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Biofuels from New Prairies:
Realities in the Development of Perennial Cellulose Crops

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May 2008

The agricultural sector plays an important role in our quest to decrease reliance on foreign oil and combat greenhouse emissions contributing to global climate change. Within the U.S. agriculture sector, bioenergy has emerged as a promising industry for providing initial answers to major alternative energy, renewable energy, and transportation questions. Thus far, biofuels—primarily ethanol and biodiesel—have dominated the bioenergy sector. However, additional questions about the consequences and limitations of continued corn and soybeans use have given rise in attention to what is often dubbed the "next generation" of feedstocks for biofuels: *cellulose.*

Cellulosic ethanol can be produced from a variety of feedstocks, including corn stover and paper pulp. Beyond transportation fuel, cellulosic ethanol could provide a wide array of local economic and energy benefits. New and existing energy facilities process various types of biomass into biofuels for heat, electricity, and local forms of energy.

In Minnesota, mixed prairie grasses and leafy forbs have recently received attention for their potential as a cellulosic feedstock. When harvested for biofuels on marginal lands, these feedstocks could create economic benefits and enhance state conservation efforts. In a February 2008 *Science* article, Dr. David Tilman and other researchers at the University of Minnesota called attention to research showing diverse mixtures of native grassland perennials grown on degraded lands have yield advantages over monocultures, release less greenhouse gases due to high carbon storage, and provide wildlife benefits[1]. As we explore the development of a grass seed industry, biomass supply issues, facilities for conversion, and profitability in potential biomass markets, it is important to address the realities and obstacles of such transitions.

How do we Identify Appropriate Seed for Growing and *preserve the genetics of local ecotype seed*[2]*?*

With only 1% of Minnesota's native prairie remaining, nearly everyone agrees that those sites must be preserved. Mark Lindquist, energy and biofuels project manager at the Minnesota Department of Natural Resources, emphasizes when fostering use of native prairie grasses for feedstock, care must be taken to not destroy what is trying to be created. This translates into careful collection of native prairie seed from natural sites around the state for further propagation as seed for new biomass plantings. Existing prairie sites are owned primarily by the DNR, railroads, government bodies which control road rights of way, and private landowners. There has been a focus on the harvest of seed with a determined origin, in order to preserve in the seed genetics those characteristics specific to the area of origin. Also, an emerging state bioenergy program will likely require recording origin of the seed used for feedstocks. According to a natural resources definitions section in chapter 84 of the 2007 Minnesota Statutes a "best management practice for native prairie restoration" means using seeds that were collected from a native prairie within 25 miles of the county's border, but not across the boundary of an ecotype region[3]. However, legislators are currently looking

[1]Fargione et al. "Land Clearing and the Biofuel Carbon Debt" *Science* http://www.sciencemag.org/cgi/content/abstract/1152747

[2] " 'Native prairie species of a local ecotype' means a genetically differentiated population of a species that has at least one trait (morphological, biochemical, fitness, or phenological) that is evolutionarily adapted to local environmental conditions, notably plant competitors, pathogens, pollinators, soil microorganisms, growing season length, climate, hydrology, and soil." - Chapter 84.02 (Department of Natural Resources) of the 2007 Minnesota Statutes

[3] According to the definitions section in chapter 84 of the 2007 Minnesota Statutes, an *ecotype region* refers to designated ecological subsections and counties based on a DNR map, "County Landscape Groupings Based on Ecological Subsections (Feb. 15, 2007.)" All counties are completely within an ecotype region.

to amend these existing definitions. The amendments introduced in the 2007-2008 legislative session would define seed collection areas for a native prairie restoration best management practice in relation to the *ecotype region*, rather than the county boundaries. These amendments provide a greater flexibility for farmers to obtain seed for cellulosic feedstocks. They would be able to use seed from within the same ecotype region as the prairie restoration, or from within 25 miles of the ecotype region boundary, rather than the county's border.

How does one find locally appropriate seeds?

While many farmers would prefer to use seed that has the most area-appropriate genetics to maximize ecological value and preserve genetic purity, both of the existing options for seed origin as described above have their limitations. Dwayne Vosejpka of Prairie Meadows Native Seed Company in Lonsdale, MN, questions the ecological sense of the ecotype boundaries for seed origins. "The most appropriate seed for your farm may lie just over an ecotype region boundary, but the farmer may be forced to use less appropriate seed from the farthest corner of his ecotype region." If the legislature passes proposed amendments to the definitions statute discussed above, then farmers will be able to obtain appropriate seed within 25 miles over a ecotype region boundary line.

Another issue with the ecotype regions involves certification requirements. There are currently fourteen native grass and forb seed producers selling Minnesota Crop Improvement Association (MCIA) certified seed. MCIA ensures that the identity of native grasses and forbs is maintained "through all phases of seed and/or seedling production.[4]" At the time the ecotype regions were established, the genetic origins of the existing certified seed weren't considered. As a result, a production plot with two types of varieties now determined to be from different ecotype regions becomes obsolete.

The 25-mile radius from the county may also be an unrealistic goal, as it is unlikely that that there will enough specie variety and/or supply of seed available within 25 miles of a county's borders. In some cases, there may be so little seed that it would take many years to produce an industrial quantity. Also, these circumstances affect the economic viability of these crops for producers.

What are the ways in which a seed producer obtains native prairie seed?

According to Vosejpka, a native seed producer may plant production fields with seed obtained in a number of ways. The producer can also obtain seed from an agency, such as the National Resources Conservation Service (NRCS). Seed from the NRCS is either a genetically selected variety or seed from multiple wild stands within a specific region. Producers can also buy seed from another producer. However, in order to certify purchased seed, the buyer must receive approval from the original grower[5]. Some seed producers will hand harvest their own seed from wild stands, often using a genetic origin which has never been collected and produced for the seed market. Most local eco-type seed in Minnesota was introduced into the market through the latter method.

Seed Supply: How will we meet the market demand for establishing biomass crops?

[4] http://www.mncia.org/program_nativegrass.html
[5] MCIA Seed Certification Handbook

The limited availability of native grass seed raises the question of how seed producers will be able to raise enough seed to meet the market demand for biomass. Different options have been proposed, including increased seed collection, second and third generation prairie reconstructions[6], and genetic modification.

However, many seed producers and farmers believe that there can be sufficient seed production using existing methods, as long as there is demand. A sufficient amount of seed can be produced within four to five years if seed production is increased in monocultures. It is important to examine whether seed is being sourced in each ecotype region. If not, growers can look to starting seed production from those regions. Additionally, Vosejpka explains that many growers have seed that is not yet certified that could be used for eventual biomass establishments.

Currently, it is hard to create demand before the product is actually available. However, many of the seed growers are optimistic that if the market demand for biomass is there, the seed supply will be there. Market demand for biomass must increase in order for seed production to accelerate. Seed production will not accelerate until this occurs because, unlike commodities, government price support subsidies or other 'safety nets' are not present in the native seed market.

How often is native seed obtained now, and would collection need to increase to meet an increased market demand for biomass?

Vosejpka explains that native seed is usually collected once or twice from a wild stand. From this seed, production fields are then planted. Collecting seed from small prairie remnants, said Vosejpka, is labor intensive and inefficient, and there is a risk of over-harvesting. Once a production field is established, it will produce good seed yields anywhere from two years to decades, depending on the species. A producer would usually raise seed in a monoculture to maximize seed production, and the seed is then easily labeled and can be mixed in a warehouse before sold for planting.

Is anyone testing the prairie species for adaptation to different regions?

"Protecting and Enhancing Minnesota's Native Prairie Plant Resources:" A 2008 LCCMR Proposal

The University of Minnesota is currently researching ways to produce a larger supply of seed, and there has been an interesting research proposal submitted by Professor Donald Wyse at the U of M, entitled "Protecting and Enhancing Minnesota's Native Prairie Plant Resources." The basic goals of his research are to collect, preserve and increase seed supply of Minnesota source-identified native prairie plants and evaluate their adaptation to diverse soil and moisture environments across Minnesota's ecotype regions[7]. In addition, any changes in genetic diversity would be monitored in the native plant populations. Professor Wyse would establish Generation 2 production fields from Generation 1 seed. Similarly, in a Prairie Seed Production and BioEnergy Project passed through the Minnesota Legislature in 2007, the DNR is set to recommend guidelines and criteria for native prairie seed harvest.

[6] According to the Minnesota DNR, "Prairie *reconstruction* or planting refers to reestablishing native plants such as prairie grasses and flowers on a site that probably grew there before being eliminated by lawns, crops or other development.

[7] 2008 LCCMR proposal: "Protecting and Enhancing Minnesota's Native Prairie Plant Resources" http://www.lccmr.leg.mn/RequestforProposals/2008/Proposals/07-083-000proposal.pdf

Within this legislation, the DNR states seed supplies from second and third generation reconstructions may be needed in order to prevent over harvesting of seed from remnant native prairies.

Is genetic modification of seed necessary to replicate seed?

According to the consensus among farmers, seed producers, and officials at the DNR, genetic modification of seed would *not* be necessary to meet the potential demand for prairie biomass. While many seed companies are looking to develop seed strains with maximum growth and disease resistant characteristics, local ecotype seed is preferred by many. One of the major risks of using genetically modified seed is the possible contamination of native prairie. Genetically modified seed could be carried by the wind or some other factor from a production field to a remnant prairie nearby, potentially leading to the genetic contamination of the native species. Seed could also be carried from one production field to another, altering the species composition and purity of the farmer's harvest.

What land is available for biomass harvest?

Questions about biomass demand factor into the issue of availability of land conversion for biomass production. Production fields would most likely need to increase as would seed harvesting fields, albeit a minimal acreage. It is unclear is how much land will be required of growers to grow sufficient amounts of grasses for the market. There is hope that seed production will be able to meet increased demand farmers increase crop establishment. There has been interest in harvesting biomass on state conservation lands (see the Chariton Valley Biomass Project), although as it stands right now, biomass on conservation lands cannot be harvested for sale[8].

Mixed Prairie Stands: *What are the benefits of harvesting* mixed *prairie species for biomass?*

The key in this transition to biofuels from prairie grasses is to maximize the environmental and conservation benefits these new kinds of prairies offer. Prairie reconstructions offer many environmental benefits on the land, regardless of the biofuels harvesting activity. Benefits include:

- Renewed Soil Fertility on Marginal Lands: Mixed prairie grasses can grow in marginal, degraded lands with little or no application of water or fertilizers. This results in renewed soil fertility on those marginal lands and permanent cover which reduces soil erosion and runoff of chemicals and nutrients into our rivers, lakes, and streams.
- Carbon Sequestration: Prairie grasses develop extensive roots systems that store carbon in the soil, sequestering enough carbon dioxide the grasses are considered to be carbon negative. Burning biomass produces greenhouse gas emissions like burning coal does, but prairie species sequester the same amount of gas they release when they are burned.
- Preservation of Wildlife Habitats: The mixed prairie stands provide habitat for nesting birds and other wildlife.

[8] USDA Conservation Reserve Program requirements

Adding forbs to the mixture…

It has been found that harvesting forbs, herbaceous flowering plants, with the mixed prairie species can provide added environmental and wildlife benefits. Some are nitrogen-fixing species benefiting the grass species and potentially eliminating the need for fertilizer. The forbs also create variation in size and height in the stand, provide food for insects, and form open spaces for wildlife to perch and nest.

While forbs can create added benefits, they also pose certain obstacles in biofuels development. Wayne Edgerton, Agricultural Policy Director at the DNR, explains that one issue is that forbs will eventually return less tonnage on biomass than grass. Also, while grass and forb seed will be raised in monocultures and then mixed for biomass production, production of forb seed is more complicated because of the variety in plant flowering habits. Growers may have some issues related to the timing of the seed harvests if they look to produce both forb and grass seed for eventual biomass harvest.

Bill Olson, owner of Feder Prairie Seed Co. and president of the Minnesota Native Wildflower/Grass Producers Association, hopes that his company will be able to benefit from their annual harvest of 60 different species of wildflower forbs grown on 300 acres in Southern Minnesota. According to Olson, one downside to mixed stands of grasses and forbs would be that it restricts any kind of herbicide. If it kills thistles, it kills forbs. While the need for herbicide is lessened by the use of perennials, it is not completely eliminated as an agricultural practice. Spot spraying could be a viable alternative.

Investment Risks

At this stage, it is reasonable that many farmers would feel hesitant about establishing perennial grasses for biomass harvest without a clear biomass market. Even if farmers were to plant mixed prairie species, they would be investing in a harvest that may not provide return until the second or third year or production. During those first harvest years, perennial grass production is not likely to generate significant income.

As stated before, another issue is how much acreage will be needed to produce sufficient harvest for energy markets. Market demand will likely require more land be put into mixed prairie production, but where will this land come from? With increasing corn and soybean prices and a lack of economic incentives for cellulosic biomass production, it is unlikely that a large amount of land will go into prairie harvest, at least right away. Farmers are even pulling land out of conservation programs, and putting them into corn or soybean production.

Current Biomass Markets/Initiatives in Minnesota:

While there may not be a significant shift to biofuels from mixed prairie for another few years, pilot projects are already underway and will be key in demonstrating the feasibility of biomass harvesting using available and known equipment and techniques. These projects will help us all to realize the realities and obstacles of what such a transition would take to succeed. Some of these models include:

- *The University of Minnesota-Morris gasification facility*

The University of Minnesota- Morris received funding from the Minnesota Legislature in April 2005 to construct a biomass gasification demonstration and research

facility[9]. The gasification reactor converts corn stalks and other residual cellulose materials into a syngas (a synthetic gas similar to natural gas), which is then burned to produce clean heat. This energy will offset more than 80% of the University's heating and cooling needs that are currently met by fossil fuels.

This project is already beginning to answer important questions about biomass harvesting methods, storage, transportation, and the economic viability of the biomass. The facility planned to use corn stover and woodwaste as the primary feedstocks, but interest in trying native grass prompted the Minnesota DNR to grow and harvest grass and forbs for processing at the Morris facility. They were harvested on two state wildlife managements areas (WMAs) and three federal waterfowl production areas (WPAs) in Steven's County, MN. According to a report about the pilot study[10], cutting was done with a haybine cutter, and the biomass was baled in large round bales. A custom baler then collected the biomass and it was delivered to the University of Minnesota, West Central Research and Outreach Center.

According to Joel Tallaksen's cost report for the pilot project, there were no significant problems reported by the contractor related to the harvest process, although the rainy weather significantly impacted the return of the harvest at the different sites. Soft wet ground resulted in reduced areas that could be harvested, and some patches of high yielding grass were unharvestable. The softened soils also was problematic with some of the baler equipment. Some bales had to remain on site until the ground had dried, permitting less destructive vehicle traffic. The biomass yields ranged from 1.2 to 2.78 tons per acre, with an average biomass yield of 1.7 tons per acre.

In terms of costs, the contractor billed for each aspect of the harvesting (cutting, baling, transportation, equipment, etc.), making it difficult to determine the total cost of harvesting per acre. The cost per ton of biomass was the lowest on the higher producing sites. The two largest sites harvested cost the University less than the initial goal of roughly $45 per ton.

How can biomass harvesting be used as a prairie management technique?

While harvesting biomass for energy has the potential to provide the UMM with a large percentage of their heating needs, offer conservation and wildlife benefits, etc., it could hold another benefit of providing the DNR an alternative grass management method to burning. Kevin Kotts, Area Wildlife Manager at the DNR, explains that the DNR would like to mow the biomass in September or October of 2008, instead of doing prescribed burns in April or May. (The UMM study was conducted during the spring, so the seasonal affects on the biomass harvest are not clear). In Minnesota, fires offer great benefits to the prairie ecosystem. Fires prevent brush and trees from invading the prairie, remove the build-up of dead vegetation, and encourage new plant growth[11]. The harvest of prairie grasses is not so different than the fires that periodically swept across the plains. The biomass harvest could provide the same restorative benefits as prescribed burns, while having the added benefit of supplying biomass to a bioenergy market.

Current Status:

[9] University of Minnesota online news

[10] "Biomass Harvesting of Native Grasslands in West Central Minnesota: A production scale pilot study." Joel Tallaksen, West Central Research and Outreach Center, University of Minnesota

[11] Minneapolis Parks and Recreation Board: http://www.minneapolisparks.org/default.asp?PageID=565

The Morris gasification project dealt with the feasibility of actually harvesting biomass from native prairie. However, the project still faces obstacles in progressing to its next phases. First, Kevin Kotts emphasizes that the University will need to secure more biomass for its heating needs, as the 300 tons that was harvested is only a part of what is needed. Furthermore, acquiring the seed from within a 25 mile radius may prove impossible, due to the University's location in farm country where there is not much native prairie. Thirdly, the baled hay is currently sitting in a pile near the plant, waiting to be processed. The gasification plant is not done yet, and the project doesn't have an emissions permit yet from the Minnesota Pollution Control Agency, to process the wood or the corn stover. The grasses will also need emissions testing, and they will most likely work with the federal EPA because a part of the biomass was harvested on federal lands.

- *The Madelia Model*

According to the project flyer[12], "The Madelia Model is centered on the concept of evolving a rural community into one that promotes a sustainable mindset through the establishment of a bio-based industrial park that utilizes agricultural crops grown in the region for renewable energy and value added processing."

Through collaboration between various partners including the City of Madelia, Minnesota and Rural Advantage, a nonprofit working to revitalize rural communities, a community vision was developed to encourage people to look beyond ethanol production and towards alternative energy and its added environmental and economic benefits. The model centers on the goal of growing or collecting enough biomass to fuel the community within a 25 mile radius of Madelia. For this project, biomass sources can be natural or industrial, as long as its origins are within the 25 mile radius[13].

The Madelia Bio-Based Eco-Industrial Assessment, published by Rural Advantage and other partners, addresses the major logistical issues of how this would work. The assessment was conducted to identify, inventory, and assess the biomass supply within the project area. Rural Advantage is looking to native grasses as the primary biomass material.

What land will be used within the 25 mile radius of Madelia?

According to the report, of the 1.9 million acres currently in corn/soybean production, 20% (380,000) acres could be converted to bio-energy crops, targeting the environmentally sensitive areas. Linda Meschke, the president of Rural Advantage, emphasizes that one of the key questions of the project is "how to carry out the conversion of environmentally sensitive areas to perennials from annual production." Similar to many projects looking to harvest biomass, targeting marginal lands provides many conservation benefits and would not attempt to take the most productive lands out of corn and soybean production, thereby avoiding competition for high-profit prime farmlands.

How can biomass harvest be made cost competitive with corn and soybean production?

Linda Meschke understands current payments for biomass are not enough to compete with corn and soybean rewards. However, Meschke emphasizes the importance of

[12] www.ruraladvantage.org The Madelia Project flier
[13] www.ruraladvantage.org Madelia Report

considering how farmers can be rewarded for biomass production. First, farmers could receive a payment, similar to CRP, for putting fields into biomass production, as is proposed in state and federal legislation. Second, there would be less production costs per acre compared to corn and soybean production (less inputs, fertilizer, etc.). Thirdly, seed sales could provide additional returns to the farmer. What Meschke and other members of Rural Advantage are working on now is the creation of an "ECoPayPack," or an ecological commodity payment package, that would consist of a payment to the farmer for the ecological services provided by the biomass production on his land, as a complement to the production payment. This concept, based on existing ecological services payment programs, places a monetary value on the ecological services that perennials provide. According to Meschke, Madelia's main ecological services could be carbon sequestration, nitrogen reduction, phosphorous reduction, aquifer recharge, and wildlife habitat improvement. Meschke believes that for the Madelia Project to be successful, this type of payment needs to be developed. Perennial biomass crops need to be competitive economically so they can drive landscape change. "We need to build a system that will be sustainable for the long term."

The model addresses one of the key issues in the development of biofuels from local sources: how to deal with voluminous bales of biomass and mitigate transportation costs. According to the Madelia Bio-Based Eco-Industrial Assessment, pyrolysis was examined as a potential biomass processing technology that would take bales of hay and convert them to a bio-oil. Pyrolysis, the chemical decomposition of organic materials by heating in the absence of oxygen, could be utilized locally, and its conversion of grasses to bio-oil would consolidate the materials and make them easier to transport.

- *The Minnesota Valley Producers (MnVAP) and biomass pelletizing initiatives*

Minnesota Valley Producers (MnVAP) is a Minnesota farmer-owned cooperative working with alfalfa processing and marketing[14]. The association has processed both alfalfa and grasses with an older line of technology and has produced alfalfa leaf pellets to be shipped to feed mills around the United States to be used as livestock feed[15]. Alfalfa, a non-native perennial species, offers many conservation benefits such as preventing soil erosion and enhancing soil and water quality. It also has great economic benefits, as alfalfa returns in southwest Minnesota have topped returns on corn and soybeans. MnVAP is now looking to produce biomass fuel pellets as a renewable energy source and has received a $1 million renewable-energy grant from the Xcel Energy Renewable Development Fund to test the KDS technology for grinding and drying high moisture agricultural fibers, such as wood, native grasses and crop residues.

What types of benefits could the KDS technology offer for biomass processing?

Concerns with biomass production and usage have prompted MnVAP to test a biomass processing method known as a kinetic disintegration system or KDS that would begin to answer the question of how we can process bulk biomass to a form that can be shipped, stored, and used for energy. According to Keith Poier, Montevideo, MN farmer and MnVAP chair, alfalfa is one of the more difficult materials to process. It is bulky, and many bioenergy facilities have already had bulk storage issues. Mr. Poier explains that the MnVAP has a four phase plan for their fuel pellets initiative, and have prioritized the issue of dealing

[14] MnVAP website: www.mnvap.com
[15] "Power Renewal: A Minnesota cooperative returns it founding vision of biomass energy" http://www.auri.org/news/ainapr08/power_renewal.htm

with the densification, transportation, and storage of biomass. The KDS technology would improve the energy efficiency of the pelletizing method by minimizing the energy costs to actually compress the biomass bales into a pellet. According to Poier, the KDS would combine energy-intensive grinding and drying steps. In the KDS, an initial shredder would still be necessary, but a spinning process would then take out the moisture from the biomass and produce heat which would dry the rest of the material, eliminating the need for a drier. Poier explained that preliminary theory estimates that the technology would save on 35-40% of power usage, greatly lowering the costs for densifying biomass material.

How can MnVAP alfalfa pelletizing be used as a relevant model for native grass processing for energy?

Poier explains that if MnVAP can lower the cost of pelletizing their primary feedstock, alfalfa, that it should follow that it will drop on different biomasses and their blends. Poier elaborates that the plan is to test sixteen different types of biomass, individually and in blends, to determine burn ability. They will include prairie grasses in their testing, in hopes of selecting appropriate varieties for the KDS technology.

- *The Chariton Valley Biomass Project*

History

The Chariton Valley Biomass Project was a very successful pilot project in Iowa where switchgrass was evaluated as a fuel source to help power a coal fired electricity plant, owned by Alliant Energy[16]. Switchgrass, a native, warm-season grass, was identified as an alternative revenue generating crop for southern Iowa farmers and growers received permission from the USDA to harvest the biomass on Conservation Reserve Program (CRP) lands. According to the project website, the primary goal of the project was to conduct all necessary research, demonstration, analysis, planning, development, and outreach work required to lay the groundwork for commercializing the project. Through initial and interim switchgrass cofire tests at the Ottumwa Generating Station in Iowa, it was determined that switchgrass could be burned to offset a small percentage of heat input to the 725 MW power plant, and that equipment improvements could result in measurable decreases in sulfur dioxide emissions and other reasonable emissions from carbon monoxide, nitrogen oxide, etc. Eventually, during the spring of 2005, Alliant Energy/Interstate Power & Light and Chariton Valley RC&D Inc. received approvals and permits necessary for operating a commercial switchgrass operating facility at Ottumwa Generating Station.

Added benefits: Fly ash byproduct

A unique feature of this project is that the energy facility not only received permission to burn up to 5% switchgrass as a heat input, but they also maintained the ability to sell the fly ash byproduct (from the switchgrass co-firing) in the profitable concrete admixture market. During the interim test burn, large samples of co-fired fly ash were collected to test for use in concrete. This fly ash proved to meet certain requirements to be mixed with concrete.

[16] www.iowaswitchgrass.com

Current Status

While the project seemed to be getting off its feet, the utility never received a production tax credit for the switchgrass fuel production and it was eventually pulled when the federal funded ended.

The project did not experience significant setbacks during its existence. One issue raised by John Sellers, former field coordinator of the project who dedicated multiple years to the project, is that the farmers had to work with partial grass stands from CRP with a density far below optimum. There was about one plant per sq. meter, and there was also high stand height variability within the same field.

However, the project results are considered to be a success. It demonstrated that a project like this *is* feasible. It was a practical experience and provided a great amount of research to aid a next generation of projects. While this project involved the harvesting of primarily monoculture stands of non local ecotype switchgrass varieties, it still provides an important framework for facilities looking to biomass processing for biofuels.

Sellers believes that two of the primary obstacles to biofuels development from cellulosic crops are the fight against grain ethanol and the current lack of a biomass market. For biofuels from prairie to really jumpstart in Minnesota, there has to be some way to make it *competitive.* He believes that harvesting on CRP lands is the only option to be competitive in the market. However, while the Chariton Valley project received permission to harvest on CRP lands, it is now much harder to gain the rights to do so. There are many competing interests in the management of CRP lands, and many conservation groups do not want to see any type of harvesting on the lands.

What does the future hold for biofuels from new prairie establishments in Minnesota?

As it stands, great optimism has been expressed in terms of creating a sustainable agriculture for biofuel production. Primarily, the development of a prairie seed industry has great potential to be matched with increased biomass crop establishments. The native seed producers provide to a niche market in Minnesota. The growers specialize in certain seed varieties, and often sell seed between producers in the area. Such a collaborative environment can be a driving force in seed industry development. While questions of seed supply and lands for biomass harvest have started to be answered, processing technologies and their pending permits are an important part of the equation as well.

Acknowledgments:
A special thanks to Loni Kemp, Mark Lindquist of Minnesota Department of Natural Resources, Dwayne Vosejpka of Prairie Meadows Native Seed Company, Wayne Edgerton of Minnesota Department of Natural Resources, Bill Olson of Feeder Prairie Seed Company, Kevin Kotts of Minnesota Department of Natural Resources, Linda Meschke of Rural Advantage, Keith Poier of Minnesota Valley Producers, and Jane Tigan of The Minnesota Project.