replacements studies with collaborators and determine their potential as value added coproducts from fuel ethanol plants/processes. 3(c) To continue development of potential low carb extruded snacks and related products using low starch corn and barley fractions resulting from upstream ethanol processes. 3(d) Continue economic analysis for feasibility of low carb extruded snacks. 4(b) To continue to conduct gasification studies to determine the potential of grain byproducts and energy crops as feedstock for production of syn gas. 4(c) To conduct process/cost simulation modeling for co-located fuel ethanol and thermochemical conversion plants to determine the economic feasibility of firing biomass-derived syngas in such plants. FY 2009 1(e) Complete process modeling and economic analysis of fractionation and ammoniation to determine economic benefit for lowering cost of fuel ethanol production. 2(c) Complete process and economic analysis for new barley process: Refine models using raw starch hydrolyzing enzymes. 2(d) Complete feed studies with collaborators and determine the potential for barley fractions and DDGS in animal feeds 3(c) To conclude development of potential low carb extruded snacks and related products using low starch corn and barley fractions resulting from upstream ethanol processes. 3(d) Complete economic analysis for feasibility of low carb extruded snacks. 4(b) To complete gasification studies to determine the potential of grain byproducts

and energy crops as feedstock for production of syn gas. 4(c) To complete process/cost simulation modeling for co-located fuel ethanol and thermochemical conversion plants with the determination of the economic feasibility of firing biomass-derived bio-oil in such plants. 4a List the single most significant research accomplishment during FY 2006. Discovery of Key Enzymes to Boost Fuel Ethanol Production from Barley. New feedstocks for fuel ethanol production are needed. Currently 95% of fuel ethanol is made from corn and continued growth of the ethanol market could create shortages of corn for food and feed uses. Barley could be a potential alternative feedstock if problems with its high viscosity and low ethanol yields could be solved. Our research has found a new combination of enzymes (beta-glucanases and beta-glucosidases) that has the potential to solve both problems of viscosity and yield. The key discovery was the use of beta-glucosidase enzymes that are currently missing from commercial enzymes for barley conversion to ethanol. Development of new commercial enzyme preparations using this new knowledge will greatly benefit the small, but growing barley-to-fuel ethanol industry, which will allow building of ethanol plants outside the corn belt, in the barley belts of the East Coast, Northwest, and Upper Midwest and produce an additional 1-2 billion gallons of fuel ethanol for the US market. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol. 4b List other significant research accomplishment(s), if any. Tocotrienols in Barley Kernel Oil and Barley Fines Oil. The outer layers of the barley kernel are low in starch and high in oil. Experiments were conducted using a commercial scarifier to abrade the outer layers of barley cultivars and evaluate the yields and composition of the oil in these layers. Abrasion for one minute removed 12 to 15% of the mass from the four barley cultivars evaluated (two common hulled cultivars and two new hullless cultivars). The amount of oil in the abraded "fines" fractions was 3-5% in the two hulled barely cultivars and 7-9% in the two hullless barley cultivars. The levels of total phytosterols (natural cholesterol lowering substances) in barley oils obtained by extracting these fines fractions were about 6-9% for the hulled cultivars and 2-5% for the hullless cultivars. Previously we reported that the levels of vitamin E components (tocopherols and tocotrienols) were high in all of the oils. During the last year we have discovered that the levels of tocotrienols in the barley oils are the highest ever reported for any natural plant oil. Previously palm oil and rice bran oil were considered to have the highest levels of tocotrienols, but barley kernel oil and barley fines oil now appear to contain higher levels of tocotrienols. This information may lead to the development of new nutraceutical oil products from barley. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Coproduct Development. Barley Hulls as a Feedstock for "Cellulosic" Ethanol. Most barley contains a hard and abrasive hull that makes up 10-15% of the weight of the kernel. When hulled barley is used to make fuel ethanol, the non-fermentable hull takes up valuable space in the fermentor, making the process inefficient. We developed a process to remove the hull from the barley, prior to grinding and producing fuel ethanol from the starchy portion of the kernel. The hull, which is rich in hemicellulose and cellulose, was then used to make "cellulosic ethanol" by pre-treatment with aqueous ammonia and then digestion with cellulases, followed by fermentation with a hexose and pentose-fermenting microorganism. The results of these studies showed that a 40 million gallon per year barley ethanol plant could increase ethanol production by 10-15% (4-6 million gallons) by converting the hull polysaccharides to additional "cellulosic" ethanol. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies. Combustion of Barley Hulls to Generate Process Steam for a Barley Ethanol Plant. In most barley ethanol plants, the hulls wind up being part of the ethanol coproduct, Distillers Dried Grains with Solubles (DDGS) that sells for less than \$70/ton as ruminant animal feed ingredients. With the rising price of natural gas that is used to produce process steam in most ethanol plants, new sources of fuel are required. In this study, barley hulls were pyrolyzed in a special pyrolysis unit and the condensable and non-condensable gases and char produced were measured under different treatment conditions. Further thermochemical analyses of the hulls were carried out that determined hulls have an average calorific value of about 19MJ/kg (similar to tree bark). The information was placed into ERRC's SuperPro Process and Cost Simulator for a 40 MGY barley ethanol plant, and it was determined that use of barley hulls in a fluidized bed combustor could replace about 40% of the natural gas usage. This information will be of value to ethanol plant designers and builders as it will provide them a design option that would result in use of less fossil- and more renewable-fuels to provide plant energy. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies. New Shake-Flask Method Helps to Study Production of Fuel Ethanol from Grains. Studying new fermentation methods to increase process efficiency can be a long and tedious process if fermentation experiments are conducted one at a time, using a traditional 72-hour fermentation in a mid-sized lab fermentor. We developed a shake-flask method to evaluate the fermentation characteristics of corn. The method permits an accurate determination of ethanol yield after 50 hours of fermentation time, while using only 50 g of corn mash for each flask. Scores of

shake-flasks can be incubated simultaneously, allowing rapid throughput of samples and faster and more accurate results. This method will be used by our researchers to save time and money during the early stages of ethanol fermentation research projects. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies. 4d Progress report. "Scarification" of Barley for Improved Fuel Ethanol and CoProduct Production. Scarification is a process that sequentially grinds off the outer surface (bran) of grain kernels as the kernels are tumbled on an abrasive surface. Based on preliminary results obtained from a limited scarification study initiated in 2004, a complete experiment was conducted to use scarification to produce fiber/oil rich and starch-rich fractions from hullless and hulled barley using three abrasive surfaces. Four barleys varieties, two hulled (Nomini and Thoroughbred) and two hullless (Doyce and Merlin) were scarified using three abrasive surfaces. All the fractions obtained at different degrees of abrasion are being evaluated to determine the chemical and physical composition of the fractions. The oil/fiber rich fractions are being characterized for potential nutraceutical coproduct applications while the starch-rich fractions will be considered for high-yielding fuel ethanol feedstock. The results of these studies will determine if scarification is a more profitable process that should be considered for future fuel ethanol plants using barley feedstock. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies and Coproducts. Roller Mill Flow Designed for Dehulling Barley May Produce Ethanol Feedstock, Value-Added Food Ingredients, and Energy to Run Ethanol Plants. The presence of a very hard and abrasive hull on most barley varieties is a major problem for using this grain in fuel ethanol production. A roller mill flow consisting of different roll passes followed by fractionation based on particle size and particle density was designed as a way to remove the barley hull and produce useful fractions. This flow is capable of separating the hulls of the hulled barley from the fractions rich in pericarp (fiber) and endosperm (starch). The fractions rich in endosperm will be used for fermentation in ethanol production and the ones rich in pericarp will be used in future studies for "whole grain" food product development. The hull fractions are used in gasification studies. If this process is successful, a roller milling process could lower the cost of fuel ethanol from barley by providing high-starch feedstock needed for high yields of ethanol, fiber and nutrient rich coproducts for nutritious foods, and hulls that could be used in a co-located fluidized bed gasifier or combustor, that could produce much of the process steam needed to run the ethanol plant. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies and Coproducts. Pyrolysis and Gasification of Energy Crops Yield Liquid and Gaseous Fuels. Pyrolysis studies were conducted on three herbaceous grasses and alfalfa stems all classified as energy crops in the national biomass initiative program. These experiments were carried out to establish their thermochemical conversion potential as a viable alternative to fermentation of energy crops to produce ethanol. While fermentation remains a popular biomass-to-biofuels conversion method, the thermochemical conversion e.g., pyrolysis to bio-oils, gasification, to syngas (CO, Hydrogen, Methane, etc.) and co-products may present a nearer term economic viability, if this can be experimentally verified. For this reason, the first ARS program on thermochemical conversion of biomass was initiated at the ERRC. Through this, pyrolysis studies employing a Pyroprobe-GC/MS setup were conducted on lowland ecotype Cave-in-Rock switchgrass (*Panicum virgatum*), reed canarygrass (*Phalaris arundinacea*), herbaceous C3 cool-season grass, eastern gamagrass (*Tripsacum dactyloides*) a warm-season herbaceous grass and alfalfa stems (*Medicago sativa* L.) All herbaceous grasses and alfalfa produced useful syngas during pyrolysis and their energy potentials were correlated with their maturity at harvest. In related research, ERRC is conducting collaborative studies with the USDA-ARS National Forage Seed Production Center in Corvallis, OR and the Western Research Institute to study a new dual-stage gasification concept to convert grass straw and other agricultural residues into syngas and other value-added energy products on a scale suitable for on- farm use. The results of these studies will be used to determine the economic viability of using pyrolysis and gasification processes to produce gaseous and liquid fuels for transportation and on-farm needs. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Process Efficiencies and Coproducts. The following section serves to document research conducted under a CRADA between ARS and Archer Daniels Midland (ADM) Corporation. Additional details of research can be found in the report for the subordinate CRIS 1935-41000-072-O2T, "Biomass Research and Development for the Production of Fuels, Chemicals and Improved Cattle Feeds". The CRADA funding originally derived from a 2003 USDA-DOE Biomass R&D Grant that was co-written by ADM and ERRC. ADM was the submitting organization. The project builds on corn ammoniation and continuous fermentation and ethanol stripping technology that was developed under the parent CRIS. This technology will be combined with other new technologies to enhance the profitability of ethanol production by the dry grind process. Progress to date at ERRC includes: 1. Continuation of the research plan for ERRC that includes development of a continuous corn ammoniator, a

new analytical method to measure ammonia levels in treated corn, new dry milling technologies for processing ammoniated and non-ammoniated corn for ethanol production, evaluating fermentability for ammoniated and non-ammoniated corn, developing more efficient fermentation processes, and conducting process and cost analysis to quantify the benefits (if any) for using ammoniation and new fermentation techniques in the corn to ethanol process. 2. Held regularly scheduled conference calls to coordinate research between two ADM locations and ERRC. Will hold quarterly meeting in fall of 2006 in Urbana-Champaign, Illinois. 3. Used the ERRC continuous ammoniator to produce 400 lb (7 bushel) and 800 lb (14 bushel) quantities of corn at two different ammoniation levels, 400 ppm and 800 ppm for evaluation of efficiency and consistency of treatment and fine-tuning its operation. 4. Updated the ARS 40 million gallon/year dry grind ethanol process and cost computer simulation model and provided this research tool to the ADM cooperators. Also provided models for dry pre-fractionation of corn, and for continuous fermentation with stripping, derived from the dry-grind base case. 5. Experiments were conducted and completed to show the effect of soaking in aqueous ammonia (SAA) on the digestibility of cellulose and hemicellulose in barley hulls. 6. Experiments were conducted to determine the effect of ammoniation on dry separations of dry-milled corn. 7. Developed a shake-flask method to evaluate the fermentation characteristics of ammoniated and non-ammoniated corn. The method permits an accurate determination of ethanol yield after 50 hours of fermentation time, while using only 50 g of corn mash for each flask.

5. Describe the major accomplishments to date and their predicted or actual impact. Researchers Built First Continuous, Pilot Plant-Scale Corn Kernel Ammoniation Device. Exposing whole corn to anhydrous (gaseous) ammonia may loosen the hull and help to separate it from the kernel prior to fuel ethanol production, a process that could lead to cheaper fuel ethanol production. To test this hypothesis, a method was needed to safely, uniformly and reproducibly treat whole corn with ammonia. It was necessary to control the amount of ammonia and time of exposure. Batch methods were not suitable, because hot spots form and the treatment is uneven. To solve this problem, a continuous flow ammoniator was designed, built and tested. The device was shown to reproducibly and safely distribute up to 1000 ppm of anhydrous ammonia into 2.5 kg/min of dry corn. Distribution of ammonia in corn was measured by assaying the ammonia content of individual corn kernels. Distribution was found to be much more uniform than in a bench-scale batch ammoniator. The idea of using ammonia to help remove the hull from corn was previously patented by ARS. The continuous ammoniator will enable research both here at ERRC and with a CRADA partner to determine the practical utility of the patent and of the technology. If the idea is found to be practical, the device may serve as a prototype, leading to industrial application of the technology to lower the cost of fuel ethanol from corn. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Coproduct Development and Process Efficiencies.

Development of the ERRC Grain Processing Research Pilot Plant. One way to lower the cost of fuel ethanol from grain is to remove non-fermentable components from corn kernels prior to fermentation to ethanol. There was a major need for a grain milling research facility that contained bench and pilot scale grain fractionation equipment to test this hypothesis. In 2004, a new Grain Processing Research Pilot Plant, unique to ARS was opened at ERRC. To expand the capability of this facility, new particle reduction and particle separation equipment was added in FY 2005. This new equipment includes four new roller mill stands and two additional sets of rolls that provide a wide range of applications in dry milling of barley and corn. Particle separation equipment includes a micron air jet separator, rotary sifter and air aspiration units. In addition, a whitener unit and a color analyses unit complete the equipment necessary to conduct fractionation studies and evaluation of milling alternatives for new barley varieties. This new facility provides unique resources that will enable ARS researchers to lower the cost of fuel ethanol through grain fractionation and fermentation research. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Coproduct Development and Process Efficiencies.

Experimental Milling Techniques May Improve Barley as a Fuel Ethanol Feedstock. In research designed to facilitate the use of barley as a feedstock for fuel ethanol production in "corn deficit states", four different experimental milling processing units designed for wheat flour production were tested with three barley varieties. This evaluation was used to determine the performance of the experimental mills and the barley varieties in the "upstream" (prior to fermentation) fractionation of barley for ethanol production. The milled streams were fermented and preliminary ethanol production characteristics determined. The chemical composition and particle size distribution of the streams produced had a major effect on fermentation rates, with some fractions fermenting 100% faster than others. The experimental milling results were used to select the most appropriate grinding equipment purchased for the ERRC Grain Processing Plant and for planning additional experiments on the small and pilot scale to fully understand the full potential of these techniques to improve fuel ethanol production from barley. This work supports the ARS National Program 307, Bioenergy and Energy Alternatives, Component 1, Ethanol Coproduct



Development and Process Efficiencies. 6. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end- user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption and durability of the technology products? Unit scientists and engineers held a meeting with Novozymes to transfer new information about barley fermentation. Novozymes has provided enzymes to ARS for this purpose. December 2005. A sophisticated computer simulation and cost model for 40 million gallons per year fuel ethanol from dry-grind corn that was developed in our Unit, was provided to approximately 100 requestors during this reporting period. These included academic researchers, private consultants and small and large companies involved in or seeking to become involved in the fuel ethanol industry including the USDA office of the Chief Economist, US Environmental Protection Agency, the National Corn to Ethanol Research Center, the Nebraska Ethanol Board, ADM, Dupont, Batelle Institute, Monsanto, Genencor, Novozymes, Booze Allen & Hamilton, Chevron, Cornell University, Lafayette College, Monsanto, Purdue University, Southern Illinois University, the Wharton School at the University of Pennsylvania, the University of Minnesota, the University of Illinois, Washington University and the University of Nebraska. Access to this model has helped the recipients with understanding the costs, energy, inputs and outputs of the ethanol process. They have used it for modeling, design and business decisions, and thus helped to improve the cost-effectiveness of fuel ethanol production from corn. The model was used by researchers in the USDA's office of the Chief Economist and many other groups across the US to study the net energy balance for ethanol. January 2006 to present. A rigorous computer simulation model for a corn wet milling plant was developed in our Unit and it represents the only one of its kind in the public domain. Nineteen copies of the corn wet milling model have been requested and distributed to various organizations and individuals. These organizations included other ARS research centers, the US Environmental Protection Agency, Booze Allen & Hamilton, Corn Products, Lafayette University, the University of California, Purdue University the Wharton School at the University of Pennsylvania. Requestors used this model to understand the corn wet milling process, to understand the inputs and outputs, capital and operating costs and construction costs. January 2006- present A Unit researcher worked through a specific cooperative agreement to transfer engineering information and assist in the design and construction of a farm-scale switchgrass gasifier in Ligonier PA. The unit was constructed and was tested. Its purpose is to gasify switchgrass and generate electricity using the gas produced. It is now available for research and development by the owner and other interested parties. January to May 2006. Unit scientists and engineers held a meeting with Genencor International to begin a new CRADA on fuel ethanol production from barley. Unit scientist and engineers transferred new computer cost and process models on the fuel ethanol process and new information on unique enzymes that have potential to increase the yield of fuel ethanol from barley, an alternative to corn that will play a major role in fuel ethanol production as corn feedstocks begin to tighten around the country due to unprecedented growth in ethanol production. Genencor will provide new enzymes and processing technologies. During the term of the CRADA new technology for barley fermentation will be developed and transferred to the ethanol industry by ARS and Genencor. June 2006. Unit scientists and engineers met with approximately 25 different groups during the year to transfer information on fuel ethanol production technologies, economics, energy balance, feedstocks, and other technical matters related to ethanol production from grains and cellulosic feedstocks. January 2006 present 7. List your most important publications in the popular press and presentations to organizations and articles written about your work. (NOTE: List your peer reviewed publications below). Hicks, K.B., Stewardship of the Earth Through Renewable Fuels. Union League of Philadelphia, November, 2005. Hicks, K.B., Flores, R.A, Kurantz, M. Taylor, F., Johnston, D., Moreau, R., Wilson, J., Kohout, K., and McAloon, A.J. Enzymes for the Production of Fuel Alcohol from Barley. Novozymes and ERRC joint meeting, Wyndmoor, PA, December, 2005. Fireman, J., Quantitative HPLC analysis of Lipids, Bioscience Technology, January 2006, pp 48-50. Hicks, K.B., New Feedstocks and Processes for Fuel Ethanol. Pennsylvania Renewable Energy Expo, State College PA, March, 2006. McAloon, Andrew, Ethanol Economics and the Net Energy Balance of Ethanol, Pennsylvania Renewable Energy Expo, State College Pa., March 2006 Hicks, K.B., Agricultural Innovations in Energy Production and other Research Initiatives. South Central Assembly for Effective Governance Agriculture Committee, Penn State, Harrisburg Campus, Middletown PA, May 2006. McAloon, Andrew, Cost Engineering in the Research Environment, Association for the Advancement of Cost Engineering, Delaware Valley Section, Philadelphia, PA, May 2006. Hicks, K.B., Kim, TH, McAloon, A.J., Taylor, F., Johnston, D. B., Boateng, A.A., and Moreau, R.A. Fuel Ethanol from Barley A Research Update. Ethanol Producers and Consumers Annual Ethanol Conference, Whitefish Montana, June, 2006. Hicks, K. B., Kim, TH, McAloon, A.J., Taylor, F., Johnston, D. B., Boateng, A.A., and Moreau, R.A. Fuel Ethanol From Hullless Barley. 22nd Annual International Fuel Ethanol Workshop & Expo, Milwaukee, Wisconsin, June, 2006. Hicks, K.B., Johnston, D.B., Moreau, R.A., McAloon, A.J.,

Ramirez, E., and Singh, V. Corn Wet Fractionation Prior to Fermentation for Recovery of Valuable Co-Products. Fifth Corn Utilization and Technology Conference, Dallas Texas, June 2006. McAloon, Andrew, Modeling the Wet Milling Process. Fifth Corn Utilization and Technology Conference, Dallas Texas, June 2006 Burkdoll, S., Researcher shares ways to improve barley feasibility in ethanol production. The Prairie Star. Wednesday, July 5, 2006. [http://www.theprairiestar.com/articles/2006/07/05/ag\\_news/farm\\_and\\_field/farm12.txt](http://www.theprairiestar.com/articles/2006/07/05/ag_news/farm_and_field/farm12.txt)

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09  
No publications reported this period.

Item No. 48 of 59

ACCESSION NO: 0407996 SUBFILE: CRIS  
PROJ NO: 1935-41000-072-02T AGENCY: ARS 1935  
PROJ TYPE: USDA INHOUSE PROJ STATUS: NEW  
START: 01 MAY 2004 TERM: 30 APR 2007

INVESTIGATOR: TAYLOR F

PERFORMING INSTITUTION:  
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BIOMASS RESEARCH AND DEVELOPMENT FOR THE PRODUCTION OF FUELS, CHEMICALS,  
AND IMPROVED CATTLE FEED

OBJECTIVES: Lower the cost of fuel alcohol through innovative engineering process development.

APPROACH: Treat whole corn kernels with anhydrous ammonia in a special continuous reactor to improve processing and conversion of the grain to fuel ethanol and valuable coproducts.

PROGRESS: 2005/10 TO 2006/09

Progress Report 4d Progress report. This report serves to document research conducted under a CRADA between ARS and the Archer Daniels Midland Corporation. Additional details of research can be found in the report for the parent CRIS 1935-41000-072- OOT, "Biomass Research and Development for the Production of Fuels, Chemicals and Improved Cattle Feeds". The CRADA funding originally derived from a 2003 USDA-DOE Biomass R&D Grant that was co-written by ADM and ERRC. ADM was the submitting organization. The project builds on corn ammoniation and continuous fermentation and ethanol stripping technology that was developed under the parent CRIS. This technology will be combined with other new technologies to enhance the profitability of ethanol production by the dry grind process. Progress to date at ERRC includes: 1. Continuation of the research plan for ERRC that includes development of a continuous corn ammoniator, a new analytical method to measure ammonia levels in treated corn, new dry milling technologies for processing ammoniated and non-ammoniated corn for ethanol production, evaluating fermentability for ammoniated and non-ammoniated corn, developing more efficient fermentation processes, and conducting process and cost analysis to quantify the benefits (if any) for using ammoniation and new fermentation techniques in the corn to ethanol process. 2. Held regularly scheduled conference calls to coordinate research between two ADM locations and ERRC. Will hold quarterly meeting in fall of 2006 in Urbana-Champaign, Illinois. 3. Used the ERRC continuous ammoniator to produce 400 lb (7 bushel) and 800 lb (14 bushel) quantities of corn at two different ammoniation levels, 400 ppm and 800 ppm for evaluation of efficiency and consistency of treatment and fine-tuning its operation. 4. Updated the ARS 40 million gallon/year dry grind ethanol process and cost computer simulation model and provided this research tool to the ADM cooperators. Also provided models for dry pre-fractionation of corn, and for continuous fermentation with stripping, derived from the dry-grind base case. 5. Experiments were conducted and completed to show the effect of soaking in aqueous ammonia (SAA) on the digestibility of cellulose and hemicellulose in barley hulls. At optimum conditions, pretreatment by SAA resulted in 83% digestibility of cellulose, and 63% digestibility of xylan. 6. Developed a shake-flask method to evaluate the fermentation characteristics of ammoniated and non-ammoniated corn. The method permits an accurate determination of ethanol yield after 50 hours of fermentation time, while using only 50 g of corn mash for each flask.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09  
No publications reported this period.

Item No. 49 of 59

ACCESSION NO: 0200354 SUBFILE: CRIS

PROJ NO: SD00134-G AGENCY: CSREES SD.

PROJ TYPE: SPECIAL GRANT PROJ STATUS: EXTENDED

CONTRACT/GRANT/AGREEMENT NO: 2004-34474-15053 PROPOSAL NO: 2004-06070

START: 01 SEP 2004 TERM: 30 APR 2007 FY: 2006 GRANT YR: 2004

GRANT AMT: \$626,826

INVESTIGATOR: Kephart, K. D.

PERFORMING INSTITUTION:

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#### PLANNING THE SUN GRANT INITIATIVE

**NON-TECHNICAL SUMMARY:** The Sun Grant Initiative is a plan to implement land grant research, Extension, and teaching programs in renewable energy and biobased products. This project will focus on developing an administrative structure for the Sun Grant Initiative. The participating universities will organize planning conferences and summarize input to develop a planning report.

**OBJECTIVES:** The objective of this project will be to define priorities and conduct public education in regard to the Sun Grant Initiative. The mission of the Sun Grant Initiative will be to (1) to enhance national energy security through the development, distribution, and implementation of biobased energy technologies; (2) to promote diversification in, and the environmental sustainability of, agricultural production in the United States through biobased energy and product technologies; (3) to promote economic diversification in rural areas of the United States through biobased energy and product technologies; and (4) to enhance the efficiency of bioenergy and biomass research and development programs through improved coordination and collaboration between the Department of Agriculture, the Department of Energy, and the land-grant colleges and universities.

**APPROACH:** There are three primary goals of this planning period. The first is to activate land grant faculty for roadmapping and for analysis of other domestic and international efforts. Land grant faculty, administrators, and stakeholders will assess previous roadmapping efforts that have been conducted by various federal agencies, the Experiment Station Committee on Organization and Policy (ESCOMP), and others. The regional roadmapping committees will determine how activities supported by the Sun Grant Initiative complement these roadmaps and how the Sun Grant Initiative can initiate appropriate activities. Sun Grant Initiative centers will initiate national and regional policy analysis efforts. The policy topics will include: Assist USDA in certification of biobased products and Federal procurement (Economic diversification); Pick up feedstock development questions left unanswered by previous DOE effort (National energy security); Interaction with Federal price supports (Economic diversification); Determine the net positive and negative externalities, assign dollar values to energy security, climate impacts, offset of imported petroleum (Economic diversification and Sustainability); Assess the status of biobased technology development and implementation (Systems and collaboration). The second goal is to develop a broad educational program on the Sun Grant Initiative. The planning activities held during 2002 and 2003 brought widespread attention to the Sun Grant Initiative within the land grant community. A common conclusion from the regions was that outreach to stakeholders that are outside of the routine land-grant community is needed. Examples of these stakeholders groups are urban energy consumers, national and state decision makers, and the energy industry. The third goal is to activate regional Sun Grant advisory boards. During 2002, every region recognized the need to have multistate involvement in directing Sun Grant activities. These boards will provide guidance and feedback for roadmapping and public education efforts. Each of the five center institutions will be responsible for establishing their advisory boards. The

regions will conduct their own roadmapping efforts; however, there will also be an effort to coalesce these activities into a single vision. Public education activities will have a national component and regional components.

**PROGRESS: 2006/01 TO 2006/12**

The regional Sun Grant Centers continued to engage the Land-Grant Universities in their respective regions by providing update reports at various regional and national meetings which included the 2006 Pacific Rim Summit on Industrial Biotechnology and Bioenergy. Each has also developed and maintained a Regional Sun Grant web page. All of the centers' web pages can be accessed through a central portal at [www.sungrant.org](http://www.sungrant.org). The five Centers have kept in close communication via teleconferences and semi-annual meeting in Washington DC. The South Eastern and North Central regions collaborated with the US Department of Energy, US Department of Agriculture, and respective governor's associations to host regional biomass biofuel feedstock workshops. The overall goal of these workshops was to help resolve the potential contribution each region could make to provide the 1 billion ton supply of cellulosic material necessary to achieve the nation's 30 X 30 renewable fuels goal outline in President Bush's 2006 State of the Union Address. The outcomes of these workshops is available at <http://www.feedstockpartnership.biomass.govtools.us/>. The other three Sun Grant Regions are planning their respective biomass biofuel workshops for late summer/fall 2007.

**IMPACT: 2006/01 TO 2006/12**

The Sun Grant Initiative is linking Land Grant Institutions across the nation to develop teaching, research, and outreach programs in biofuels and bioproducts to help America decrease its dependency on imported petroleum.

**PUBLICATIONS (not previously reported): 2006/01 TO 2006/12**

No publications reported this period

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ACCESSION NO: 0194763 SUBFILE: CRIS  
 PROJ NO: SD00392-R AGENCY: CSREES SD.  
 PROJ TYPE: HATCH PROJ STATUS: NEW MULTISTATE PROJ NO: S-1007  
 START: 01 OCT 2002 TERM: 30 SEP 2007

INVESTIGATOR: Gibbons, W. R.; Julson, J. L.

PERFORMING INSTITUTION:  
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**THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY**

**NON-TECHNICAL SUMMARY:** Agriculture and many other facets of the U.S. economy are highly dependent on a low cost, abundant source of fossil fuels. This has placed our economy in a very vulnerable situation. This project will utilize the Land Grant University System to develop technologies that can "wean" us from use of fossil fuels. This will involve technology development, outreach to the private sector, and education/training of students to develop the manpower needed to implement this technology.

**OBJECTIVES:** 3. Develop, evaluate, and optimize integrated processes to convert biomass resources into biomaterials with commercial applications.

**APPROACH:** SD scientists will evaluate the mechanical properties (strength, elasticity, flexibility, etc) of microbial exopolysaccharides (gellan, scleroglucan, and polyhydroxyalkanoate) produced by fermentation of corn byproducts. SD scientists will also evaluate the use of C-4 warm season native grasses (big bluestem, switchgrass, etc) soybean hulls, and other natural fibers as reinforcing fiber sources for use in blended plastic composites.

**PROGRESS:** 2006/01 TO 2006/12

The 2006 annual meeting of S1007 was held in Minneapolis, MN (Sept). Kasi Muthukumarappan reported on research being conducted at SDSU to convert corn ethanol byproducts into valuable chemicals. We studied the effect of conventional extrusion processing parameters (temperatures of 25, 100 C and screw speeds of 200 and 400 rpm) on DDGS digestibility. Moisture content adjusted DDGS samples (15, 20, 25, 30, 40% wet basis) were extruded using a Twin-Screw conventional extruder with a barrel length to diameter ratio of 30:1 and compression ratio of 3:1. The amount of glucose in the extruded DDGS was measured by HPLC. We found no significant difference in the glucose recovery of DDGS when the moisture content was increased from 15 to 40% wb. However, we observed higher glucose recovery of DDGS samples when extruded at 200 rpm compared to 400 rpm, primarily due to higher reaction time at 200 rpm. Moreover, we were able to achieve about 33% glucose recovery when the fine ground DDGS were extruded compared to coarse ground (16%) DDGS. In general, we observed higher glucose recovery when the samples were extruded at 100 C compared to 25 C. Between single-screw extruder and twin-screw extruder studies we didn't observe any significant differences in glucose recovery of DDGS.

Research on production of citric acid from *Aspergillus niger* and fumaric acid from *Rhizopus oryzae* used untreated and acid-pretreated DDGS as substrates. Fungal strains were grown in shake flask cultures via solid-state fermentation at 25°C for 10 days. *A. niger* ATCC strains 9029, 9142, 10577, 11414, 12846, 26550 and 201122 were investigated for citric acid production. Strain ATCC 9142 produced the highest citric acid level (10.6 g/Kg) on untreated wet corn distillers' grains after 10 days of growth, while ATCC 11414 and ATCC 12846 produced slightly lower citric acid levels (7 g/Kg). We found that *R. oryzae* ATCC 20344 was capable of producing 3 g/Kg fumaric acid on the untreated or treated grains after 10 days of growth. Another research project aims to produce short chain length polyhydroxyalkanoates (scl-PHA) from cellulosic feedstocks. We determined that the best growth medium for *R. eutropha* consists of 240 g/l CCS, supplemented with nitrogen to a 50:1, carbon to nitrogen ratio, with continual pH adjustment. This resulted in a growth rate of 0.25h<sup>-1</sup> and a generation time of 2.77 h. Trials to evaluate how volatile fatty acids normally present in CCS (succinic, propionic, acetic, and lactic) were utilized by *R. eutropha* showed complete utilization. Even though it was present in the highest amount (1.5-2.5 g/L), lactic acid was utilized at the fastest rate (consumed by 12-18 h). Succinic acid was initially present at 0.7 g/L and was also consumed by 12-18 h. Acetic acid took slightly longer for complete metabolism (18-20 h), while propionic acid took up to 48-54 h for utilization. This data suggested the preference order for VFAs was lactic, succinic, acetic, and propionic.

**IMPACT:** 2006/01 TO 2006/12

Research to develop a biobased economy will require collaboration across disciplines and institutions. S1007 is a multi-institutional organization that is using a multidisciplinary approach to develop fuels, chemicals, and biomaterials from renewable resources.

**PUBLICATIONS** (not previously reported): 2006/01 TO 2006/12

1. Xie, G. and T. P. West. 2006. Citric acid production by *Aspergillus niger* on wet corn distillers grains. *Lett. Appl. Microbiol.* 43:269-273.
2. Xie, G. and T. P. West. 2006. Comparison of citric acid production by *Aspergillus niger* ATCC 9029 and ATCC 12846 on corn distillers grains with solubles. *Res. J. Microbiol.* 1:540-545.
3. West, T. P., and B. V. Reed. 2006. Effect of treatment of corn distillers grains with solubles on fungal fumaric acid production. Abstracts of the 2006 Society for Industrial Microbiology Annual Meeting, Abstract P76A, page 182.

**PROJECT CONTACT:**

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ACCESSION NO: 0212915 SUBFILE: CRIS  
PROJ NO: SD00H238-07IHG AGENCY: CSREES SD.  
PROJ TYPE: HATCH PROJ STATUS: PENDING NEW  
START: 01 OCT 2007 TERM: 30 SEP 2008

INVESTIGATOR: Rupp, S. P.; Jensen, K. C.; Boe, A.; VanDerSluis, E.

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DEVELOPING SUSTAINABLE HARVEST STRATEGIES FOR CELLULOSE-BASED BIOFUELS:  
THE EFFECT OF INTENSITY AND SEASON OF HARVEST ON WILDLIFE AND BIOMA

NON-TECHNICAL SUMMARY: Use of native grasses for biofuel production may negatively affect wildlife populations. Season and intensity of harvest need to be considered. This project examines how harvest intensity and timing affect both wildlife and biomass production. An full economic analysis will also be completed.

OBJECTIVES: In his 2006 State of the Union Address, President Bush espoused the goal of making cellulosic ethanol practical and competitive within six years. Government incentive programs, such as the Conservation Reserve Program (CRP), were initially established to diminish soil erosion and improve water quality on highly erodible lands, but have also been considered for use as cellulose-based biofuels. Because 23% of CRP is in the Northern Great Plains, even small, incremental reductions in wildlife benefits due to misdirected policies may have wide-ranging impacts on wildlife populations. As a result, developing appropriate harvesting strategies which consider maximizing both yield and wildlife use of bioenergy stands has been identified as a research priority if native warm-season perennial grasses are to significantly expand as energy crops. Therefore, the objectives of this research are to 1) determine which combination(s) of stubble height and season of harvest are most beneficial for maximizing biomass production/quality in mixed-grass native grasslands, 2) determine which combination(s) of stubble height and season of harvest are most beneficial for maximizing nesting success/diversity of economically important bird species in eastern South Dakota, and 3) provide an economic analysis of the trade-offs associated with various combinations of biomass and wildlife production based on results obtained.

APPROACH: A series of study sites on South Dakota Game Production Areas, Waterfowl Production Areas, and/or private lands in eastern South Dakota will be identified. Data will be analyzed either with (a) a two-factor factorial randomized complete block design, (b) a completely randomized design or a randomized block design with a split plot arrangement, or (c) a completely randomized design with a factorial arrangement of stubble height and season of growth, to determine the effects of treatment application on bird species diversity and nesting success of pheasants and waterfowl over 6 replicates. Harvest intensity will be assessed at 3 levels (10-cm stubble, 30-cm stubble, and a control) and season at two different times of the year (fall and spring) over the course of two years. Tiller density, biomass production, species composition, aerial partitioning of the biomass, and effect of aerial position on chemical composition of the biomass will be analyzed. Mineral, lignin, and carbohydrate analyses will be completed at South Dakota State University. Potential ethanol yield will be calculated using U.S. Department of Energy protocols. Study sites will be searched for pheasants and ducks by chain-dragging. Data recorded will include species, clutch size, age of clutch, dominant plant species, and vegetation height/density. Microclimate measurements will be taken. Hatching date will be estimated by using the egg flotation method for pheasants or candling for all other species. Nests will be revisited at least once per week to determine fate between 23 June and 24 July. A generalized linear mixed model with a binomial link function will be used to analyze nest success. Diversity will be measured using Simpsons and

Shannon-Weiner indices. Yield and quality data will be analyzed using a mixed model analysis of variance. Variance assumptions will be tested using a Mauchly or Hartley test. If sphericity is violated, a univariate F-statistic with the Greenhouse and Geisser adjustment will be used. Pairwise comparisons will be performed with an LSD test using error terms specific to each contrast. Nest success data will be analyzed using Program MARK and compared among treatments utilizing Program CONTRAST. An analysis of the economic trade-offs associated with various intensities and timing of biomass harvest and utilization will be conducted. Besides analyzing the benefits associated with alternative biomass harvesting regimes and the costs of producing, collecting, storing, and transporting the biomass to energy production facilities, the economic analysis also includes providing estimates of the costs involved with foregone revenues due to the production and presence of wildlife. Additional elements included in the total economic costs involved with biomass harvest include estimating soil productivity losses due to nutrient and organic matter losses and as a result of soil compaction. The framework and projections of this research will provide a basis for policy makers to develop appropriate policies related to energy production from biomass.

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ACCESSION NO: 0197017 SUBFILE: CRIS  
 PROJ NO: TEN02003-02985 AGENCY: CSREES TEN  
 PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: TERMINATED  
 CONTRACT/GRANT/AGREEMENT NO: 2003-35400-13860 PROPOSAL NO: 2003-02985  
 START: 15 AUG 2003 TERM: 31 AUG 2006 FY: 2006 GRANT YR: 2003  
 GRANT AMT: \$136,000

INVESTIGATOR: English, B. C.; De La Torre Ugarte, D. G.

PERFORMING INSTITUTION:  
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**ECONOMIC IMPACTS FROM INCREASED COMPETING DEMANDS FOR AGRICULTURAL FEEDSTOCKS TO PRODUCE BIOENERGY & BIOPRODUCTS**

**NON-TECHNICAL SUMMARY:** We propose to develop expansion curves for the growth of the bioenergy and bioproducts industries by estimating a national bioenergy and bioproducts demand for agricultural feedstock, the agricultural resources demanded and the price and income impacts on the agricultural sector.

**OBJECTIVES:** The overall objective of this proposed project is to develop a national bioenergy and bioproduct expansion curve. As bioenergy and bioproduct production increases, demand for, and price of agricultural products will increase. This analysis will quantify these expected increases considering various demand quantities of bioenergy and bioproducts.

**APPROACH:** Develop national ethanol, biodiesel, electricity, and bioproduct demand quantities and incorporate them into a dynamic agricultural sector model (POLYSYS). Estimate regional feedstock supply curves necessary to meet national bioenergy and bioproduct demand quantities by modifying a dynamic agricultural sector model (POLYSYS) to include cellulose feedstock in addition to existing agricultural grain and oilseed crops. Develop regional bioenergy and bioproduct supply curves using regional feedstock supply curves, representative transportation costs, and representative technical and economic cost estimates for each feedstock-technology-product combination considered. Construct a national expansion curve for the bioenergy and bioproduct industry. Evaluate key indicators of agricultural sector performance including

net farm income, agricultural prices, government cost, etc. in meeting national bioenergy and bioproduct demand quantities.

**PROGRESS: 2003/08 TO 2006/08**

Supply and demand for bioenergy and bioproducts have been estimated. Expansion curves reflect growth of bioenergy and bioproduct industries. The impact that the growth of these industries has on the agricultural sector has been estimated including price, income, and government payment impacts. Feedstocks included in the expansion path are crop residues (corn stover and wheat straw), traditional crops (corn and soybeans), and dedicated crops such as switchgrass. Each of these feedstocks can be converted to bioenergy, bioproducts, or both. These feedstocks compete for land and other resources based on net returns. As resources become limited, price of feedstock increases. End product demands modeled include transportation fuels, ethanol and biodiesel, and electricity as well as bioproduct building blocks of Lactic, Levulinic, and Succinic Acids, and 1,3-Propanediol. According to the model, demand for biopower increases from 88 bil kwh in 2005 to 160 bil kwh in 2014. Projected demand for ethanol increases from 2.3 bil gal in 2005 to 18.4 bil gal in 2014 and demand for biodiesel increases from .2 to .6 bil gal in 2005 and 2014, respectively. Demands for biochemicals are also placed on the system. While demand from Levulinic (175 mil lbs.) and succinic (33 mil lbs.) acid do not change over time, demand for Lactic acid increases from 400 to 1700 mil lbs. and demands for 1,3 Propanediol increase from .2 to 320 mil lbs. over the 2005 to 2014 period. Little change occurs in agricultural sector commodity prices through 2010. However, as demands build, and conversion of pasture and hay opportunities become limited, prices increase. In 2010, corn prices increase from \$2.45/bu to \$3.40, and soybeans increase from \$5.55/bu to \$6.37. Other nonfeedstock prices also increase. Wheat goes from \$3.40/bu to \$3.81. Cotton and rice prices increase in 2010 only \$0.02/lb and \$0.77/cwt, respectively. By 2014, price gains would be very significant. Corn rose from a baseline of \$2.45/bu to \$4.16, and soybeans increased from \$5.70/bu to \$6.84. Wheat went from \$3.60/bu to \$4.04. Cost of cellulosic feedstock also increases. Starting at \$31/dry ton, price of biomass jumps to \$50/ton in 2014. Electricity and ethanol are the largest potential users of biological feedstocks. Simulation of potential bioproduct demands showed that a biomass price of \$30/dry ton (dt) could fill all cellulosic demands until 2011. Ethanol demand, in excess of what could be provided by \$30/dt biomass, can be met by use of corn grain as a feedstock at a total cost less than biomass until 2011. In 2011, stresses upon the corn grain sector raise corn price so that biomass becomes competitive in ethanol production. Beyond 2011, supply stresses push biomass prices up to \$49.34/dt and corn grain price up to \$4.16 by 2014. Nationally, pasture conversion allows 13.6 mil ac of additional land to come into production. MO, KY, and TN can gain more than 250,000 ac, with a majority of them being converted to switchgrass. By 2014, biofuels, biopower, and bioproduct demand increases total net farm income from \$54.5 bil to \$72.1 bil, a gain of \$17.7 bil to the agricultural sector.

**IMPACT: 2003/08 TO 2006/08**

The project provides insight into the regional and national viability and impacts of different feedstock choices in an increasingly larger bio-based industry, and provides key information needed in the decision making process to meet research and commercialization goals. The project showed that crop residue collection can be quickly increased to fill biomass demand in the initial years while switchgrass production matures. As switchgrass matures, residue collection falls until stresses upon corn grain demand necessitate increased collection. The use of all three bioproduct feedstock sources (biomass, residues, and corn grain) allows the market to smoothly adjust to the rapid increase in demand. Without the use of all three, the ability of the agricultural sector to meet bio-product demands would be severely stressed. The conversion of lands currently in pasture into cropland also increases feedstock quantities.

**PUBLICATIONS (not previously reported): 2003/08 TO 2006/08**

No publications reported this period

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ACCESSION NO: 0211192 SUBFILE: CRIS  
PROJ NO: TEX09131 AGENCY: CSREES TEX  
PROJ TYPE: HATCH PROJ STATUS: NEW  
START: 25 JUN 2007 TERM: 24 MAY 2012

INVESTIGATOR: Capareda, S. C.

PERFORMING INSTITUTION:  
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TEXAS A&M UNIV  
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#### ADVANCED BIO-ENERGY AND ENVIRONMENTAL QUALITY RESEARCH FOR SUSTAINABLE AGRICULTURE

**NON-TECHNICAL SUMMARY:** The goal of this research work is to focus on researchable aspects of bio-fuels that have the potential to play a larger role in the future economy of the US. The leading bio-fuel candidate in the US today is ethanol. The current US ethanol production is 4.8 billion gallons in year 2006 (RFA, 2006). Biodiesel is the second most popular bio-fuel whose current production is estimated at 75 million gallons per year (Urbanchuk, 2006). Cellulosic bio-fuels are of particular importance primarily because the feedstock is not used as food and fiber. However, bio-fuel production via cellulosic feedstock has a number of researchable gaps that need to be addressed very quickly in addition to identifying high cellulosic biomass candidates. Sorghum biomass is a promising biomass resource due to its having high yielding characteristics coupled with lower water requirements compared to corn (McCutchen, 2006). The research studies outlined in this proposal will build on a solid science-based approach in all aspects of bio-fuels production and environmental quality to address the needs of bio-refineries in the future. This project will evaluate effective ethanol and biodiesel production studies and improved gasification research using numerous biomass feedstocks. In addition, all environmental aspects associated with the establishment of biorefineries will be investigated.

**OBJECTIVES:** The following objectives outline an overarching research framework in which laboratory and pilot experiments will be planned to address interrelated key questions in energy and air quality. In the context of understanding energy and air quality interactions, research activities will address the following objectives: a. To investigate optimal ethanol production process from wood sugar, highly digestible sorghum strain, sweet sorghum, and sorghum biomass; b. To study engine emissions of biodiesel blends and emerging bio-fuels such as ethanol, synthesis gas and synthetic petroleum; c. To investigate the slagging and fouling problems of selected biomass (cotton gin trash, animal manure and sorghum biomass) through advanced gasification/pyrolysis systems; and d. To evaluate environmental issues associated with the production and use of emerging bio-fuels.

**APPROACH:** Objective 1. Optimal Ethanol Production Systems from Highly Digestible Grain Sorghum (HDGS), Wood Sugar (Temulose) and other Sorghum Feedstock. This study will investigate the production of ethanol from various biomass resources most abundant in the state of Texas that are potential candidates for high volume production. Objective 2. Engine Emissions Testing of Biofuels (Biodiesel and Blends, Ethanol and Producer Gas). This study will investigate the various barriers to improved production and how to reduce production costs. For every new oil feedstock that will be converted into biodiesel, an understanding of the unique properties of the oil needs to be investigated. This will ensure that gummy, wax formation, phosphates accumulation, rancidity, discoloration, among others are not encountered. Pre-treatment and other removal processes have to be developed for each new oil feedstock. Two potential areas of research include: enzymatic biodiesel production and solid state processes. Objective 3. Slagging and Fouling Problems of Biomass Through Thermal Conversion Systems. Bio-fuels can be readily produced from any biomass resource through thermal conversion processes. The high ash content of biomass makes it unsuitable for combustion system. Only gasification processes would work for high ash biomass. Possible processes include pyrolysis (absence of oxidant) and gasification (deficient O<sub>2</sub>). TAMU has developed and patented a fluidized bed gasifier that is capable of producing synthesis gas (CO and H<sub>2</sub>) that could be readily reformed to synthetic fuels such as gasoline, diesel, or aviation fuel (Parnell and LePori, 1988). Objective 4. Environmental Issues Associated with the Production and Use of Biofuels. This

study involves the evaluation of all environmental and air quality issues associated with the production and use of bio-fuels.

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Item No. 54 of 59

ACCESSION NO: 0205429 SUBFILE: CRIS  
 PROJ NO: VA-135747 AGENCY: CSREES VA.  
 PROJ TYPE: HATCH PROJ STATUS: NEW  
 START: 01 OCT 2005 TERM: 30 SEP 2010 FY: 2006

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**BIOFUELS PRODUCTION FROM COTTON GIN WASTE AND RECYCLED PAPER SLUDGE**

**NON-TECHNICAL SUMMARY:** Renewable energy sources can provide the United States with a stable reliable domestic energy supply, contribute very little, if any, net carbon dioxide into the atmosphere, reduce the demand for fossil fuels and hence reduction in NO<sub>x</sub>, SO<sub>x</sub>, carbon monoxide, and hydrocarbon emissions into the atmosphere. It can revitalize rural agricultural economies and thus create new jobs. USDA estimated that a 100 million gallon bioethanol plant could create 2,250 local jobs (temporary and/or permanent) in the United States. Cotton gin waste (CGW) is an agro-industrial residue, which could be potentially used for ethanol production. Unlike other lignocellulosic feedstocks, this material is concentrated at the processing sites and therefore harvesting and transportation costs could be considerably less than those for agricultural and forestry residues and dedicated biomass feedstocks. Recycled paper sludge is a short fiber cellulosic feedstock, which could also be potentially used for ethanol production. Similar to the CGW, this material is concentrated at processing sites and therefore transportation cost could be considerably reduced. By combining these feedstocks, ethanol in high yields can be produced for fuel applications and waste disposal problems in these industries can be solved simultaneously. The purpose of this project is to develop an in situ detoxification process for the bioconversion of cotton gin waste and recycled paper sludge mixtures into ethanol in high yields.

**OBJECTIVES:** Our previous studies on cotton gin waste showed that we could produce ethanol at very good yields at one-liter scale level if the pretreated material is properly detoxified. However, the process was not been demonstrated for the cotton gin waste/recycled paper sludge combination. The overall goal of this project is to develop an in situ detoxification process for the bioconversion of cotton gin waste and recycled paper sludge mixtures into ethanol using steam explosion, enzyme hydrolysis, and fermentation technologies. The process has the potential of solving a waste disposal problem while simultaneously generating a new product stream for the cotton and paper and pulp industries. The specific objectives of this project are: 1. Collect and fractionate cotton gin waste from cotton gins in five states to access the impact of harvesting method on the quality of the feedstock. 2. Characterize recycled paper sludge and cotton gin waste from various states to assess impact of ginning on feedstock composition. 3. Investigate the in situ detoxification of cotton gin waste/recycled paper sludge during steam explosion pretreatment. 4. Investigate the bioconversion of steam exploded cotton gin waste/recycled paper sludge mixture to ethanol. 5. Analyze biomass-to-ethanol fermentation residue to assess the nature of the unhydrolyzed residual cellulose. This technology could be applied to other biomass feedstocks and thus eliminate the extra processing step required for the bioconversion of biomass to fuels and chemicals. This will obviously improve the biomass-to-ethanol process economics. The conversion of RPS and CGW to fuel ethanol has

other potential advantages. It will solve waste disposal problem in two industries, it will create new jobs in rural America and further it will stimulate both paper recycling and increase processing of cotton. Increased processing of cotton will of course impact USA agriculture, which is one of the goals of the Hatch Program. The processing of cotton gin waste and recycled paper sludge to ethanol will reduce greenhouse gas emission, and replace petroleum products. It cannot be overemphasized that this proposal fits the objectives of this program because it will assist in implementing new ethanol production capacity and it has a potential for near-term applicability and replication in Southern United States.

**APPROACH:** Objective 1. Collect and fractionate cotton gin waste from cotton gins in five states to access the impact of harvesting method on the quality of the feedstock. a) Collection of cotton gin waste. Cotton gin waste samples will be collected from five cotton gins in Virginia, Mississippi, Texas, Georgia, and North Carolina, and the RPS will be collected from the International Paper recycling facility in Franklin, Virginia. Samples will be collected every year for three years during the project. b) Fractionation of cotton gin waste. About 1 kg dry CGW samples from the five gins will be shipped to the USDA-ARS Cotton Ginning Laboratory, (Stoneville, MS) to be fractionated into clean lint, hulls, sticks/stems, grass, seeds, small leaf, and pin trash. Additionally, some cotton gin waste fractions will be generated from the pilot scale ginning machine for the studies. Objective 2. Characterize recycled paper sludge and cotton gin waste from various states to assess impact of ginning on feedstock composition. The CGW, RPS, and CGW/RPS samples will be analyzed for their summative composition (cellulose, lignin, hemicellulose, ash, and extractives) using ASTM standard methodologies. In addition, the RPS will also be analyzed for elemental composition. Objective 3. In situ detoxification of cotton gin waste/recycled paper sludge during steam explosion pretreatment. a) Steam explosion of cotton gin waste and recycled paper sludge. We will steam explode CGW and RPS mixtures at various CGW to RPS ratios, moisture contents, and severity parameters in the batch steam explosion unit. The CGW and RPS will be steam exploded as received without any milling or presoaking. b) Enzyme hydrolysis of steam exploded material. Steam exploded CGW and RPS will be hydrolyzed independently to determine their hydrolysis rates and their fermentable sugar yields. The hydrolysis will be carried out for 72 h at 50 deg. C using commercial cellulase enzyme preparation such as Spezyme CP. We will investigate various CGW/RPS ratios and the influence of potential heavy metal content of the RPS on the sugar yield. Objective 4. Investigate the bioconversion of steam exploded cotton gin waste/recycled paper sludge mixture to ethanol. a) Fermentation of hydrolysates. We will use both *Saccharomyces cerevisiae*, and *E. coli* KO11 for the fermentation. We will investigate the effect of the following parameters on ethanol yield: severity of steam explosion, CGW/RPS ratio, degree of enzyme hydrolysis, composition of CGW, feedstock source, temperature, pH and additives content of RPS. b) Optimization of in situ detoxification process. Factorial designs and response surface methodology will be used to determine the best operating parameters for in situ detoxification and ethanol production. c) Scale-up of process to 1-liter scale. We will scale-up the process from shaker flask level to one-liter scale after the optimization of the process parameters.

**PROGRESS: 2005/10 TO 2006/09**

We have investigated steam explosion pretreatment of mixtures of cotton gin waste and recycled paper sludge for bioethanol production. The cotton gin waste was obtained from Emporia, VA, whereas the recycled paper sludge was obtained from Weyerhaeuser recycling paper mills in Cedar Rapids, IA and Marlboro, SC. We investigated the insitu detoxification of the cotton gin waste samples. In this process, no overliming of the steam exploded material is necessary before hydrolysis and fermentation to ethanol. The mixtures of cotton gin waste to recycled paper sludge in the ratios of 1:1, up to 4:1 were steam exploded at a severity of 3.8. We investigated enzyme hydrolysis of the steam exploded materials using proprietary enzymes from Novozymes Inc, and Genecor Int. Because of the insitu detoxification process, the steam exploded materials were not overlimed before the detoxification. We successfully hydrolyzed 90 percent of reducing sugars in the steam exploded material into monomeric sugars. These results showed a proof of concept that it is not necessary to overlime the samples if the insitu detoxification method is used. The steam explosion process was scale-up to 1000 kg/h and the recycled paper sludge and cotton gin waste were processed on that scale. Our results show that we could scaleup the process successfully.

**IMPACT: 2005/10 TO 2006/09**

Southside Virginia cotton industry is experiencing waste disposal problems because of potential particulate emissions if the cotton gin waste is combusted. The conversion of the cotton gin waste to bioethanol will simultaneously solve the waste disposal problem and generate new product streams for both industries. Thus, we expect this project to create new jobs in the area when completed. Furthermore, Xethanol Inc,

which has acquired rights to the process, plans to build small footprint plants in Southside Virginia and thus provide new jobs in rural Virginia.

PUBLICATIONS (not previously reported): 2005/10 TO 2006/09  
No publications reported this period

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ACCESSION NO: 0210227 SUBFILE: CRIS  
PROJ NO: VAK-2007-00181 AGENCY: CSREES VA.K  
PROJ TYPE: SMALL BUSINESS GRANT PROJ STATUS: NEW  
CONTRACT/GRANT/AGREEMENT NO: 2007-33610-18017 PROPOSAL NO: 2007-00181  
START: 01 JUN 2007 TERM: 31 JAN 2008 GRANT YR: 2007  
GRANT AMT: \$80,000

INVESTIGATOR: Blaylock, M. J.

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PLANT EXPRESSION OF CELLULASE FOR BIOMASS ETHANOL PRODUCTION

NON-TECHNICAL SUMMARY: Cellulosic ethanol production has the potential to provide a renewable, clean source of automobile fuel. Current production costs (including the costs of required enzymes) are prohibitively expensive. This project seeks to provide a significant cost savings for cellulosic ethanol production by incorporating the ability to produce stable enzymes in the plant tissue of select Energy Crops.

OBJECTIVES: Edenspace Systems Corporation seeks to achieve a substantial decrease in the production costs of cellulosic ethanol biofuel by engineering a promising biofuel crop, switchgrass (*Panicum virgatum* L.), with up to three different genes that produce cellulases. When activated by heat, these enzymes break down biomass cellulose into simple sugars that can serve as biofuel feedstocks. Microbially-produced cellulases currently used to produce ethanol from corn and other biomass cost more than \$0.45 per gallon of ethanol produced. With successful completion of this project to produce the cellulases in switchgrass biomass, this cost can be drastically reduced to the current goal of \$0.10 per gallon or perhaps eliminated, with further cost savings from simplified ethanol production operations. Switchgrass, a versatile, perennial, high-biomass grass, provides significant environmental benefits with respect to maintaining soil quality and sequestering carbon while providing feedstocks for biomass based fuels. In Phase I, an existing accession of switchgrass transformed with the *Acidothermus cellulolyticus* E1 endoglucanase gene will be tested for biomass production and composition, cellulase activity, and enzymatic stability with respect to ethanol production from plant biomass. Switchgrass will be engineered with additional cellulase genes for testing in Phase II. Successful completion of this project will provide substantial cost benefits for the production of ethanol and other biomass feedstocks. In addition, growing enhanced switchgrass for biofuels could provide new income potential for farmers, particularly those participating in the Conservation Reserve Program.

APPROACH: The Phase I study has three major objectives: 1. Demonstrate that E1 switchgrass shows comparable growth and biomass characteristics to nontransformed switchgrass. 2. Show that cellulase activity and conversion of cellulose to fermentable sugars in E1 switchgrass biomass takes place at rates comparable to levels obtained in nontransformed switchgrass using external cellulases. 3. Prepare and

constructs for additional cellulases (hemicellulase, and exoglucanase) and begin switchgrass transformation for testing in Phase II. This project will utilize transgenic E1 switchgrass lines being developed under a CRADA between Edenspace and the USDA-ARS Western Regional Research Center (WRRL) in Albany, CA. Over an 8-month demonstration period, the team will seek to achieve the SBIR objectives by completing the following tasks: Task 1.0. Demonstrate that E1 switchgrass shows comparable growth and biomass characteristics to nontransformed switchgrass. The growth characteristics and biomass yield of transformed switchgrass (T0) will be compared with existing high biomass lines (i.e. Alamo). Seeds of transformed and Alamo switchgrass will be planted in commercial potting mix (e.g., Promix) in the growth chamber using twelve replicates of each genotype. Leaf tissue samples from each plant genotype will be collected at four week intervals beginning one month after emergence. The tissue samples will be analyzed for cellulose, hemicellulose and lignin content to assess differences in composition. Soluble sugars in the plant tissue will also be analyzed at monthly intervals. Task 2.0. Show that cellulase activity and conversion of cellulose to fermentable sugars in E1 switchgrass biomass takes place at rates comparable to levels obtained in nontransformed switchgrass using external cellulases. The T0 generations (i.e., those plants formed through the transformation procedure) of transformed switchgrass generated by WRRL will be grown for six months in the growth chamber at Edenspace using a 16:8 hour light:dark regime. Seeds will be planted in containers with 1 kg of a silt loam soil limed to pH 6 or above and fertilized according to soil fertility recommendations to provide a minimum of 50 mg/kg of N, P and K. The growth will be monitored and documented through weekly digital images. Cellulase activity will be evaluated in those lines through several methods: 1. Analysis of purified extracts. 2. Cellulose hydrolysis in biomass after pretreatment to remove hemicellulose and lignin. 3. Enzymatic Stability. Task 3 Prepare constructs for additional cellulases (hemicellulase and exoglucanase) and begin switchgrass transformations for testing in Phase II. Gene constructs for additional glycoside hydrolases with reported endo, exo, and hemicellulase activities will be synthesized for use in plant transformations. Stable switchgrass calli will be generated and propagated and used for transformation.

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ACCESSION NO: 0194359 SUBFILE: CRIS  
 PROJ NO: WVA00428 AGENCY: CSREES WVA  
 PROJ TYPE: HATCH PROJ STATUS: TERMINATED MULTISTATE PROJ NO: S-1007  
 START: 01 OCT 2002 TERM: 30 SEP 2007 FY: 2005

INVESTIGATOR: Russell, R. W.

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**THE SCIENCE AND ENGINEERING FOR A BIOBASED INDUSTRY AND ECONOMY**

**NON-TECHNICAL SUMMARY:** The availability of quantities of oil necessary to power our economy is becoming less certain. We are challenged with harnessing solar energy in quantities to meet our food and fuel needs of the present and future. The purpose of the project is to organize the expertise and activities of the land-grant university system to form the science and engineering base necessary for developing a biobased economy and associated biobased industries.

**OBJECTIVES:** Objective 2. Expand the scientific knowledge leading to significant economic improvements in biofuel production processes.

**APPROACH:** Development of improved thermochemical processes for biofuel production. Three basic thermochemical conversion approaches to be evaluated include direct combustion (CA, NE), gasification (CA, OK, NE), and direct conversion to liquid fuel (WV). Problems of fouling, slagging, and boiler efficiency associated with co-firing biomass with coal will be studied (CA). A close-coupled fluidized bed biomass gasification and direct combustion system will be investigated for reduction of NO<sub>x</sub> emissions through reburning (CA). Other gasification studies will optimize production of syngas for use as a substrate for fermentation to fuel alcohol (OK). The reaction of biomass with water under conditions of high temperature and high pressure will be optimized with respect to reaction time, temperature, and water content for different types of biomass.

**PROGRESS:** 2002/10 TO 2007/09

This project has demonstrated the process of using heat and pressure for effective conversion of agriculture and forestry biomass/waste to a diesel fuel additive at the experimental level. Demonstrations through the national Farm Bureau organization have been conducted to demonstrate that the end product of this conversion process can successfully run a diesel generator. The patent disclosure has been filed for the process. This project has supported the faculty structure within the University to garner effective input from the College of Engineering with the collaboration of two faculty members. The Davis College has been a participant in the regional project for the development of alternative fuel systems.

**IMPACT:** 2002/10 TO 2007/09

The purpose of the project is to organize the expertise and activities of the land-grant university system to form the science and engineering base necessary for developing a biobased economy and associated biobased industries.

**PUBLICATIONS** (not previously reported): 2002/10 TO 2007/09

No publications reported this period

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ACCESSION NO: 0212875 SUBFILE: CRIS  
PROJ NO: WIS01302 AGENCY: SAES WIS  
PROJ TYPE: STATE PROJ STATUS: NEW  
START: 01 OCT 2007 TERM: 30 SEP 2012

**INVESTIGATOR:** Donohue, T.

**PERFORMING INSTITUTION:**

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**BIOENERGY RESEARCH**

**NON-TECHNICAL SUMMARY:** The potential for biofuels to address a looming energy crisis is significant, yet their contribution to the US energy portfolio is small. A major reason for their relatively small contribution is that various factors limit transformation of sunlight or plant biomass into biofuels. To apply the full power of contemporary science to this looming crisis, we will create the Great Lakes Bioenergy Research Center (GLBRC). The GLBRC will conduct basic, genomics-based research to design the microbial and plant systems needed to realize the potential of biofuels.

**OBJECTIVES:** To increase the contribution of biofuels to the US energy portfolio, the Great Lakes Bioenergy Research Center (GLBRC) will conduct fundamental, genomics-based research to remove bottlenecks in the biofuel pipeline. The Principal Investigator and Scientific Director of the GLBRC will be Professor Timothy Donohue. The GLBRC will be housed at the University of Wisconsin-Madison, with Michigan State University as a major partner. Additional scientific partners will be based at DOE National Laboratories (Pacific Northwest and Oak Ridge National Labs), other universities (University of Florida, Illinois State University, Iowa State University), and biotechnology companies (Lucigen Corporation). To function as a worldwide center of excellence, the GLBRC will develop programs that bring bioenergy breakthroughs and technology to stakeholders, including other centers with complementary missions, both here and abroad; academic and research hubs; regional, national or international members of the agricultural and private sector; educators in the scientific, business, or academic community; and the general population.

**APPROACH:** To achieve its vision, the GLBRC will develop a set of vertically integrated research programs aimed at removing existing bottlenecks in the bioenergy pipeline, developing economically- and environmentally-sustainable bioenergy practices, and educating society scientists and biomass producers or consumers about bioenergy issues. To support its programs, the GLBRC will assemble an interactive management team that has regular feedback from a scientific advisory board, pilot plant partners, and a collaborative network to align GLBRC products with our needs for energy, thereby increasing the contribution of biofuels to the US energy portfolio. To accomplish its short-, intermediate-, and long-term goals, the GLBRC will have the following major research thrusts: (1) Improve the characteristics of biomass plants. Difficulties in using biomass for bioenergy production include degradation of the major plant cell wall constituents (cellulose, hemicellulose, and lignin) and the inability of many plants to store carbon in energy-rich hydrocarbons. Long-term goals of the GLBRC for improving plant biomass are to increase the yields of easily degraded polysaccharides within cell walls and to increase the yields of hydrocarbons in biomass tissues. (2) Improve the processing of plant biomass. Processing of plant biomass to sugars is a major problem in economical production of cellulosic ethanol or other bioenergy products. To remove this bottleneck, new treatments are needed for processing the feedstocks (corn stover, switchgrass, or wood chips) envisioned for the bioenergy pipeline. In this area, the long-term goal of the GLBRC will be to develop new physical and biological ways to process existing and improved plant biomass. (3) Improve how we convert biomass into energy products. To accomplish this, the GLBRC will overcome difficulties encountered during conversion of plant-derived chemicals to bioenergy compounds. The long-term biomass conversion goals of the GLBRC are to improve methods for conversion of cellulosic biomass into ethanol and to develop novel biological or chemical ways to convert plant material into H<sub>2</sub>, electricity, or other chemical feedstocks that can replace fossil fuels. (4) Evaluate the economic and environmental sustainability of the biomass to biofuel pipeline. For a bioenergy economy to positively impact the US energy sector, we must address complex issues in agricultural, industrial, and behavioral systems. Another long term goal of the GLBRC is to develop economically viable and environmentally responsive practices for the biomass-to-bioenergy pipeline. (5) Integrate enabling technologies into bioenergy research. To achieve its short- and long-term goals, the GLBRC will deploy high-throughput technologies; integrate information from computational, physical, and genomic approaches; and develop predictive models for relevant enzymes, pathways, or networks. Success of the GLBRC will hinge on having biological, physical and computational approaches to enable biomass production, processing, conversion, and sustainability.

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ACCESSION NO: 0189207 SUBFILE: CRIS

PROJ NO: WIS04517 AGENCY: CSREES WIS

PROJ TYPE: NRI COMPETITIVE GRANT PROJ STATUS: TERMINATED

CONTRACT/GRANT/AGREEMENT NO: 2001-35504-10695 PROPOSAL NO: 2001-01418

START: 15 SEP 2001 TERM: 30 SEP 2004 FY: 2004 GRANT YR: 2001

GRANT AMT: \$200,000

INVESTIGATOR: Jeffries, T. W.

PERFORMING INSTITUTION:  
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MADISON, WISCONSIN 53706

#### QUANTITATIVE ANALYSIS OF GENE EXPRESSION DURING XYLOSE FERMENTATION BY YEASTS

**NON-TECHNICAL SUMMARY:** Agricultural residues could be used to produce renewable fuels and chemicals if ways can be found to efficiently ferment the hemicellulosic sugars. The resulting fermentation industry would create new income sources and provide rural jobs while reducing global change. This project will elucidate the regulatory patterns and genes necessary for efficient fermentation of xylose by yeasts. It will use contemporary techniques to track and quantify the large-scale expression of genes in yeasts.

**OBJECTIVES:** The overall goal of this research is to understand the principal genes and physiological conditions that govern metabolism of xylose in yeasts so we can manipulate their expression to enhance ethanol production from lignocellulosic residues. Ultimately this research will be used to establish an agro-based industry for the production of clean burning renewable fuels from agricultural residues. Implementation of this technology will enable a sustainable economic environment for rural communities while helping to stem global warming. Objectives supporting this goal are the identification of genes essential for xylose metabolism, understanding their patterns of induction and integrating that information into a model that will enable us to interpret the overall flow of metabolites. This research addresses two basic questions: First, how does one maintain and maximize a flow of metabolites (a metabolic flux) from xylose to ethanol under respiro-fermentative conditions in *P. stipitis*? Second, how would one go about altering the flow of metabolites in central pathways of other organisms? This research is relevant to general metabolic engineering in eukarya and more specifically to the enhancement of xylose fermentations for value added products from agricultural residues.

**APPROACH:** We will transform *S. cerevisiae* with genes for xylose metabolism and cultivate the cells on glucose and xylose to determine which sets of genes are induced on xylose. The patterns of expression (or lack thereof) should indicate which regulatory cascades are essential for fermentation. Large data sets already exist that describe induction patterns for *S. cerevisiae* cultivated under aerobic and oxygen limited or fermentative conditions, and the regulatory proteins controlling these patterns are under active investigation. These prior and contemporaneous studies will serve as reference standards for induction (or lack thereof) for cells cultivated on D-xylose. Depending on the results from the initial carbon source studies, we might also examine the effect of aeration levels on mRNA induction in cells transformed with the xylose assimilation genes. The gene chip experiments should identify sets of enzymes that are regulated in response to oxygen, xylose and the presence or over expression of xylose metabolizing genes in the *Saccharomyces* genome. These direct studies will not, however, reveal what additional proteins are necessary for high fermentation levels, so we must examine *P. stipitis* as well. We do not have a complete sequence of the *P. stipitis* genome, and the gene sequences that we do have for *P. stipitis* show that it has diverged far enough from *S. cerevisiae* such that cross hybridization with a *S. cerevisiae* gene chip would not render productive data. Therefore, it is essential to use sequential analysis of gene expression (SAGE) technology to identify the relevant genes in this organism. There is a strong correlation between the levels of mRNA detected by SAGE and gene chip technologies, so the results obtained by these two approaches should be comparable. In the case of *P. stipitis*, we will compare mRNA expression levels of wild-type cells grown on glucose and xylose under fully aerobic and oxygen limited conditions. This will tell us which enzymes are essential for xylose metabolism and fermentation in this organism. We will then perform comparative analyses of control cells and mutants that have site-specific deletions of alcohol dehydrogenase (*PsADH1* and *PsADH2*), which blocks ethanol formation, and cytochrome *c* (*PsCYC1*), which blocks cytochrome respiration. These analyses should indicate the adaptive response that the cells take to blockages in their fermentation and respiration pathways, respectively. We will cultivate parental and *adh1* cells on xylose under identical continuous oxygen limiting conditions, harvest the cells, recover the mRNA, convert the pools into SAGE libraries then compare the homeostatic adaptation of cells at the



mRNA level to this targeted disruption. Incomplete fermentation of xylose to ethanol should reduce the internal ATP charge. The SAGE analysis should show us whether any other proteins are induced along with PsADH2.

**PROGRESS: 2001/09 TO 2004/09**

The overall objective of this research has been to understand how intermediary metabolism is regulated. We will apply this knowledge to increase the fermentation of xylose by engineered yeasts. This research has shown that *Saccharomyces cerevisiae* engineered for xylose metabolism through the overexpression of three genes, XYL1, XYL2 and XYL3, requires further genetic manipulation for efficient xylose fermentation. First, the overexpression of XYL3 inhibits the growth of some strains of *S. cerevisiae* when the transformed cells are cultivated on xylose. However, several mutational events can occur spontaneously in *S. cerevisiae* to relieve that inhibition. Moreover, the extent of inhibition depends on the strength of the promoter used for XYL3, the number of copies present in the cell and the carbon source used for growth. Because of these numerous variables, and the fact that inhibition resistant mutants arise spontaneously with high frequency, the literature on this subject is somewhat contradictory. Our research used two approaches to identify the mutational events. We transformed *S. cerevisiae* with a cassette that overexpressed XYL1, XYL2 and XYL3 on a multi-copy expression vector, and we then transformed the resulting strain (which would not grow on xylose) with a transposon-mutated library of the *S. cerevisiae* genome. These were targeted to create insertional mutations. We were able to recover and verify two mutational events that overcome the growth inhibition imposed by XYL3 overexpression. These studies have formed the basis for a patent disclosure. In a separate approach we transformed the cells carrying XYL123 with an overexpression library. This also revealed a number of genes that could overcome the XYL3 growth inhibition. Second, our research has shown that even when *S. cerevisiae* is transformed with XYL123 in a construct that allows an appropriate low level of expression and when mutational events are present in the genetic background that enable the cells to resist growth inhibition, they still do not recognize xylose as a fermentable carbon source. Rather, they induce the TCA cycle and respiration pathways. By creating respiration deficient mutants of these genetically engineered cells it has been possible to increase the fermentation rate and the ethanol yield. A metabolic model based on metabolic flux and redox balances predicted that these engineered cells would require oxygen for xylose assimilation. In keeping with this model, our respiration deficient mutants would not grow on xylose. A similar study in the xylose assimilating yeast, *Kluyveromyces marxianus* showed that disruption of CYC blocked growth on xylose with this organism as well. In separate studies, we showed that when D-xylose kinase is deleted in *Pichia stipitis*, the resulting cells tend to produce xylitol rather than ethanol. This is consistent with our studies of engineered *S. cerevisiae* and the finding confirms that in order to produce ethanol from xylose it is necessary to increase the flux of metabolites through the pathway.

**IMPACT: 2001/09 TO 2004/09**

The efficient fermentation of xylose is essential for the commercial conversion of renewable biomass to fuels and chemicals. This research identifies which changes in genes and regulatory pathways are necessary for the fermentation of xylose in *Pichia stipitis*. This information will be used to increase efficiency of xylose fermentation to ethanol by both *P. stipitis* and *S. cerevisiae*. This research will increase utilization of agricultural processing wastes such as corn, oat, wheat and rice hulls by enabling improved ethanol yields. It will also enable farmers to realize additional revenues through the sale of corn cobs, corn stover, and soybean residues. The ethanol and other renewable chemicals produced from lignocellulosic xylose will reduce dependence on imported petroleum and thereby increase domestic security while reducing the accumulation of greenhouse emissions.

**PUBLICATIONS (not previously reported): 2001/09 TO 2004/09**

1. Mu, Yi, Jose M. Laplaza, T.W. Jeffries. Cloning and disruption CYC in *Kluyveromyces marxianus* CBS 6556. 26th Symposium on Biotechnology for fuels and Chemicals. Chattanooga, TN, May 9-12, 2004
2. Laplaza, Jose M., Chenfeng Lu, and T.W. Jeffries. Screen of novel yeast strains for fermentation of xylose and glucose. 26th Symposium on Biotechnology for Fuels and Chemicals. Chattanooga, TN, May 9-12, 2004.
3. Jin, Yong-Su and T. W. Jeffries. 2004. Stoichiometric network constraints on xylose metabolism by recombinant *Saccharomyces cerevisiae*. *Metabol. Engineer.* 3:229-238
4. Jin, Yong-Su, Laplaza, J.M., and T.W. Jeffries. 2004 *Saccharomyces cerevisiae* engineered for xylose metabolism exhibits a respiratory response. *Appl. Environ. Microbiol.* 70:6816-6825.

5. Jin, Yong-Su, and TW Jeffries. Xylitol production by a *Pichia stipitis* D-xylulokinase mutant. 2005. *Appl. Microbiol. Biotechnol.* (in press)
6. Jeffries, T.W. and Jin, Y.S. Xylose Fermenting recombinant yeast strains. US application B0190030 Filed January 2003

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ACCESSION NO: 0196241 SUBFILE: CRIS  
PROJ NO: WIS04749 AGENCY: SAES WIS  
PROJ TYPE: STATE PROJ STATUS: TERMINATED  
START: 01 SEP 2002 TERM: 31 AUG 2011 FY: 2006

INVESTIGATOR: Weimer, P. J.

PERFORMING INSTITUTION:  
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**COMPARATIVE INVESTIGATION OF PHYSIOLOGICAL FEATURES OF CELLULOSE**

**NON-TECHNICAL SUMMARY:** *Clostridium thermocellum* is a cellulose-fermenting bacterium with potential for conversion of biomass resources into fuels and industrial chemicals, particularly ethanol. The purpose of this research is to determine how much of its energy and resources this organism invests in assembling the surface layer of the cell that is partially responsible for the process of cellulose fermentation.

**OBJECTIVES:** The purpose of this research is 1) to determine the composition and structure of the glycocalyx (extracellular polysaccharide and associated protein) of the anaerobic bacterium *Clostridium thermocellum*; and 2) to identify potential genes involved in biosynthesis of the EPS component of the glycocalyx.

**APPROACH:** *Clostridium thermocellum* will be grown on cellulose and on cellobiose as energy sources, and cells will be treated to remove the glycocalyx. Chemical hydrolysis and derivatization, combined with gas chromatography/mass spectrometry, or liquid chromatography/mass spectrometry, will be used to identify and quantify the monosaccharides in the *C. thermocellum* glycocalyx, and to determine their linkage patterns. The protein content of the glycocalyx will be determined by standard chemical techniques, and mode of interaction (covalent or noncovalent) between protein and EPS will be determined. Mass balances of cells, fermentation products, and glycocalyx components will be determined to estimate the allocation of metabolic effort required for biosynthesis of the glycocalyx, and candidate genes involved in biosynthesis of glycocalyx precursors will be identified from known pathways of EPS biosynthesis and from the nearly completed and publicly available *C. thermocellum* genome in the TIGR Website for Unfinished Genomes.

**PROGRESS:** 2002/09 TO 2011/08

Expression of 17 genes involved in cellulose degradation and primary catabolism by the thermophilic, anaerobic cellulose-degrading bacterium *Clostridium thermocellum* ATCC 27045 were determined, using real-time PCR of mRNA recovered from cells grown in continuous culture on cellulose or on a soluble cellulose building block, cellobiose. Relative to growth on cellulose, expression of genes encoding the cellulosome scaffoldin (CipA) and main exoglucanase (CelS), as well as a mannanase (ManA) and one alcohol dehydrogenase was decreased when cells were grown on cellobiose at high growth rates, but not at low growth rate, suggesting that expression of these genes was regulated by growth rate, not (as previously

believed) by substrate type. Expression of genes encoding known catabolite regulatory proteins was not quantitatively affected by growth rate or by substrate type. Growth on cellulose, but not on cellobiose, was accompanied by production of a polysaccharide-rich sticky substance (called a glycocalyx) that allowed cells to adhere tightly to cellulose (a requirement for cellulose degradation by this species). The glycocalyx from *C. thermocellum* and from a related bacterium, *Ruminococcus albus*, had similar carbohydrate compositions, suggesting a similar function and a similar evolutionary origin. Variable pressure scanning electron microscopy (VP-SEM), a technique not previously applied to the study of biofilms, allowed accurate visualization of the *R. albus* cells without physical disruption of the biofilm. The biofilm consisted of a single layer of bacterial cells attached by the glycocalyx to one another and to the cellulose substrate. Compositional and linkage analysis of the polysaccharide component of the glycocalyx revealed chains of six-carbon sugars of up to 26 units in length, with substantial branching of the main polysaccharide chain, indicating that the glycocalyx is structurally different from other bacterial polysaccharides studied thus far. Analysis based on known biochemical pathways for microbial polymer assembly suggest that *R. albus* must invest only a small fraction (<4%) of the energy available from cellulose fermentation in order to assemble the polysaccharide component of the glycocalyx that it needs to attach to the cellulose.

**IMPACT: 2002/09 TO 2011/08**

This research indicates that important cellulolytic functions in *C. thermocellum*, a potentially useful organism for biomass conversion to ethanol, are not exclusively controlled by substrate type. This, in turn, suggests novel strategies for regulating biomass conversion by this organism. This research also identifies the unique structure of the polysaccharide component of this glycocalyx, provides both a means of estimating glycocalyx yield and energy demands, provides guidance for future studies to link composition and structure of the glycocalyx-containing fermentation residues to the functional behavior of the glycocalyx as a potentially adhesive for manufacture of plywood and other bonded wood products.

**PUBLICATIONS (not previously reported): 2002/09 TO 2011/08**

1. Weimer, P.J., N.P.J. Price, O. Kroukamp, L.M. Joubert, G.M. Wolfaardt, and W.H. Van Zyl. 2006. Studies of the extracellular glycocalyx of the anaerobic cellulolytic bacterium *Ruminococcus albus*. *Appl. Environ. Microbiol.* 72:7559-7566.
2. Lynd, L.R., P.J. Weimer, G. Wolfaardt, and Y.H.P. Zhang. 2006. Cellulose hydrolysis by *Clostridium thermocellum*: A microbial perspective. In: I.A. Kataeva (ed.). *Cellulosome: Molecular Anatomy and Physiology of Proteinaceous Machines* (Uversky V.N., Series Editor). Nova Science Publishers, Hauppauge, New York (In press).

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## Custom Literature Search, Infotrac Database

Lundeen, Tim."ARS, DOE team up to study bioenergy generation." Feedstuffs. 74.34 (August 19, 2002): 3(1). Expanded Academic ASAP. Gale.

Fatka, Jacqui."Food versus fuel debate burns." Feedstuffs. 78.40 (Sept 25, 2006): 24(1). Expanded Academic ASAP. Gale.

Carey, John, Adrienne Carter, and Assif Shameen."Food vs. Fuel; As energy demands devour crops once meant for sustenance, the economics of agriculture are being rewritten." Business Week. 4020 (Feb 5, 2007): 80. Expanded Academic ASAP. Gale.

Yulsman, Tom."Grass is . . greener: with demand soaring for alternative fuels, the market for corn-derived ethanol is hotter than ever. But there's another promising source of energy now growing on the American prairie. And unlike corn, this biofuel could power our cars at a much lower cost to the planet. (ENERGY). " Audubon. 109.5 (Sept-Oct 2007): 80(7). Expanded Academic ASAP. Gale.

Moreira, Naila."Growing expectations: new technology could turn fuel into a bumper crop." Science News. 168.14 (Oct 1, 2005): 218(3). Expanded Academic ASAP. Gale.

Pahl, Greg."Heat your home with biodiesel: heating your home with dirty fossil fuels in an oil furnace? This winter, add some biodiesel for a cleaner, greener burn." Mother Earth News. 201 (Dec 2003): 30(7). Expanded Academic ASAP. Gale.

"Peanut biodiesel could save farmers millions." Western Farm Press. 29.19 (August 18, 2007): NA. Expanded Academic ASAP. Gale.

CHOO, YUEN-MAY, and AH-NGAN MA."Plant power." Chemistry and Industry. (August 21, 2000): 530. Expanded Academic ASAP. Gale.

Schuff, Sally."Rey looks to biomass mix.(Inside Washington) (United States. Forest Service's Mark Rey). " Feedstuffs. 79.18 (April 30, 2007): 2(1). Expanded Academic ASAP. Gale.

"US funds biofuel research." Agra Europe. 2138 (Jan 7, 2005): N/4(1). Expanded Academic ASAP. Gale.

"USDA and DOE fund genomics projects for bioenergy fuels research." Scientific Computing. 23.10 (Sept 2006): 8(1). Expanded Academic ASAP. Gale.

"USDA budget plan stresses biofuel research." Agra Europe. n1477 (Feb 7, 1992 n1477): N8(1). Expanded Academic ASAP. Gale.

"USDA forum to focus on bioenergy.(News Watch) (United States. Department of Agriculture) (Brief article). " Feedstuffs. 79.1 (Jan 1, 2007): 2(1). Expanded Academic ASAP. Gale.

"World oilseed consumption to outstrip production." *Agra Europe*. 2220 (August 11, 2006): M/4(1). Expanded Academic ASAP. Gale.

Clapp, Stephen."Biotech will help meet demand for food and fuel, says BIO.(BIOTECHNOLOGY). " *Pesticide & Toxic Chemical News*. 35.12 (Jan 15, 2007): 25(2). Expanded Academic ASAP. Gale.

"Mercer County Cheese Plant Breaks Ground on Biogas Facility." *US Newswire*. (Oct 11, 2007): NA. Expanded Academic ASAP. Gale.

"Noble Foundation Receives Federal Awards for Bioenergy Fuels Research. " *AScribe Science News Service*. (August 14, 2006): NA. Expanded Academic ASAP. Gale.

"Progress Made in Biomass-to-Biofuels Conversion Process; Genetic Sequencing of Yeast a Step Toward Economical Production of Biofuels." *AScribe Higher Education News Service*. (March 6, 2007): NA. Expanded Academic ASAP. Gale.

"U.S. Departments of Agriculture, Energy Fund Genomics Projects for Bioenergy Fuels Research." *AScribe Science News Service*. (August 11, 2006): NA. Expanded Academic ASAP. Gale.

Manuel, John."Battle of the biofuels.(Spheres of Influence). " *Environmental Health Perspectives*. 115.2 (Feb 2007): A92(4). Expanded Academic ASAP. Gale.

Erbach, Donald C., and L. Frank Flora."Biobased products: America's second green revolution. (Forum)." *Agricultural Research*. 50.4 (April 2002): 2(1). Expanded Academic ASAP. Gale.

Schmidt, Charles W."Biodiesel: cultivating alternative fuels. (Focus). " *Environmental Health Perspectives*. 115.2 (Feb 2007): A86(6). Expanded Academic ASAP. Gale.

Cassida, K.A., J.P. Muir, M.A. Hussey, J.C. Read, B.C. Venuto, and W.R. Ocumpaugh."Biofuel component concentrations and yields of switchgrass in south central U.S. environments." *Crop Science*. 45.2 (March-April 2005): 682(11). Expanded Academic ASAP. Gale.

Core, Jim."Biofuel gets less expensive." *Agricultural Research*. 50.4 (April 2002): 9(1). Expanded Academic ASAP. Gale.

"Biofuels.(Headline Science)(Net Greenhouse Gas Flux of Bioenergy Cropping Systems Using Daycent). " *Journal of College Science Teaching*. (May-June 2007): 10. Expanded Academic ASAP. Gale.

Cassida, K.A., J.P. Muir, M.A. Hussey, J.C. Read, B.C. Venuto, and W.R. Ocumpaugh."Biomass yield and stand characteristics of switchgrass in south central U.S. environments." *Crop Science*. 45.2 (March-April 2005): 673(9). Expanded Academic ASAP. Gale.

McCarl, Bruce A., Darius M. Adams, Ralph J. Alig, and John T. Chmelik."Competitiveness of biomass-fueled electrical power plants.(Author abstract). " *Annals of Operations Research*. 93.1-4 (Jan 2000): 37(19). Expanded Academic ASAP. Gale.

Nash, Steve."Decrypting biofuel scenarios: an energy-food-environment maelstrom, an a prairie plan." *BioScience*. 57.6 (June 2007): 472(6). Expanded Academic ASAP. Gale.

Vogel, Kenneth P."Energy production from forages (or American agriculture - back to the future)." *Journal of Soil and Water Conservation*. 51.n2 (March-April 1996): 137(3). Expanded Academic ASAP. Gale.

Loeffler, Dan, David E. Calkin, and Robin P. Silverstein."Estimating volumes and costs of forest biomass in Western Montana using forest inventory and geospatial data." *Forest Products Journal*. 56.6 (June 2006): 31(7). Expanded Academic ASAP. Gale.

Lynd, Lee R., Janet H. Cushman, Roberta J. Nichols, and Charles E. Wyman."Fuel ethanol from cellulosic biomass." *Science*. 251.n4999 (March 15, 1991): 1318(6). Expanded Academic ASAP. Gale.

Moore, Taylor."Harvesting the benefits of biomass." *EPRI Journal*. 21.n3 (May-June 1996): 16(10). Expanded Academic ASAP. Gale.

Tenenbaum, David J."Harvesting the potential of biomass." *Environmental Health Perspectives*. 113.11 (Nov 2005): A750(4). Expanded Academic ASAP. Gale.

Andersen, Glen."Homegrown energy: as America copes with climate change, many see hope in biofuels.(Cover story)." *State Legislatures*. 33.6 (June 2007): 16(4). Expanded Academic ASAP. Gale.

"National fire plan recognizes school heating project." *Forest Products Journal*. 55.4 (April 2005): 4(1). Expanded Academic ASAP. Gale.

"Peanuts studied as biodiesel fuel source.(UPDATE). " *Resource: Engineering & Technology for a Sustainable World*. 14.7 (Oct 2007): 24(1). Expanded Academic ASAP. Gale.

Benson, Christine C."Putting your money where your mouth is: the varied success of biofuel incentive policies in the United States and the European Union." *Transnational Law & Contemporary Problems*. 16.2 (Wntr 2007): 633(29). Expanded Academic ASAP. Gale.

"Soy-Powered Aircraft." *The Futurist*. 35.6 (Nov 2001): 2. Expanded Academic ASAP. Gale.

"Studying switchgrass genetics to unlock bioenergy.(Conservation news you can use)(Brief article). " *Journal of Soil and Water Conservation*. 62.3 (May-June 2007): 50A(1). Expanded Academic ASAP. Gale.

Comis, Don."Switching to switchgrass makes sense; this deep-rooted carbon-storing perennial has great biofuel production potential." *Agricultural Research*. 54.7 (July 2006): 19(1). Expanded Academic ASAP. Gale.

RUSSO, EUGENE."Turning Trash into Treasure." *The Scientist*. 15.14 (July 9, 2001): 3. Expanded Academic ASAP. Gale.

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# **USDA ACTIVITIES**





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## USDA Activities in the Area of Biofuels by Topic

### Economics

The USDA Office of the Chief Economist has issued many reports, news releases, analysis, policy statements, and presentations. The Web site includes many relevant documents.

See

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Ausda.gov%2Foce&btnG=Search>

General USDA Web Search:

[http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=i4F&q=%28economics+%7C+economic+%7C+financ\\*+%7C+money+%7C+monetary+%7C+development%29+%28biofuel++%7C+bioenergy+%7C+biomass+%7C+biofuels++%7C+biodiesel%29+site%3Ausda.gov&btnG=Search](http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=i4F&q=%28economics+%7C+economic+%7C+financ*+%7C+money+%7C+monetary+%7C+development%29+%28biofuel++%7C+bioenergy+%7C+biomass+%7C+biofuels++%7C+biodiesel%29+site%3Ausda.gov&btnG=Search)

Articles:

De La Torre, Ugarte, D.G., Walsh, M.E., Shapouri, H., Slinsky, S.P. The economic impacts of bioenergy crop production on U.S. agriculture. 2003 USDA Agric. Econ. Rpt. No. 816

Perlack, R.D., Wright, L.L., Turhollow, A.F., Graham, R.L., Stokes, B.J., Erbach, D.C. 2005 Biomass as feedstock for bioenergy and byproducts industry: The technical feasibility of a billion-ton annual supply, Joint report by USDA & DOE. DOE/GO-102995-2135

News releases:

Economic Feasibility of Ethanol Production from Sugar in the United States:

[http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newstype=prfactsheet&type=detail&item=pf\\_20040801\\_comop\\_en\\_biopr04.html](http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newstype=prfactsheet&type=detail&item=pf_20040801_comop_en_biopr04.html)

Economic Analysis:

USDA ERS Biofuels

<http://www.ers.usda.gov/Briefing/Bioenergy/>

The Future of Biofuels: A Global Perspective

Amber Waves <http://www.ers.usda.gov/AmberWaves/November07/Features/Biofuels.htm>

### Biofuels and the Environment

Articles:

Biofuels to the Invasive Species Fire? (Sep 2006) -

[http://weblogs.nal.usda.gov/invasivespecies/archives/2007/02/biofuels\\_to\\_the.shtml](http://weblogs.nal.usda.gov/invasivespecies/archives/2007/02/biofuels_to_the.shtml)

PERENNIAL CROPS FOR BIO-FUELS AND CONSERVATION, 2006 -

<http://www.usda.gov/oc/forum/2006%20Speeches/PDF%20speech%20docs/Ruark2806.pdf>

Web Searches:

## Biofuels and Air

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+air+site%3Ausda.gov%2F+&btnG=Search>

## Biofuels and land

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+%28earth+%7C+land+%7C+oil+%7C+tree+%7C+trees+%7C+forest+%7C+forests%7C+plant+%7C+plants+%29+site%3Ausda.gov%2F+&btnG=Search>

## Biofuels and water

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+water+site%3Ausda.gov%2F+&btnG=Search>

## Biofuels and Water Quality Conference -

[http://www.csrees.usda.gov/nea/nre/in\\_focus/water\\_if\\_biofuels.html](http://www.csrees.usda.gov/nea/nre/in_focus/water_if_biofuels.html)

**Research**

## ARS

## Strategic Plan

[http://www.ars.usda.gov/aboutus/docs.htm?docid=1766&pf=1&cg\\_id=0](http://www.ars.usda.gov/aboutus/docs.htm?docid=1766&pf=1&cg_id=0)

## Research in Biobased Products &amp; BioEnergy – Research Themes / Programs in

## Biobased Products

## Biofuels

## Energy Crops

<http://www.ars.usda.gov/research/themes/biopande.htm>

## Bioenergy and Energy Alternatives - Research Action Plan

[http://www.ars.usda.gov/research/programs/programs.htm?np\\_code=307&docid=281](http://www.ars.usda.gov/research/programs/programs.htm?np_code=307&docid=281)

ARS Laboratories Engaged in Biofuels Research

## Vegetable and Forage Crops Research Laboratory – research priorities

<http://www.ars.usda.gov/Main/docs.htm?docid=10250>

## Agroecosystem Management Research Laboratory

<http://www.ars.usda.gov/Aboutus/docs.htm?docid=10570>

## Fermentation Biotechnology Research Laboratory

## Cost-Effective Bioprocess Technologies for Production of Biofuels from Lignocellulosic Biomass

[http://www.ars.usda.gov/research/projects/projects.htm?ACCN\\_NO=408951](http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=408951)

## Soil and Water Quality Research Laboratory

## Ecologically-Based Soil Management for Sustainable Agriculture and Resource Conservation -

[http://www.ars.usda.gov/research/projects/projects.htm?ACCN\\_NO=409570&showpars=true&fy=2006](http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=409570&showpars=true&fy=2006)

ARS Reports and Publications:

[Biofuel Feedstocks in Washington](#) - (Popular Publication) Collins H.P., Boydston, R.A., Fransen, S., Hang A.N. 2006. Biofuel Feedstocks in Washington. In Sustaining the Pacific Northwest - Food, Farm, & Natural Resource Systems, Newsletter, CSNAR, Washington State University Extension. Vol 4,3:1-4.

[Growth of switchgrass as biofuel in the Pacific Northwest](#) - (Proceedings/Symposium) Steve Fransen, Harold P. Collins and Rick A. Boydston. 2006. Growth of switchgrass as biofuel in the Pacific Northwest. Pp 2-3. Proceedings of the 5th Eastern Native Grass Symposium, Harrisburg, PA October 10-13, 2006.

Comment on "Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass"  
[http://www.ars.usda.gov/research/publications/publications.htm?seq\\_no\\_115=206489](http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=206489)

Value-Added Products from Forages and Biomass Energy Crops - Will Biofuels Leave Dairying In The Dust? -  
[http://www.ars.usda.gov/research/publications/Publications.htm?seq\\_no\\_115=219506](http://www.ars.usda.gov/research/publications/Publications.htm?seq_no_115=219506)

Corn Stover as a Biofuel  
[http://www.ars.usda.gov/research/publications/publications.htm?SEQ\\_NO\\_115=148320](http://www.ars.usda.gov/research/publications/publications.htm?SEQ_NO_115=148320)

The Potential Use of Kudzu as a Biofuel  
[http://www.ars.usda.gov/research/publications/publications.htm?seq\\_no\\_115=202385](http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=202385)

Winter Cover Crop Biomass for Biofuel Production, Implications for Soil Coverage and Profitability  
[http://www.ars.usda.gov/research/publications/publications.htm?seq\\_no\\_115=200597](http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=200597)

Impact of Residue Removal for Biofuel Production on Soil - Renewable Energy Assessment Project (Reap)  
[http://www.ars.usda.gov/research/projects/projects.htm?ACCN\\_NO=410653](http://www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=410653)  
[http://www.ars.usda.gov/main/site\\_main.htm?modecode=53-25-38-00](http://www.ars.usda.gov/main/site_main.htm?modecode=53-25-38-00)

USDA Global Conference On Agricultural Biofuels: Research And Economics -- International Perspectives  
 SESSION A [www.ars.usda.gov/meetings/Biofuel2007/files/Intl%20Perspectives%20A-Revised.doc](http://www.ars.usda.gov/meetings/Biofuel2007/files/Intl%20Perspectives%20A-Revised.doc)

#### Research Grants:

CSREES Grants Program - <http://genomicsgtl.energy.gov/research/DOEUSDA/index.shtml>

#### CSREES Reports and Publications:

Sept 2006 Report on Biofuels/Bioenergy/ Biobased Products  
[http://nareeeab.ree.usda.gov/nal\\_display/index.php?info\\_center=20&tax\\_level=2&tax\\_subject=419&topic\\_id=1812&&placement\\_default=0](http://nareeeab.ree.usda.gov/nal_display/index.php?info_center=20&tax_level=2&tax_subject=419&topic_id=1812&&placement_default=0)

#### Other Reports:

Advisory Committee on Biotechnology & 21st Century Agriculture (AC21) Meeting: September 15-16, 2003 -- Meeting Summary  
[http://www.usda.gov/agencies/biotech/ac21/meetings/mtg\\_sept03/mtgsummary\\_sept03.html](http://www.usda.gov/agencies/biotech/ac21/meetings/mtg_sept03/mtgsummary_sept03.html)

## Farm Loan Programs

### Farm Services Agency

October 2006 Fact Sheet

[http://www.fsa.usda.gov/FSA/printapp?fileName=pf\\_20061026\\_insup\\_en\\_benint06.html&newsType=prfactsheet](http://www.fsa.usda.gov/FSA/printapp?fileName=pf_20061026_insup_en_benint06.html&newsType=prfactsheet)

[http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newsType=prfactsheet&type=detail&item=pf\\_20040801\\_comop\\_en\\_biopr04.html](http://www.fsa.usda.gov/FSA/newsReleases?area=newsroom&subject=landing&topic=pfs&newsType=prfactsheet&type=detail&item=pf_20040801_comop_en_biopr04.html)

[http://www.fsa.usda.gov/FSA/printapp?fileName=pf\\_20040801\\_comop\\_en\\_biopr04.html&newsType=prfactsheet](http://www.fsa.usda.gov/FSA/printapp?fileName=pf_20040801_comop_en_biopr04.html&newsType=prfactsheet)

## Trade

A search of the Foreign Agriculture Service Web site for ethanol produced a list of many documents; most of which are in PDF, Word, or even PowerPoint formats. Many relate to trade issues regarding ethanol. Included in the list is a PowerPoint, “The Value Added Benefits and Economic Impacts of Biofuel ...” and other interesting reports.

See [http://www.fas.usda.gov/search.asp?sort=date%3AD%3AL%3Ad1&output=xml\\_no\\_dtd&ie=UTF-8&mode=simple&client=usda&num=10&site=FAS\\_MAIN&q=ethanol](http://www.fas.usda.gov/search.asp?sort=date%3AD%3AL%3Ad1&output=xml_no_dtd&ie=UTF-8&mode=simple&client=usda&num=10&site=FAS_MAIN&q=ethanol)

#### Analysis:

FAS Biofuels Trade Analysis <http://www.fas.usda.gov/cmp/biofuels/biofuels.asp>

#### Partnerships – International focus:

Google: <http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=Pla&q=%28international+partnership%3F%29+%28biofuel+++7C+bioenergy+%7C+biomass+%7C+biofuels+++7C+biodiesel%29+site%3Ausda.gov&btnG=Search>

Google: <http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=Oma&q=%28international+development%3F%29+%28biofuel+++7C+bioenergy+%7C+biomass+%7C+biofuels+++7C+biodiesel%29+site%3Ausda.gov&btnG=Search>

## Web Searches by Agency

### AMS

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Aams.usda.gov%2F&btnG=Search>

### APHIS

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Aaphis.usda.gov&search=search>

Google: <http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Aaphis.usda.gov%2F&btnG=Search>

### ARS Research

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Aars.usda.gov&search=search>

Google: <http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Aars.usda.gov&btnG=Search>

### CSREES Research

Ask:

<http://www.ask.com/web?qsrc=2352&o=0&l=dir&q=biofuels+usda+site%3Acsrees.usda.gov&search=search>

Exalead: <http://www.exalead.com/search/results?q=biofuels+++site%3Acsrees.usda.gov+&x=0&y=0>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Acsrees.usda.gov&btnG=Search>

ERS

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Aers.usda.gov&search=search>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Aers.usda.gov%2F&btnG=Search>

FAS

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Afas.usda.gov%2F&btnG=Search>

FS

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Afs.usda.gov&search=search>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Afs.usda.gov&btnG=Search>

FSA

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Afas.usda.gov&search=search>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Afsa.usda.gov%2F&btnG=Search>

NASS

Ask: No Results

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Anass.usda.gov%2F&btnG=Search>

NRCS

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Anrcs.usda.gov&search=search>

Exalead: <http://www.exalead.com/search/results?q=biofuels++site%3Anrcs.usda.gov+&x=0&y=0>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Anrcs.usda.gov&btnG=Search>

Office of Chief Economist

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Ausda.gov%2Foce&btnG=Search>

OCFO

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Ausda.gov%2Focfo%2F&btnG=Search>

## Rural Development

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Aurdev.usda.gov&search=search>

Exalead: <http://www.exalead.com/search/results?q=biofuels++site%3Aurdev.usda.gov+&x=0&y=0>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Aurdev.usda.gov%2F+&btnG=Search>

## RMA

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=biofuels+usda+site%3Arma.usda.gov&search=search>

Google:

<http://www.google.com/search?num=100&hl=en&safe=active&q=biofuels+site%3Arma.usda.gov%2F+&btnG=Search>

## Food Security

Ask:

<http://www.ask.com/web?qsrc=167&o=0&l=dir&q=%28%28food+security+%29+%28biofuel+%7C+bioenergy+%7C+biomass+%7C+biofuels+%7C+biodiesel%29%29+site%3Ausda.gov&search=search>

Google: <http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=5na&q=%28%28food+security+%29%29+%28biofuel++%7C+bioenergy+%7C+biomass+%7C+biofuels++%7C+biodiesel%29+site%3Ausda.gov&btnG=Search>

## Sustainability

General Web Search:

Exalead: <http://www.exalead.com/search/results?q=sustainable+biofuels++site%3Ausda.gov&x=0&y=0>

Google: <http://www.google.com/search?num=100&hl=en&safe=active&client=firefox-a&rls=org.mozilla%3Aen-US%3Aofficial&hs=nja&q=%28sustainable+%7C+livable+%7C+viable+%29+%28biofuel++%7C+bioenergy+%7C+biomass+%7C+biofuels++%7C+biodiesel%29+site%3Ausda.gov&btnG=Search>

Conference Proceedings:

USDA Global Conference on Agricultural Biofuels: Research and Economics - Biofuels: Challenges and Opportunities Ahead <http://www.ars.usda.gov/meetings/Biofuel2007/presentations/index.htm>

Sustainable Production & Environmental Considerations Technical challenges of biofuel crops to enhance their sustainability Moderator: Dr. Robert P. Elde, Dean, College of Biological Sciences, University of Minnesota

[Making Crop Residues a Sustainable Feedstock for Biofuel Production](#), Dr. Wallace Wilhelm, Plant Physiologist, USDA-ARS and Director of the Renewable Energy Assessment Project

Sustainability of Biomass Production in Context, Dr. David I. Bransby, Professor, Energy Crops and Bioenergy, Auburn University, Alabama

[Ethanol Production and Water Quality](#), Dr. Thomas W. Simpson, Professor, University of Maryland

[Biofuels from Perennial Prairie Plant Polycultures and the Ecosystem Services they Provide](#), Dr. Jason Hill, Research Associate, University of Minnesota

[Biofuel Climatic Risks Zoning in Brazil](#), Dr. Eduardo Assad, Agroclimatologist, Embrapa, Brazil

## General Resources

### BIOENERGY and BIOFUELS BIBLIOGRAPHY

January 2002 to December 2003 <http://www.nal.usda.gov/ttic/biofuels/biobib.html>

### BIOENERGY AND BIOFUELS

[http://afsic.nal.usda.gov/nal\\_display/index.php?info\\_center=2&tax\\_level=2&tax\\_subject=281&topic\\_id=1365](http://afsic.nal.usda.gov/nal_display/index.php?info_center=2&tax_level=2&tax_subject=281&topic_id=1365)

### BIOFUELS FROM AN INFORMATION PERSPECTIVE

[www.nal.usda.gov/downloads/Chicago/Chicago.ppt](http://www.nal.usda.gov/downloads/Chicago/Chicago.ppt)

### BIOFUELS WEB SITE GENERAL SEARCH

<http://www.google.com/search?q=biofuels+site:usda.gov&hl=en&client=firefox-a&channel=s&rls=org.mozilla:en-US:official&start=100&sa=N>

## Domestic Renewables program

Ambassador Reno Harnish

Principal Deputy Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

USDA Global Conference on Agricultural Biofuels

Minneapolis, Minnesota

August, 21, 2007

# **USDA BIOFUELS**





## USDA Web Search Bioenergy and agriculture

Ash, M.; Dohlman, E. (Sep 2006) **International Trade, Biofuel Initiatives Reshaping the Soybean Sector**. Amber Waves (ERS publication) 4(4): 8. [Web link: <http://www.ers.usda.gov/AmberWaves/September06/PDF/InternationalFindingSeptember06.pdf>]

Baker, A.; Zahniser, S. (Apr 2006) **Ethanol Reshapes the Corn Market**. Amber Waves (ERS publication) 4(2): 30-35. [Web link: <http://www.ers.usda.gov/AmberWaves/April06/pdf/EthanolFeatureApril06.pdf>]

Collins, Keith. (2007) **USDA Chief Economist's Statement Before the U.S. Senate Committee on Agriculture, Nutrition, and Forestry** (January 10, 2007). [Web link: [http://www.usda.gov/oce/newsroom/congressional\\_testimony/Collins\\_011007.pdf](http://www.usda.gov/oce/newsroom/congressional_testimony/Collins_011007.pdf)]

Coyle, W. (Nov 2007) **The Future of Biofuels: A Global Perspective**. Amber Waves (ERS publication) 5(5): 24-29. [Web link: <http://www.ers.usda.gov/AmberWaves/November07/PDF/Biofuels.pdf>]

Economic Research Service. (2007) **Global Biofuel Developments: Modeling the Effects on Agriculture**. Presentations made at ERS/Farm Foundation Biofuels Modeling Workshop held February 27, 2007. [Web link: <http://www.farmfoundation.org/projects/07-27GlobalBiofuelDevelopments.htm>]

Economic Research Service. (1993-1997) **Industrial Uses of Agricultural Materials and Outlook Report**. This series published between 1993 and 1997 followed topics such as biofuels, ethanol and feedstocks. [NAL call no. aHD9001.S58. [Web link.](#)]

Economic Research Service. (2002) **Title IX: Energy - 2002 Farm Bill**. Outlines energy programs from the 2002 Farm Bill. [Web link: <http://www.ers.usda.gov/Features/farmbill/titles/titleIXenergy.htm>]

Economic Research Services; USDA Office of the Chief Economist. (May 2007) **An Analysis of the Effects of an Expansion in Biofuel Demand on U.S. Agriculture**. Assesses the effects on agriculture of alternative levels of biofuels production from corn and soybean oil. In addition, the potential for expansion of cellulosic ethanol production is reviewed. [Web link: <http://www.usda.gov/oce/newsroom/chamblissethanol5-8-07.doc>]

Interagency Agricultural Projections Committee. (2003) **USDA Agricultural Baseline Projections to 2012**. Staff report, U.S. World Agricultural Outlook Board. (Document no. WAOB-2003-1). "Ethanol Production Boosts Demand for U.S. Corn" discussion in Crops chapter. [NAL call no. aHD1769 .U83 2003. [Web link.](#)]

Interagency Agricultural Projections Committee. (2007) **USDA Agricultural Baseline Projections to 2016**. Staff report, U.S. World Agricultural Outlook Board. (Document no. OCE-

2007-1). "U.S. Biofuel Overview" and "Biofuel Tax Credits and Import Tariffs" discussions in Crops chapter. [[Web link.](#)]

Lewandrowski, J.; Peters, M.; Jones, C.; House, R.; Sperow, M.; Eve, M.; Paustian, K. (Mar 2004) **Economics of Sequestering Carbon in the U.S. Agricultural Sector** (ERS Technical Bulletin no. 1909). [Web link: <http://www.ers.usda.gov/Publications/tb1909/>]

Natural Resources Conservation Service. (1995) **Biofuels**. Resources Conservation Act paper (RCA Issue Brief no. 2). [Web link: <http://www.nrcs.usda.gov/Technical/land/pubs/ib2text.html>]

Ruark, G.; Josiah, S.; Riemenschneider, D.; Volk, T. **Perennial Crops for Bio-Fuels and Conservation**. Presented at 2006 USDA Agricultural Outlook Forum – Prospering In Rural America, Arlington, Virginia, February 16, 2006. [Web link: <http://www.usda.gov/oce/forum/2006%20Speeches/PDF%20speech%20docs/Ruark2806.pdf>]

Sanderson, M.A.; Adler, P.R.; Bpateng, A. A; Casler, M.D.; Sarath, G. (Dec 2006) **Switchgrass as a biofuels feedstock in the USA**. Canadian Journal of Plant Science 86(5): 1315-1325. [NAL call no. 450 C16.]

Shapouri, H.; Salassi, M. (Jul 2006) **The Economic Feasibility of Ethanol Production from Sugar in the United States**. [Web link: <http://www.usda.gov/oce/EthanolSugarFeasibilityReport3.pdf>]

Shapouri, H.; Gallagher, P. (Jul 2005) **USDA's 2002 Ethanol Cost-of-Production Survey**. (Agricultural Economic Report no. 841) Published through Office of the Chief Economist, Office of Energy Policy and New Uses. [Web link: [http://www.usda.gov/oce/reports/energy/USDA\\_2002\\_ETHANOL.pdf](http://www.usda.gov/oce/reports/energy/USDA_2002_ETHANOL.pdf)]

Shochet, M. (2004) **Bioenergy and Biofuels Bibliography: January 2002 to December 2003**. Published through the Technology Transfer Information Center, National Agricultural Library. [Web link: <http://www.nal.usda.gov/ttic/biofuels/biobib.html>]

Soil Quality National Technology Development Team. (Aug 2006) **Crop Residue Removal For Biomass Energy Production: Effects on Soils and Recommendations**. Soil Quality – Agronomy Technical Note no. 19. [Web link: [http://soils.usda.gov/sqi/management/files/sq\\_atn\\_19.pdf](http://soils.usda.gov/sqi/management/files/sq_atn_19.pdf)]

Suszkiw, J. (Jul 6, 2007) **Measuring the Merits of Corn Stover-Based Ethanol** (ARS press release). [Web link: <http://www.ars.usda.gov/is/pr/2007/070706.htm>]

U.S. Department of Agriculture. (2005) **Johanns Awards \$4.4 Million for Woody Biomass Utilization Projects: Grants Support President's Healthy Forests Initiative to Reduce Risk of Wildfire** (USDA Press Release). [Web link: <http://www.usda.gov/wps/portal/usdahome?contentidonly=true&contentid=2005/06/0195.xml>]

U.S. Mission to the European Union. (2007) **Biofuels**. Published through USDA Foreign Agricultural Service. [Web link: <http://useu.usmission.gov/agri/Biofuels.htm>]

### **Benefits of conservation-related programs and research**

Bucks, D.; Horton, M.; Ribaldo, M.; Howard, L.; Makuch, J.; Rives, S.; Smith, D.; Adams, L.; Swader, F. (Sep 1997) **Water Quality: A Report of Progress**. Published through the U. S.

Department of Agriculture, Working Group on Water Quality. [Web link: <http://www.nal.usda.gov/wqic/wgwq/progress.shtml>]

Cattaneo, A.; Claassen, R.; Johansson, R.; Weinberg, M. (Jun 2005) **Flexible Conservation Measures on Working Land** (Economic Research Report no. 5). [Web link: <http://www.ers.usda.gov/publications/err5/err5.pdf>]

Christensen, L. A. (Apr 2002) **Soil, Nutrient, and Water Management Systems Used in U.S. Corn Production** (Agriculture Information Bulletin no. 774). Web link: <http://www.ers.usda.gov/publications/aib774/aib774.pdf>

Claassen, R.; Morehart, M. (Mar 2006) **Greening Income Support and Supporting Green** (Economic Brief no. 1). Web link: <http://www.ers.usda.gov/publications/EB1/EB1.pdf>

Clark, R.N.; Meidinger, E.E.; Miller, G.; Rayner, J.; Layseca, M.; Monreal, S.; Fernandes, J.; Shannon, M.A. (Sep 1999) **Integrating Science and Policy in Natural Resource Management: Lessons and Opportunities from North America**. Published by the U.S. Forest Service. [Web link: [http://www.fs.fed.us/pnw/pubs/gtr\\_441.pdf](http://www.fs.fed.us/pnw/pubs/gtr_441.pdf)]

Conservation Effects Assessment Project. (Aug 2007) **Influence of U. S. Department of Agriculture Programs and Conservation Practices on Ecological Services Provided by Playa Wetlands in the High Plains**. [Web link: [ftp://ftp-fc.sc.egov.usda.gov/NHQ/nri/ceap/thp\\_research\\_plan.pdf](ftp://ftp-fc.sc.egov.usda.gov/NHQ/nri/ceap/thp_research_plan.pdf)]

Crutchfield, S.R.; Feather, P.M.; Hellerstein, D.R. (Jan 1995) **Benefits of Protecting Rural Water Quality: An Empirical Analysis**. Agricultural Economics Report no. AER701. 36 pp. [Web links: <http://www.ers.usda.gov/publications/aer701/AER701.PDF> and <http://www.ers.usda.gov/Publications/AER701/>]

Crutchfield, S.R.; Cooper, J.C.; Hellerstein, D. (Jul 1997) **Benefits of Safer Drinking Water**. Agricultural Economic Report no. 752. [Web link (summary): <http://www.ers.usda.gov/Publications/Summaries/AER752.htm>]

Dissmeyer, G.E. (Sep 2000) **Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature**. Published through the U.S. Forest Service, Southern Research Station. [Web link: <http://purl.access.gpo.gov/GPO/LPS13713>]

Dobrowolski, J.P.; O'Neill, M.P.; Duriancik, L.F. (2006) **Agricultural Water Security Listening Session: Final Report**. Report from USDA Research, Education, and Economics Mission Area, workshop held in Park City, UT, September 9-10, 2004. [Web link: [http://www.csrees.usda.gov/nea/nre/pdfs/ree\\_water\\_security.pdf](http://www.csrees.usda.gov/nea/nre/pdfs/ree_water_security.pdf)]

Euliss, N.H.; Gleason, R.A.; Laubhan, M.; Finocchiaro, R.; Browne, B.A.; Olness, A. (Dec 2006) **Impact of U.S. Department of Interior and U.S. Department of Agriculture Programs on Ecological Services Derived from Restored Prairie Wetlands and Adjacent Grasslands**. Published through the U.S. Geological Survey. [Web link: <ftp://ftp-fc.sc.egov.usda.gov/NHQ/nri/ceap/studyplanweb14dec06.pdf>]

Gagnon, Stuart; Makuch, Joseph; Sherman, Ted. (2004) **Environmental Effects of U.S. Department of Agriculture Conservation Programs**. Water Quality Information Center. The bibliography is a guide to literature examining environmental effects of USDA conservation programs. It provides an overview of various environmental outcomes resulting from landowner

participation in USDA conservation programs. The information is useful for assessing on-the-ground results of conservation programs from various environmental perspectives. [1986-2004 <<http://www.nal.usda.gov/wqic/ceap/ceap01.shtml>>. 2004 to present: articles <<http://tinyurl.com/26v5an>>, books <<http://tinyurl.com/2ef8kz>>]

Hansen, L.; Hellerstein, D. (March 2006) **Better Targeting, Better Outcomes**. U.S. Department of Agriculture Economic Research Service (Economic Brief no. 2). Voluntary conservation payment programs need to specify who is eligible to receive payments, how much can be received, for what actions, and the means by which applicants are selected. The achievement of program goals in a cost-effective manner hinges on the choices policymakers and program managers make when answering these questions. This Economic Brief is one in a set of five exploring specific design options these decisionmakers face. [Web link: <http://www.ers.usda.gov/publications/EB2/EB2.pdf>]

Hrubovcak, J.; Vasavada, U.; Aldy, J. E. (Jul 1999) **Green Technologies for a More Sustainable Agriculture**. For U.S. agriculture to continue along a sustainable path of economic development, further production increases must be generated by technologies that are both profitable and more environmentally benign. In this context, we assess the role of these green or sustainable technologies in steering agriculture along a more sustainable path. However, the lack of markets for the environmental attributes associated with green technologies can limit their development. In addition, simply making a technology available does not mean it will be adopted. Experience with green technologies such as conservation tillage, integrated pest management, enhanced nutrient management, and precision agriculture demonstrates that even when technologies are profitable, barriers to adopting new practices can limit their effectiveness. [Web link: <http://www.ers.usda.gov/publications/aib752/>]

Koteen, J.; Alexander, S. J.; Loomis, J. B. (2002) **Evaluating benefits and costs of changes in water quality**. Published through the U.S. Forest Service, Pacific Northwest Research Station. [Web link: <http://www.fs.fed.us/pnw/pubs/gtr548.pdf>]

Lubowski, R. N.; Bucholtz, S.; Claassen, R.; Roberts, M. J.; Cooper, J. C.; Gueorguieva, A.; Johansson, R. (Aug 2006) **Environmental Effects of Agricultural Land-Use Change: The Role of Economics and Policy**. [Web link: <http://www.ers.usda.gov/publications/err25/err25.pdf>]

Mausbach, M. J.; Dedrick, A. R. (Nov 2004) **The Length We Go: Measuring Environmental Benefits of Conservation Practices**. Journal of Soil and Water Conservation 59(5): 96A-103A. [Web link: <ftp://ftp-fc.sc.egov.usda.gov/NHQ/nri/ceap/swcsceapreprint.pdf>]

Meekhof, Ronald; Kuzma, Jennifer; Mauriello, David; Osborn, Tim; Powell, Mark; Rice, Cliff; Shafer, Steven. (1997) **Adaptive risk analysis for resource conservation programs**. Proceedings of the Conference on Risk-Based Decision Making in Water Resources, pp. 172-186. [NAL call no. TC401.R563.]

Natural Resources Conservation Service. (Aug 1999) **CORE4 Conservation Practices Training Guide: The Common Sense Approach to Natural Resources Conservation**. [Web link: <http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf>]

Potter, S.R.; Andrews, S.; Atwood, J.D.; Kellogg, R.L.; Lemunyon, J.; Norfleet, L.; Oman, D. (Jun 2006) **Model Simulation of Soil Loss, Nutrient Loss and Soil Organic Carbon Associated with Crop Production**. Published through Conservation Effects Assessment Project (CEAP). [Web link: <http://www.nrcs.usda.gov/Technical/nri/ceap/croplandreport/>]

Ribaudo, M.O.; Hoag, D.L.; Smith, M.E.; Heimlich, R. (2001) **Environmental indices and the politics of the Conservation Reserve Program**. *Ecological Indicators* 1(1): 11-20.

Ribaudo, M.O.; Horan, R.D; Smith, M.E. (Dec 1999) **Economics of Water Quality Protection From Nonpoint Sources: Theory and Practice** (Agricultural Economic Report No. 782).

Published through the Resource Economics Division, Economic Research Service. [Web link: <http://www.ers.usda.gov/publications/aer782/aer782.pdf>]

Ribaudo, M.; Weinberg, M. (Sep 2005) **Improving Air and Water Quality Can Be Two Sides of the Same Coin**. *Amber Waves* 3(4): 34-41. [Web link:

<http://www.ers.usda.gov/AmberWaves/September05/pdf/FeatureAirQualitySeptember2005.pdf>]

Robertson, G.P.; Allen, V.G.; Boody, G.; Boose, E.R.; Creamer, N.G.; Drinkwater, L.E.; Gosz, J.R.; Lynch, L.; Havlin, J.L.; Jackson, L.E.; Pickett, S.T.; Pitelka, L.; Randall, A.; Reed, A.S.; Seastedt, T.R.; Waide, R.B.; Wall, D.H. (2006) **Long-Term Agricultural Research (LTAR): A Research, Education, and Extension Imperative**. White Paper Report of the LTAR-EE Workshop, USDA-CSREES, Washington, DC, held August 17-18, 2006. [[Web link.](#)]

Sutton, J. D. (Jul 1997) **Water Quality and Agriculture: Status, Conditions, and Trends** (NRCS Working Paper no. 16). [Web link:

<http://www.nrcs.usda.gov/technical/land/pubs/WP16.pdf>]

U.S. Department of Agriculture. (Sep 2001) **Food and Agricultural Policy: Taking Stock for the New Century**. Serves as a stocktaking exercise for the development of important principles that stakeholders can use to help guide strategic thinking about food and agriculture in the 21st century. [Web link: <http://www.usda.gov/news/pubs/farmpolicy01/fullreport.pdf>]

Weinberg, M.; Claassen, R. (Mar 2006) **Rewarding Farm Practices versus Environmental Performance** (Economic Brief no. 5). [Web link:

<http://www.ers.usda.gov/publications/EB5/EB5.pdf>]

=====