

**U.S. DEPARTMENT OF  
AGRICULTURE**

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**FY 2007  
ANNUAL REPORTING ON  
TECHNOLOGY TRANSFER**



*January 3, 2008*

*U.S. Department of Agriculture (USDA)*

# **Annual Reporting on Agency Technology Transfer<sup>1</sup>**

This report covers technology transfer activities and metrics for the Agricultural Research Service (ARS), the Animal Plant Health Inspection Service's Wildlife Services (APHIS-WS), and also includes tabular metrics of inventions, licenses, and Cooperative Research and Development Agreements for the Forest Service.

## **Agricultural Research Service (ARS)**

### **Mission Statement**

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority to:

- ensure a high-quality, safe, abundant food supply;
- assess the nutritional needs of Americans;
- sustain a competitive agricultural economy;
- enhance U.S. natural resources and the environment; and to
- provide economic opportunities for rural citizens, communities, and society as a whole.

### **Structure of Research**

ARS is USDA's principal intramural scientific research agency. Agency goals are to find solutions to agricultural problems that affect Americans every day, from field to table, such as (a) protecting crops and livestock from pests and diseases, (b) improving the quality and safety of agricultural products, (c) determining the best nutrition for people from infancy to old age, (d) sustaining our soil and other natural resources, (e) ensuring profitability for farmers and processors, and (f) keeping costs down for consumers.

ARS employs approximately 2300 permanent full-time scientists who conduct research in projects funded by Congressional appropriations at over 100 locations. Research projects are grouped into 21 National Programs under the four broad pillars of Animal Production and Protection; Nutrition, Food Safety and Quality; Natural Resources and Sustainable Agricultural Systems; and Crop Production and Protection. The National Program Staff in Beltsville, MD coordinates the scope and objectives of Agency research projects, while eight Area Directors implement research projects at the locations in their geographic areas. All research projects undergo a mandatory 5-year peer review and assessment cycle to meet the changing needs of customers and stakeholders. The Office of Scientific Quality Review convenes panels of industry and university scientists to review research progress, evaluate the 5-year research proposals, and evaluate the scientific qualifications and abilities of agency researchers. The process is designed to ensure quality, impact, and research relevance.

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<sup>1</sup>In response to the requirements identified for the annual "agency report on utilization by 15 USC Sec. 3710 (f)(2).

# Animal Plant Health Inspection Service (APHIS) – Wildlife Services (WS)

Beginning in FY 2006, the ARS Office of Technology Transfer expanded its services to APHIS-WS. APHIS is responsible for protecting and promoting U.S. agricultural health, administering the Animal Welfare Act, and carrying out wildlife damage management activities. The 2003-2008 APHIS Strategic Plan indicates that for wildlife issues, programs will be expanded in the areas of wildlife disease and invasive species control, with increased emphasis on research in these areas. APHIS and its stakeholders have become aware of the need to pay more attention to wildlife diseases—particularly those that are transmissible to humans and domestic livestock—and invasive species that impact ecosystems. APHIS's National Wildlife Research Center in Ft. Collins, CO will continue to expand its research into these areas. This research has important implications for APHIS emergency preparedness initiatives. APHIS will continue to partner with the Federal Aviation Administration to work with managers of the country's airports to minimize the risks wildlife pose to public safety and the aviation industry.

## I. ARS Approach and Plans for Technology Transfer

### Technology Transfer Principles, Modes, and Plans

ARS has been delegated authority by the Secretary of Agriculture to administer the patent program for ARS, and the technology licensing program for all intramural research conducted by USDA. Thus, ARS's Office of Technology Transfer (OTT) is assigned the responsibility for protecting intellectual property, developing strategic partnerships with outside organizations, and performing other activities that effectively transfer ARS research outcomes and technologies to the marketplace. The Patent Section of the USDA Office of General Counsel provides legal guidance to OTT.

ARS-OTT is centralized in policy and approval procedures, but maintains field offices to provide one-on-one customer service to ARS researchers. To facilitate technology transfer, OTT is organized into five sections. The *Administrative/Headquarters Section* conducts day-to-day operations, coordinates technology transfer policy development, and executes licenses and Cooperative Research and Development Agreements (CRADAs). The *Patent Section* assists scientists in protecting intellectual property (IP), coordinates invention reports, prepares and prosecutes patent applications, and oversees any patent applications prepared by contract law firms. The *Licensing Section* negotiates licenses for IP developed by USDA scientists and monitors license performance. The *Marketing Section* develops, implements, and coordinates marketing strategies to facilitate technology transfer. ARS has seven *Technology Transfer Coordinators* (TTCs) strategically stationed across the United States who are responsible for facilitating the development and transfer of USDA technologies. They serve as liaisons with scientists, ARS managers, university partners, and the private sector. They also negotiate CRADAs and other technology transfer agreements. The TTC for the Northern Plains Area, located in Ft. Collins, CO, also serves as the principal point of contact and liaison for scientists conducting research within APHIS-WS.

Technology transfer is accomplished through many mechanisms, such as:

- written information including scientific publications, publications in trade journals, and reports to stakeholders,
- public release of plant germplasm,

- transfer of research materials to scientists outside of ARS,
- formal partnership agreements such as CRADAs, and other cooperative agreements,
- delivering specific research results to regulatory agencies to support their actions,
- licensing of IP (patents, Plant Variety Protections Certificates, and biological materials),
- meetings with industry organizations and universities, workshops and field days; and
- information distributed by the ARS Information Staff, the National Agricultural Library, and other media.

Because the ARS mission is to transfer technologies for broad public use by the most effective mechanism, ARS pursues patents and licensing principally when this facilitates technology transfer to the marketplace. This is usually the case when complementary investment by the private sector is necessary to commercialize a product, and patent protection is required to protect this investment.

ARS holds periodic patent committee meetings to review invention disclosures and make recommendations to the Assistant Administrator for Technology Transfer on whether a patent is necessary for effective technology transfer. For APHIS-WS, invention disclosures are deliberated within ARS patent review committees that are expanded to include three APHIS-WS members. ARS committee recommendations for APHIS-WS inventions are made to the Director of the APHIS National Wildlife Research Center in Ft. Collins. ARS Patent Advisors prepare, file, and prosecute ARS patent applications and WS inventions on behalf of APHIS, and coordinate patent application filings in other countries through a contractor.

### **Strengthening Performance Metrics**

Meaningful performance metrics in technology transfer are often difficult for research agencies. For example, for ARS, successful outcomes may be improved agricultural practices, scientific information that enhances U.S. competitiveness, increased awareness about pathogens which help prevent human and animal diseases; or findings that help corporations and universities make informed decisions in allocating their research resources.

Notwithstanding the difficulties in measuring certain types of technology transfer outcomes, ARS is continuing to work on defining better metrics for technology transfer. In FY 2007, OTT hired a consultant to survey recent CRADA partners to help assess the impact of the CRADA program on individual small businesses that participated in the program, and to provide feedback from these customers about the delivery of OTT services. The results of this survey will be available early in FY 2008.

OTT now has fully functional patent and licensing database modules within the Agricultural Research Information System (ARIS) to allow portfolio development of “technology families.” The Invention Disclosure process for determining patent protection has been expanded by adding two new modules for tracking plant materials and biological material inventions. The Biological Materials Inventions module is designed for tracking information where private sector licensing is requested for those materials. This allows a refined process for documenting research outcomes. The Plant Materials module provides a way to review new plant varieties to determine the merits of protecting

and licensing intellectual property, versus making a public release. This module allows OTT to track research outcomes and document adoption by the private sector. Collectively, this improved infrastructure enables OTT to track technology transfer involving disclosed IP, plant germplasm and biological materials. Because licensing activities require detailed information on USDA patents, the ARIS database now includes all inventions arising from FS and APHIS-WS.

OTT uses a different ARIS module for the TTCs that capture information about potential and executed Confidentiality Agreements, Material Transfer Agreements, and CRADAs. All TTC activities on this database are linked to ARS National Program (NP) projects so that annual metrics can be obtained for each NP and included in annual reports for the Government Performance and Results Act, the Project Assessment Rating Tool, and the Budget Performance Integration. OTT prepares monthly reports to senior ARS management summarizing the activities tracked by this database. This allows Area Directors and National Program Leaders to monitor accomplishments and receive early notice of potential future technology transfer activities.

OTT continues to expand and improve its technology transfer activities. These include the following activities that reflect continued or new initiatives for FY 2007:

- Tradeshow attendance continued to be a part of OTT's marketing strategy in 2007. These shows allow OTT to diversify and reach new target customers. OTT's goal continues to be to have an ARS-presence at major industry conferences to present technologies available for licensing and research partnering opportunities of interest to industry. Tradeshows are an important element of the total marketing program used to communicate what ARS has to offer. OTT alternates the types of tradeshows it attends each year. In FY 2007 OTT participated in BIO 2007 and the International Food Technology Showcase. Shows are selected in part on the types and number of technologies in a particular area needing commercial partners.
- The ARS-OTT Technology Alerts, continues to expand its membership in 2007. Strategic marketing plans continue to focus on providing specific targeted information to agency customers. The Marketing Staff continues to fine-tune its Technology Alerts list by expanding list options. The list now includes technologies specific for: Animal Production; Swine; Cattle; Aquaculture; Poultry; Other Animals (every other animal, e.g. deer, sheep); Food, Safety and Nutrition; Biobased Products/Biofuels; Natural Resources; Biotechnology; and Crop Production; Corn; Cotton; Soybean; Wheat; and Other Crops (such as specialty and energy crops). Technology Alert customers may subscribe to one or more of these options.
- Given the increased emphasis during FY 2007 on sustainable energy and reducing the national reliance on petroleum, ARS is redefining and expanding research on bioenergy. The new National Program (213) brings emphasis to this research topic by realigning and combining components of other National Programs and planning new research. OTT and the National Program staff plan on conducting a technology transfer workshop in FY 2008 specifically addressing the technology transfer processes necessary to enhance bioenergy research outcomes. OTT is also designing a new public exhibition module on this topic in collaboration with the ARS Information Staff.
- The ARS and FS research capacities are strategically positioned to help federal agencies meet preferred procurement of biobased technologies, as defined in the 2002 Farm Bill. "Biopreferred" procurement is expected to be enhanced in the 2007 Farm Bill.

During 2007, OTT detailed an employee to assist USDA's Departmental Administration with promoting the Biopreferred program to Federal buyers and industry producers.

- OTT also plays a key role in the USDA Energy Council, which was established in FY 2006 to enhance coordination of research and technology transfer efforts in bioenergy and biobased products toward the goal of reducing reliance on petroleum and petroleum-based products. OTT is taking a leadership role in helping to expand research opportunities with the private sector toward this important national goal.
- OTT has created a Web-based intranet using Microsoft SharePoint to improve customer service by enhancing internal communications and efficiency. Now all draft CRADA agreements are transmitted from field locations electronically to secure folders for final preparation, approvals, and signatures. The system also includes tracking and status of routing and approvals, so that metrics can be developed on the efficiency of OTT activities. Metrics from the system can be used as a tool to identify areas where improvement can be achieved. This reduces execution time, allows for continuous improvement while also giving all technology transfer practitioners access to all CRADA documents from field locations. OTT has converted all Invention Disclosure Review Committees to a paperless system, again using the secure connections of the intranet in SharePoint. This reduces costs of copying and shipping all confidential supporting documentation to each of the committee members who are located across the country. In addition to the cost savings, this process also allows "last minute" inclusions of supporting information, and facilitates electronic archiving of all deliberations and decisions.
- Beginning with FY 2006, ARS-OTT expanded its services to APHIS-WS, and this Annual Report includes sections on APHIS-WS. Research operations for APHIS-WS are centered in Ft. Collins, CO at the National Wildlife Research Center (NWRC) where research activities focus on four major areas. These include Bird Research (e.g., hazards to aircraft, nonlethal repellents and attractants), Mammal Research (e.g., wildlife impacts on forest damage, predator ecology, behavior and management; rat damage to crops), Product Development Research (e.g., analytical chemistry, APHIS pesticide registrations and labels, wildlife damage management, immunocontraception and other fertility controls, Brown Treesnake), and Wildlife Disease Research (e.g., rabies and bovine tuberculosis, avian disease, chronic wasting disease, psuedorabies).
- ARS is evaluating the role that Enhanced Use Lease (EUL) authority would provide to technology transfer efforts, if such authority is granted to USDA. In combination with Partnership Intermediary Agreements, EUL may aid in developing long-term partnerships with the private sector. As USDA increases research on biofuels, EUL agreements may help address difficult technological barriers by providing private sector firms access to ARS pilot plants and bioenergy research facilities over extended periods.
- The five agency Patent Committees were realigned in FY 2007 to form three national committees by discipline/subject matter to minimize time between submission and review, and to provide better consistency of decisions across the agency. These new committees were instituted on October 1, 2007 (FY 2008).
- OTT also launched on October 1, 2007, a "Natural Resources Research Update" system as a three year pilot program in response to feedback from customers and stakeholders

of the Soil Resource Management National Program, who wanted access to ARS's latest scientific results from natural resources programs. The Natural Resources Research Update system will allow customers to subscribe to the system via the web and select categories of information they would like to receive. When an ARS scientist posts a research update, it is categorized based on key words, and then emailed to customers requesting information from that category—ensuring information is transferred to customers in a timely manner. OTT will also solicit feedback from the customers about the impact of the research updates on their operations.

- In FY2008, OTT and NPS will release an electronic *ARS Handbook for Plant Breeders* which will provide advice to ARS researchers in National Program 301. The handbook will describe ARS policies and procedures related to release and technology transfer of plant germplasm. It will also cover how to use the ARIS Plant Materials module and provide guidance on ARS management of plant IP issues.
- ARS continues to work closely with the Biotechnology Research and Development Corporation (BRDC) in Peoria, IL. Historically, through a series of research awards and subawards administered by BRDC, a number of technologies have been patented and licensed. Discoveries of new biobased products were licensed to two start-up companies in the Midwest. One company is developing a conjugated soy oil molecule as an additive for cosmetics. A second company is focusing on a process to produce natural sweetening agents that can replace sucrose and the synthetic sweeteners currently in use. In addition, technologies for identifying swine resistant to *E. coli* and a number of animal disease vaccines for swine, poultry, sheep, and cattle are in the final stages of development.
- In the closing days of FY2007, ARS executed its first Partnership Intermediary Agreement. This new instrument to ARS was developed to facilitate partnerships with private sector companies through an economic development intermediary that can provide complementary business and financial assets to ARS research or license partners. This inaugural agreement was signed with the Maryland Technology Development Corporation (TEDCO) to focus on biobased and bioenergy technology development to assist private sector economic sustainability, principally of Maryland companies.

Collaborative Relationships for Research & Development (R&D)

CRADAs and Other R&D

Agricultural Research Service (ARS)	FY 2003	FY 2004	FY 2005	FY 2006 <sup>1</sup>	FY 2007
<b>• CRADAs, total active in the FY</b>	229	205	199	185	207
- New, executed in the FY	55	44	55	50	55
▪ Traditional CRADAs, total active in the FY	212	185	171	163	184
- New, executed in the FY	48	36	45	40	47
▪ Non-traditional CRADAs, total active in FY	17	20	28	22	23
- New, executed in the FY	10	8	11	10	8
▪ Material Transfer - CRADA, total active in the FY	6	4	6	7	5
- New, executed in the FY	4	0	3	2	2
▪ Master, total active in the FY	1	2	1	1	1
- New, executed in the FY	1	1	0	0	0
▪ Multiple Cooperators, total active in the FY	10	9	17	7	10
- New, executed in the FY	3	3	4	1	3
▪ Foreign - CRADA, total active in the FY	5	5	9	7	7
- New, executed in the FY	3	3	4	2	3
<b>• Amendments<sup>2</sup>, total in the FY</b>	65	67	70	73	77
<b>• Other collaborative R&amp;D relationships, total active in the FY<sup>3</sup></b>					
▪ Confidentiality Agreements					
- New, executed in the FY		162	242	227	329
▪ Material Transfer Agreements					
- New, executed in the FY	355	498	722 <sup>4</sup>	700 <sup>5</sup>	788 <sup>6</sup>
▪ Other Agreements, total active in the FY <sup>3</sup>	174	1,166	5,028	3,477	4,084
- New, executed in the FY	N/A	741	722	676	1,159
<b>• Animal and Plant Health Inspection Service (APHIS)</b>					
▪ CRADAs, total active in the FY	N/A	N/A	N/A	2	3
- New, executed in the FY	N/A	N/A	N/A	2	1
▪ Material Transfer - CRADA, total active in the FY	N/A	N/A	N/A	1	7
- New, executed in the FY	N/A	N/A	N/A	N/A	6
▪ Confidentiality Agreements	N/A	N/A	N/A	N/A	12
- New, executed in the FY	N/A	N/A	N/A	N/A	4
<b>• Forest Service (FS)</b>					
▪ CRADAs, total active in the FY	N/A	N/A	N/A	8	20
- New, executed in the FY	N/A	N/A	N/A	5	13

<sup>1</sup> Data for 2006 from APHIS and FS was originally reported with ARS CRADA data. The APHIS and FS data is now separate and reflected in rows identified

<sup>2</sup> Amendments extend existing CRADAs for additional years to a maximum of 5 years, and/or change Statements of Work, and/or change funding levels.

<sup>3</sup> Includes Trust Fund Agreements, Reimbursable Agreements, and Non-Funded Cooperative Agreements; data incomplete for FY 2003.

<sup>4</sup> Includes 523 processed for outgoing materials, representing research outcomes of interest to other researchers and private sector companies.

<sup>5</sup> Includes 500 processed for outgoing materials, representing research outcomes of interest to other researchers and private sector companies.

<sup>6</sup> Includes 564 processed for outgoing materials, representing research outcomes of interest to other researchers and private sector companies.



**Invention Disclosure and Patenting**

Intellectual Property Management<sup>1</sup>

<b>Agricultural Research Service (ARS)</b>	<b>FY 2003</b>	<b>FY 2004</b>	<b>FY 2005</b>	<b>FY 2006</b>	<b>FY 2007</b>
• New invention disclosures in the FY	121	142	125	105	124
• Patent applications filed in the FY	60	81	88	83	107
• Non-Provisional	43	59	62	59	68
• Provisional	17	22	26	24	39
• Patents issued in the FY	64	50	27	39	35

<sup>1</sup> Includes data from APHIS. Includes data from FS through FY 2006

<b>Forest Service (FS)</b>	<b>FY 2003</b>	<b>FY 2004</b>	<b>FY 2005</b>	<b>FY 2006</b>	<b>FY 2007</b>
• New invention disclosures in the FY	N/A	N/A	N/A	N/A	2
• Patent applications filed in the FY	N/A	N/A	N/A	N/A	7
• Non-Provisional	N/A	N/A	N/A	N/A	5
• Provisional	N/A	N/A	N/A	N/A	2
• Patents issued in the FY	N/A	N/A	N/A	N/A	2

**Licensing**

Profile of Active Licenses<sup>1</sup>

<b>Agricultural Research Service (ARS)</b>	<b>FY 2003</b>	<b>FY 2004</b>	<b>FY 2005</b>	<b>FY 2006</b>	<b>FY 2007</b>
• All licenses, number total active in the FY	270	296	320	332	327
• New, executed in the FY	27	29	33	25	25
• Invention licenses, total active in the FY	270	296	320	332	327
• New, executed in the FY	27	29	33	25	25
- Patent licenses, total active in FY	269	290	309	316	327
• New, executed in the FY	26	24	28	20	20
- Material transfer (invention), total active in FY	1	6	11	16	22
• New, executed in the FY	1 <sup>2</sup>	5	5	5	5

<sup>1</sup> "Active" means legally in force at any time during the FY, whether or not the license is income bearing. USDA licenses are patent invention and material transfer (invention) licenses. There are no other invention licenses or other IP licenses. FS data included for 2003-2006. Data for FY 2003 and FY 2004 was corrected for typographical errors.

<sup>2</sup> This represents USDA's first material transfer (invention) license.

<b>Forest Service (FS)</b>	<b>FY 2003</b>	<b>FY 2004</b>	<b>FY 2005</b>	<b>FY 2006</b>	<b>FY 2007</b>
• All licenses, number total active in the FY	N/A	N/A	N/A	N/A	12
• New, executed in the FY	N/A	N/A	N/A	N/A	0
• Invention licenses, total active in the FY	N/A	N/A	N/A	N/A	12
• New, executed in the FY	N/A	N/A	N/A	N/A	0

Income Bearing Licenses<sup>1</sup>

Agricultural Research Service (ARS)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
<b>• All income bearing licenses, number</b>	<b>268</b>	<b>294</b>	<b>318</b>	<b>330</b>	<b>337</b>
◦ Exclusive	183	200	220	233	241
◦ Partially exclusive	41	41	37	32	24
◦ Non-exclusive	44	53	61	65	72
<b>• Invention licenses, income bearing</b>	<b>268</b>	<b>294</b>	<b>318</b>	<b>330</b>	<b>337</b>
◦ Exclusive	183	200	220	233	241
◦ Partially exclusive	41	41	37	32	24
◦ Non-exclusive	44	53	61	65	72
- Patent licenses, income bearing	267	288	307	314	315
◦ Exclusive	183	200	220	233	238
◦ Partially exclusive	41	41	37	32	24
◦ Non-exclusive	43	47	50	49	53
- Material transfer (invention) licenses, income bearing	1	6	11	16	22
◦ Exclusive	0	0	0	0	3
◦ Partially exclusive	0	0	0	0	0
◦ Non-exclusive	1	6	11	16	19
<b>• All royalty bearing licenses, number <sup>2</sup></b>	<b>75</b>	<b>82</b>	<b>99</b>	<b>100</b>	<b>106</b>
<b>• Invention licenses, royalty bearing</b>	<b>75</b>	<b>82</b>	<b>99</b>	<b>100</b>	<b>106</b>
- Patent licenses, royalty bearing	75	82	96	93	101
- Material transfer (invention) licenses, royalty bearing	0	1	3	7	5

<sup>1</sup> Includes data from FS.

<sup>2</sup> Totals include only those licenses that actually **received** royalty income.

Licensing Management

Agricultural Research Service (ARS)	FY 2003 <sup>5</sup>	FY 2004 <sup>4</sup>	FY 2005 <sup>3</sup>	FY 2006 <sup>2</sup>	FY 2007 <sup>1</sup>
<b>• Number of licenses</b>					
▪ <b>Invention licenses, total active in the FY</b>	270	296	320	332	339
◦ New, executed in the FY	27	29	33	25	25
<b>• Elapsed execution time, licenses granted in the FY</b>					
<b>▪ Invention licenses</b>					
◦ average (months)	7.0	7.1	5.5	11.2	8.9
◦ median (months)	6.6	6.8	3.5	7.6	8.2
◦ minimum (months)	2.8	3.5	1.1	2.3	2.6
◦ maximum (months)	13.3	13.1	21.7	27.7	23.7
<b>- Exclusive and partially exclusive invention licenses</b>					
◦ average (months)	7.6	8.7	4.3	14.3	11.6
◦ median (months)	6.7	8.0	3.9	15.0	9.3
◦ minimum (months)	2.8	6.8	1.1	3.9	3.0
◦ maximum (months)	13.3	13.1	9.2	27.7	23.7
<b>- Non-exclusive invention licenses</b>					
◦ average (months)	5.9	6.2	6.8	6.7	6.9
◦ median (months)	5.8	6.0	2.9	5.9	8.2
◦ minimum (months)	3.5	3.5	1.7	2.3	2.6
◦ maximum (months)	9.9	11.5	21.7	12.1	11.5
<b>▪ Patent invention licenses</b>					
◦ average (months)	7.1	8.2	6.1	12.1	9.6
◦ median (months)	6.6	7.5	3.9	7.6	7.2
◦ minimum (months)	2.8	3.5	1.1	2.3	2.6
◦ maximum (months)	13.3	13.1	21.7	27.7	23.7
<b>- Exclusive and partially exclusive patent invention licenses</b>					
◦ average (months)	7.6	8.7	4.3	14.3	11.6
◦ median (months)	6.7	8.0	3.9	15.0	9.3
◦ minimum (months)	2.8	6.8	1.1	3.9	3.0
◦ maximum (months)	13.3	13.1	9.2	27.7	23.7
<b>- Non-exclusive patent invention licenses</b>					
◦ average (months)	6.1	7.8	8.6	4.8	6.5
◦ median (months)	6.6	7.1	5.8	5.9	6.4
◦ minimum (months)	3.5	3.5	2.6	2.3	2.6
◦ maximum (months)	9.9	11.5	21.7	6.3	11.5
<b>▪ Material transfer (invention) licenses</b>					
◦ average (months)	5.0	4.4	2.3	8.2	7.3
◦ median (months)	5.0	4.0	2.3	8.4	9.2
◦ minimum (months)	5.0	3.6	1.7	3.9	3.0
◦ maximum (months)	5.0	6.0	2.9	12.1	9.2
<b>- Non-exclusive material transfer (invention) licenses</b>					
◦ average (months)	5.0	4.4	2.3	8.2	7.3
◦ median (months)	5.0	4.0	2.3	8.4	9.2
◦ minimum (months)	5.0	3.6	1.7	3.9	3.0
◦ maximum (months)	5.0	6.0	2.9	12.1	9.2
<b>• Licenses terminated for cause, in the FY</b>					
▪ Invention licenses	0	1	0	0	0
▪ Patent invention licenses	0	1	0	0	0
▪ Material transfer (invention) licenses	0	0	0	0	0

<sup>1</sup> During FY 2007, USDA received 32 new invention license applications, for which 5 new licenses were granted, 22 license agreements are currently in negotiation, 1 application was withdrawn by the applicant, and 4 applications are on hold by request of the applicants. The FY 2007 data is based upon 19 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.

<sup>2</sup> During FY 2006, USDA received 35 new invention license applications, for which 1 new license was granted, 23 license agreements are currently in negotiation, 4 applications were withdrawn by the applicants, and 7 applications are on hold by request of the applicants. The FY 2006 data is based upon 17 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.

<sup>3</sup> Based upon 14 licenses granted to commercial licensees. FY 2005 data does not include the elapsed execution time (29.4 months) for a license granted to a commercial co-owner who delayed the company's decision to license USDA's rights in the licensed invention. The elapsed execution time data presented also does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore a license application is not required.

<sup>4</sup> Based on 17 licenses granted. The elapsed execution time data presented does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore a license application is not required. Records for which license applications were received prior to October 1, 2000 also were not included, because ARS did not track this data prior to FY 2001.

<sup>5</sup> Based on 16 licenses granted. The elapsed execution time data presented does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202 (e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore a license application is not required. Records for which license applications were received prior to October 1, 2000 also were not included, because ARS did not track this data prior to FY 2001.

License Income <sup>1</sup>

Agricultural Research Service (ARS)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
• Total income, all patent invention licenses active in the FY	\$2,290,903	\$2,163,507	\$3,315,486	\$3,161,869	\$3,588,148
• Invention licenses	\$2,290,903	\$2,163,507	\$3,315,486	\$3,161,869	\$3,588,148
- Patent licenses	\$2,290,903	\$2,140,466	\$3,302,371	\$3,100,219	\$3,521,739
- Material transfer (invention licenses)		\$23,041	\$13,115	\$61,650	\$46,409
• Other IP Licenses	\$0	\$0	\$0	\$0	\$0
• Total Earned Royalty Income (ERI)	\$1,560,825	\$1,426,876	\$2,089,174	\$2,337,323	\$2,681,552
▫ Median ERI	\$3,102	\$5,645	\$5,325	\$5,000	\$4,657
▫ Minimum ERI	\$159	\$124	\$49	\$18	\$12
▫ Maximum ERI	\$236,306	\$154,213	\$263,648	\$230,296	\$388,730
▫ ERI from top 1% of licenses	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>
▫ ERI from top 5% of licenses	\$696,532	\$499,709	\$890,414	\$908,123	\$1,230,251
▫ ERI from top 20% of licenses	\$1,292,383	\$1,026,141	\$1,647,700	\$1,879,229	\$2,205,066
• Invention licenses, total ERI	\$1,560,825	\$1,426,876	\$2,089,174	\$2,337,323	\$2,681,552
▫ Median ERI	\$3,102	\$5,645	\$5,325	\$5,000	\$4,657
▫ Minimum ERI	\$159	\$124	\$49	\$18	\$12
▫ Maximum ERI	\$236,306	\$154,213	\$263,648	\$230,296	\$388,730
▫ ERI from top 1% of licenses	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>
▫ ERI from top 5% of licenses	\$696,532	\$499,709	\$890,414	\$908,123	\$1,230,251
▫ ERI from top 20% of licenses	\$1,292,383	\$1,026,141	\$1,647,700	\$1,879,229	\$2,205,066
- Patent (and patent application) licenses, total ERI	\$1,560,825	\$1,423,835	\$2,083,059	\$2,301,172	\$2,662,122
▫ Median ERI	\$3,102	\$6,870	\$5,601	\$5,194	\$4,662
▫ Minimum ERI	\$159	\$124	\$49	\$18	\$89
▫ Maximum ERI	\$236,306	\$154,213	\$263,648	\$230,296	\$388,730
▫ ERI from top 1% of licenses	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>
▫ ERI from top 5% of licenses	\$696,532	\$499,709	\$890,414	\$908,123	\$1,230,251
▫ ERI from top 20% of licenses	\$1,292,383	\$1,002,660	\$1,624,258	\$1,854,214	\$2,178,046
- Material transfer (invention licenses), total ERI	\$0	\$3,041	\$6,115	\$36,150	\$19,430
▫ Median ERI	\$0	\$3,041	\$1,925	\$2,645	\$3,428
▫ Minimum ERI	\$0	\$3,041	\$600	\$153	\$12
▫ Maximum ERI	\$0	\$3,041	\$3,591	\$17,053	\$9,784
▫ ERI from top 1% of licenses	\$0	\$3,041	\$3,591	\$17,053	\$9,784
▫ ERI from top 5% of licenses	\$0	\$3,041	\$3,591	\$17,053	\$9,784
▫ ERI from top 20% of licenses	\$0	\$3,041	\$3,591	\$17,053	\$9,784

<sup>1</sup> Includes data from USDA, Forest Service through FY 2006.

<sup>2</sup> Represents a single license.

Forest Service (FS)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
• Total income, all licenses active in the FY	N/A	N/A	N/A	N/A	\$46,080
• Invention licenses	N/A	N/A	N/A	N/A	\$46,080
- Patent licenses	N/A	N/A	N/A	N/A	\$46,080

Disposition of License Income <sup>1</sup>

Agricultural Research Service (ARS)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
• Income distributed <sup>2</sup>					
• Invention licenses, total distributed	\$2,586,583	\$2,297,065	\$2,675,740	\$2,561,281	\$3,158,217
▫ To Inventors	\$40,399	\$389,927	\$831,375	\$998,042	\$1,015,450
▫ To Others	\$1,156,936	\$1,280,002	\$1,226,104	\$1,032,573	\$1,344,186
- Patent licenses, total distributed	\$2,586,583	\$2,274,043	\$2,661,184	\$2,534,208	\$3,114,853
▫ To inventors	\$540,399	\$380,916	\$821,677	\$982,756	\$990,344
▫ Salaries of some technology transfer staff	\$1,156,936	\$1,265,991	\$1,221,246	\$1,020,786	\$1,325,928
▫ Patent filing preparation, fees, and patent annuity payments	\$785,218	\$627,136	\$618,261	\$530,666	\$798,581
▫ Other technology transfer expenses	\$104,030	\$0	\$0	\$0	\$0
- Material transfer (invention) licenses, total distributed	\$0	\$23,022	\$14,556	\$27,073	\$43,364
▫ To inventors	\$0	\$9,011	\$9,698	\$15,286	\$25,106
▫ Salaries of some technology transfer staff	\$0	\$14,011	\$4,858	\$11,787	\$18,258
▫ Patent filing preparation, fees, and patent annuity payments	\$0	\$0	\$0	\$0	\$0
▫ Other technology transfer expenses	\$0	\$0	\$0	\$0	\$0

<sup>1</sup> Includes data from FS through FY 2006.

<sup>2</sup> Some of income distributed reflects income received in the prior fiscal year.

Forest Service (FS)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
• Income distributed					
• Invention licenses, total distributed	N/A	N/A	N/A	N/A	\$15,890
▫ To Inventors	N/A	N/A	N/A	N/A	\$15,890
▫ To Others	N/A	N/A	N/A	N/A	\$0
- Patent licenses, total distributed	N/A	N/A	N/A	N/A	\$15,890
▫ To inventors	N/A	N/A	N/A	N/A	\$15,890
▫ To Others	N/A	N/A	N/A	N/A	\$0

## Downstream Outcomes from Technology Transfer Activities

### Nutrition, Food Safety/Quality



### Human Nutrition

**What's in that burger?** -- Ground beef is one of the most popular meat products in the United States because it is reasonably priced, easy to cook, widely available, and tastes great. But, the nutrient composition of ground beef varies depending on its lean and fat content. To provide researchers, industry and consumers with accurate nutrient composition information for this variable product, scientists at the ARS Nutrient Data Laboratory (NDL) in Beltsville, MD, the University of Wisconsin, and the University of Maryland conducted a collaborative study.



To gather data, ground beef products were purchased nationwide, and raw and cooked patties, loaves, and crumbles were prepared for chemical analysis. Then composition was determined for both raw and cooked ground beef products. A computer program, the Ground Beef Calculator (GBC), was developed based on this information, which can be used to estimate nutrient profiles for products containing any fat level between 5% and 30%. Estimates for proximate nutrients (i.e., moisture, protein, fat, and ash), minerals, B-vitamins, folate, choline, vitamins A, E, and K, as

well as major fatty acid classes (including saturated and trans fatty acids) are also included. This program complements the ground beef data previously available in USDA's National Nutrient Database for Standard Reference (SR).

The GBC has been available electronically since September 2006 and is receiving approximately 1000 unique hits per month. The program provides up-to-date nutrition information based on the continuously changing consumer food basket and is being used in clinical practice, food service, research, media relations, and everyday life. In addition, the Food Safety and Inspection Service (FSIS) has specified that the GBC is to be the source of nutrient information for ground beef labeling in its proposed regulation for labeling of single ingredient meats. The GBC can be launched directly from the NDL's website at <http://www.ars.usda.gov/Services/docs.htm?docid=13933>.

**New high-protein snacks** -- ARS researchers at the USDA/ARS Eastern Regional Research Center (ERRC) in Wyndmoor, PA, have discovered a way to increase the protein content of corn flour snacks, breakfast cereals, and energy bars by up to 35% by adding specially-treated whey proteins. Whey proteins are by



products of cheese manufacturing. Normally, whey will not combine easily with starches due to differences in molecular structure and component conformation (shape). ARS researchers used extrusion-based processes to texturize the whey proteins, which allow them to combine with certain carbohydrate and protein polymers. The outcome of the research is texturized whey protein, which is being used by the food industry to fortify food products with increased protein, without affecting taste, texture or appearance of the final product.

Texturized whey protein was patented by ARS, and ARS researchers worked with a Cooperative Research and Development Agreement (CRADA) partner, Harden Foods, Inc. of Philadelphia, PA, to commercialize the new ingredient. Harden Foods, a minority-owned business with over 17 years of food science and nutraceutical experience, developed a line of high-protein snacks that includes cheese curls, tortilla chips, and corn chips. The company subsequently licensed the technology and is spending \$2 million dollars to introduce a new branded line of “Good-For-You” Snack Foods. Harden Foods, Inc. has also entered into distributorship and manufacturing agreements with other businesses to develop an array of nutritional products for the sports nutrition market, including gyms, fitness centers, and nutritional retail stores. One such product is called Muscle Puffs™, which contains 33 grams of protein per serving. Sales of Muscle Puffs™ reached \$4 million in 2006.

*Charles Onwulata (North Atlantic Area, Wyndmoor, PA) and Jerome Harden (Industry Partner) won a 2007 Superior Effort ARS Technology Transfer Award for this work.*



**Novel sweetener reaches market** -- ARS researchers at the USDA/ARS Bioproducts and Biocatalysis Research Unit at the National Center for Agricultural Utilization Research (NCAUR), in Peoria, IL, are working in partnership with Cargill on the use of enzymes to convert sugar and corn syrup to value-added complex carbohydrates. Using ARS-developed methods to produce

and characterize novel carbohydrate products from agricultural materials, ARS and Cargill surveyed more than 100 microbial isolates from culture collections and natural isolations. This research led to the discovery of a novel low-glycemic index sweetener, called Xtend™ sucromalt. The new product provides food and beverage customers with a natural and slow release carbohydrate syrup. This fully digestible, low glycemic syrup provides natural sweetness for products such as nutritional beverages and bars, cereals, ice cream, jams and jellies, and yogurts. The product is named sucromalt because it is derived from a combination of sucrose (cane or beet sugar) and maltose (corn sugar).



This technology was transferred through a Cooperative Research and Development Agreement (CRADA), in which ARS provided facilities and expert scientific contributions to the production and characterization of novel carbohydrate materials and related enzyme systems and Cargill tested and developed applications. ARS identified microbial strains and Cargill developed the commercial product. Cargill has licensed ARS's background technology and has filed patent applications for the use of low-glycemic sweeteners in food and beverage compositions.

Cargill is commercially producing Xtend™ sucromalt as a food ingredient, rather than a finished food product, for use in such products as the recently-introduced energy drink Fuelosophy (currently in Whole Foods stores across the Midwest), and the products marketed under their Glucerna™ trade name for diabetics and others who need or desire to follow a low-glycemic index diet. The Glucerna products, which include cereal, shakes and snack bars, are now available in stores across the country.

Cargill's sucromalt provides food and beverage customers with a natural and slow release carbohydrate syrup. The slow and complete digestibility of sucromalt makes it unique among other sweeteners. In food and beverages, sucromalt releases its carbohydrates into the bloodstream slowly, resulting in a muted blood sugar response and a 'sustained energy' release versus the 'fast energy' release and higher glycemic response of sugar. Sucromalt offers manufacturers and consumers health benefits over traditional sweeteners, while still providing a satisfying, sweet taste. It is 70% as sweet as sugar. Food industry studies predict sales of low glycemic index products in the United States to grow at a rate of 45.7% through 2011, when the market is expected to reach \$1.8 billion per annum.

*The Low Glycemic Index Sweetener Team of Gregory Cote, Timothy Leathers, Melinda Nunnally, and Sheila Maroney (Midwest Area, Peoria, IL), Ting Carlson and Anton Woo (Cargill, Inc) won a 2007 Superior Effort ARS Technology Transfer Award for this work.*

### **Food and Feed Safety**

**Testing for food and feed contaminants** -- To safeguard the food supply for humans and animals, there is a growing need to quickly determine if food or feed is contaminated by chemicals. This necessitates the development of assays that can accurately determine the presence of contaminants from non-treated, whole food or feed samples. In addition, effective testing methods must be capable of handling large numbers of samples and obtaining the results rapidly so as not to interfere with commerce. One of the few assays capable of meeting these needs are enzymed-linked immunosorbent assays based on antibody detection, called ELISA test kits.

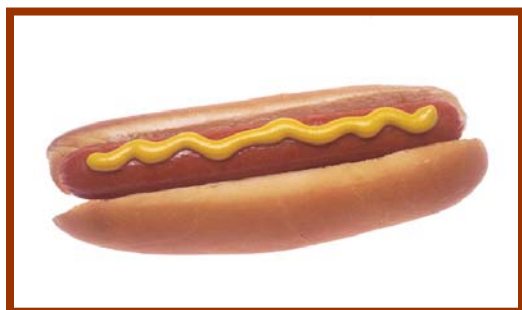


The ARS Animal Metabolism-Agricultural Chemicals Research Unit at the Biosciences Research Laboratory in Fargo, ND has made great strides in providing antibodies for simple ELISA test kits to protect our food and feed supply. These include detection kits for feed contaminants (ractopamine, zilpaterol), a pesticide (thiamethoxam), and several environmental contaminants (triclosan and polybrominated diphenyl ethers).

ARS develops antibodies by exposing animals (principally mice, rabbits, and goats) to an antigen that causes the animal to develop antibodies that will bind to the specific molecule(s) of interest. The design and synthesis of these antibodies requires innovation and state-of-the-art skills in chemistry, biochemistry and immunology. The successful integration of these skills has allowed the Fargo laboratory to produce a number of antibodies that have been successfully commercialized through license agreements with private companies.

Consumers in the U.S. and throughout the world are benefiting from these technologies. For example, the kits utilizing the patented ractopamine antibody are widely used in the United States and assure potential buyers of the quality of American products. The triclosan ELISA kit, although just recently introduced, has been purchased by several U.S. institutions as well as by a government agency in Spain. These users report that the test kit technology allows extremely rapid screening of the large numbers of samples, which is necessary for consumer protection.

***Slick new method protects ready-to-eat meat products*** -- *Listeria monocytogenes* is a well documented foodborne bacterial pathogen responsible for severe illness in humans and costly product recalls. It is a particular problem in ready-to-eat (RTE) foods such as hams, roast beef, turkey breast, and frankfurters. In recent years, 1.2-2.4 billion dollars have been lost in recalls of these products. Previous post processing methods can reduce the presence of *Listeria* by 90 to 99.9%, but these methods may have a negative impact on flavor, or add to production costs and processing time.



To overcome these problems, a team of USDA/ARS researchers at the Eastern Regional Research Center (ERRC) in Wyndmoor, PA developed a new process called the Sprayed Lethality in Container intervention delivery method or SLIC. SLIC sprays fluid containing a food-grade antimicrobial chemical into packages immediately prior to inserting the food product. A vacuum is used to seal the container uniformly, which distributes the antimicrobial across the product surface and allows for contact time throughout shelf

life. The SLIC process successfully inhibits outgrowth of *Listeria monocytogenes* during extended refrigerated storage, resulting in a 99.999% reduction of *Listeria* within 24 hours at 4°C. Equally important, the RTE product has no reduction in taste quality. Because of its effectiveness and safety, SLIC has achieved Food Safety and Inspection Service (FSIS) regulatory status.

The ERRC researchers entered into a Cooperative Research and Development Agreement (CRADA) with a major meat-processing company to evaluate SLIC on RTE ham products. The results of the studies, conducted as part of the CRADA, were published in a peer-reviewed publication. A second CRADA with the same cooperator is evaluating SLIC on other RTE meat and poultry products. A third CRADA, with another industrial partner was recently signed to further develop SLIC for RTE meats and poultry. This new industrial partner intends to collaborate with the other food processors to ensure that SLIC is broadly available and adopted.

The technology has already had a great impact on the processing of RTE food products. One company is now using SLIC on four different production lines for hams and frankfurters, with a production capacity of 2.7 million pounds per year. Another processor is using SLIC to treat 19 million pounds a year of RTE chicken, turkey, and beef products. A third company is in the



process of testing SLIC on 13 of its ham production lines, with an approximate production capacity of 176.5 million pounds per year, nine of its sliced luncheon meat production lines, with the approximate production capacity of 33 million pounds per year, and 10 of its frankfurter production lines with approximate annual production capacity of 150 million pounds. It is estimated that the average production cost of RTE foods using SLIC is reduced from 2-3 cents per pound to 0.2 to 0.9 cents per pound. This results in cost savings of about \$1 to 2 million per year for large processing plants. More importantly, consumers are being better protected from products potentially contaminated with *Listeria monocytogenes*.

*John Luchansky and Neil Goldberg (Microbial Food Safety Research Unit, North Atlantic Area, Wyndmoor, PA) and Alas Oser (Industry partner) won a 2007 Superior Effort ARS Technology Transfer Award for this work.*

**Innovations improve beef safety** -- The United States has some of the highest food safety standards in the world; thus its food supply is among the safest. However, millions of Americans contract foodborne illnesses every year. Foodborne illnesses are caused when bacterial pathogens, such as *E. coli* O157:H7, *Listeria*, *Salmonella*, *Shigella*, *Vibrio*, and *Yersinia*, enter the food supply. Although most cases of foodborne illnesses are the result of improper handling and preparation of foods, in some cases the bacterial pathogens are already present at the processing stage.

For the U.S. beef industry, foodborne illnesses linked to contaminated ground beef products significantly threatens the productivity and livelihood of the total industry. Typically, *E. coli* O157:H7 is the bacteria responsible for most severe of the foodborne illnesses and the Centers for Disease Control and Prevention (CDC) estimates that foodborne contamination with *E. coli* O157:H7 causes 73,000 illnesses and 60 deaths annually. Over the last ten years, the beef processing industry has spent more than 750 million dollars on measures to increase the safety of beef products. A vast majority of these efforts have focused on removing contaminants from carcasses.

A new effective method was developed by a group of researchers at the USDA/ARS Roman L. Hruska U.S. Meat Animal Research Center, in Clay Center, NE. This group demonstrated that *E. coli* O157:H7 tends to gather on cattle hides, which becomes a problem if meat is contaminated during hide removal. Thus, removing pathogens before removing the hides would be a very effective way to reduce the risk from carcass contamination. The group developed a practical, effectively hide-on cattle washing system to reduce on-hide pathogen levels. This process includes cleaning the hide-on carcass using a high-pressure water washing cabinet to remove excess organic matter, then spraying the hide-on carcass with an antibacterial compound. The washing step is critical to the success of the process because these antimicrobial compounds are less effective if the high bacterial load or organic matter on the hide is not removed before treatment. The researchers found several effective compounds to use in the washing process.



The Clay Center scientists collaborated with several industry partners while developing and transferring this technology, including the National Cattlemen's Beef Association, Cargill Meat Solutions, Harris Ranch Beef, Future Beef Operations, Tyson Fresh Meats, Inc., Swift &

Company, and Safe Foods Corporation. Once convinced of the usefulness of this approach, Cargill Meat Solutions made multi-million dollar modifications to their harvest floors and installed hide-washing cabinets in each of the company's six processing plants. Throughout the last three years the USDA/ARS has worked with the industry to fine-tune the protocols and compounds used to maximize effectiveness and return on investment. It is estimated that 50% of the beef slaughtered in the United States now undergoes a hide-on carcass washing treatment prior to processing.

Decreasing the pathogens in beef products has reduced the incidence of related foodborne illness. The U.S. Department of Agriculture's Food Safety and Inspection Service reported that the incidence of *E. coli* O157:H7-positive ground beef samples collected fell by 43 percent after the beef industry started using the washing cabinets. The CDC also noted significant reductions in illnesses caused by *E. coli* and the pathogens *Listeria*, *Campylobacter*, *Yersinia*, and *Salmonella*.

*The Post-Harvest Food Safety Group of Mohammad Koohmaraie, Terry M. Arthur, Joseph M. Bosilevac, Steven D. Shackelford and Tommy Wheeler (North Pacific Area, Clay Center, NE) won a 2007 Outstanding Efforts ARS Technology Transfer Award.*

### **Biobased Products**



#### **Domestic production of hypoallergenic rubber --**

Natural rubber is a strategic raw material used in over 40,000 applications. The United States consumes over 20% of the world supply of natural rubber and is completely dependent on imports, largely from countries in South East Asia. Given that there are no perfect substitutes for natural rubber, any disruptions in the supply of natural rubber could seriously impact our nation's defense, transportation, medicine and consumer markets. To diversify our supply, ARS scientists at the Western Regional Research Center in Albany, CA, and the U.S. Arid-Land Agricultural Research Center, in Maricopa, AZ, have been working on guayule, an indigenous rubber producing plant native to the southwestern United states. In the past, commercial production of rubber from guayule had been attempted, but was never perfected because of agronomic and industrial processing issues. However, over a period of many years, ARS researchers were able to overcome these obstacles, permitting industrial-scale rubber production from guayule. The extraordinary result has been the creation of a new, profitable industrial crop that allows for the domestic production of a strategic material.

The research that has led to the commercialization of guayule as a new crop has many facets. The first effort, beginning in the early 1990s, involved the harvesting of wild stands of guayule. Then ARS breeders in Arizona developed high yielding lines that produced improved yields of latex – the form of rubber commonly used in many products. The Arizona group worked with university collaborators to determine the agronomic characteristics and best growing methods for the new high yielding lines. At the same time, WRRRC researchers in Albany were developing a new latex extraction technology. In the process of developing this method,



researchers conducted tests that determined that guayule latex is hypoallergenic. This is a critically important trait because millions of Americans are allergic to latex from the Brazilian rubber tree – the main source of imported latex. USDA/ARS obtained a patent on the production of hypoallergenic latex from guayule.

To commercialize the new technology, ARS entered into an exclusive license agreement and a Cooperative Research and Development Agreement (CRADA) with Yulex Corporation, a start-up company focusing on commercialization of the guayule. In 2006, Yulex completed construction and began its operation of the first U.S. commercial guayule latex plant in Maricopa, AZ. By the end of 2007, production is expected to 800,000 lbs/year of Yulex™, the company's commercial guayule latex. Yulex signed an exclusive deal in 2005 to sell its latex worldwide through Centrotech. Yulex also recently announced a joint effort to produce guayule latex balloon catheter products in partnership with TechDevice Corporation of Watertown, MA. This will enable patients who are allergic to non-guayule latex to undergo balloon angioplasty for heart disease.

***Rolling oil for the metalworking industry*** -- Aluminum producers use petroleum-based mineral oil for flat-rolling operations, which produce aluminum sheets for everything from beer cans to aircraft-wing panels.



In the United States, it is estimated that 7.5 billion gallons of industrial lubricants, which includes metalworking fluids, will be consumed in 2008. Alcoa, Inc. is the world's leading producer of primary aluminum, fabricated aluminum, and alumina. To help reduce its dependency on petroleum-based products, Alcoa contacted USDA/ARS's National Center for Agricultural Utilization Research (NCAUR) in Peoria, IL, to discuss the feasibility of developing bio-based fluids for use in its reversing hot mills, continuous hot mills, mineral oil-based mills and water-based cold mills. In 2001,

USDA/ARS formalized its relationship with Alcoa through a Cooperative Research and Development Agreement (CRADA).

To produce this technology, a team of NCAUR scientists developed the base fluid by optimizing the structural-property relationship and additive combinations to reduce the cost of final formulation. The resulting bio-based fluids were then scaled-up so that a 150-gallon sample could be tested at Alcoa's Reno, NV, mill. Results of the test were very favorable because the bio-based fluids are quite cost-effective, conform to all industrial hot/cold rolling oil standards, and in certain cases, exceed the performance properties of current mineral oil derived fluids. As a result, ARS-developed bio-based fluids are now used routinely at Alcoa's Reno, NV, mill.

Bio-based lubricants also provide significant health benefits to workers. For instance, in a single day, an Alcoa mill was using 500 gallons of petroleum-based fluid—most of which escapes into the air as fumes containing volatile organic compounds (VOCs). Cutting down on VOCs minimizes workers' exposure to synthetic fluids and other chemical additives. According to National Institute for Occupational Safety and Health, respiratory conditions, like chronic bronchitis, and skin irritations, such as rashes, are among potential health problems associated with the use of petroleum-based products in the metalworking industry. Switching to bio-based lubricants would reduce exposure to VOCs for 1.2 million U.S. workers in machine finishing, machine tooling, and other metalworking and metal-forming operations.

***Innovative process turns cotton gin waste into effective soil erosion product*** -- The USDA/ARS Cotton Production & Processing Research Unit (CPPRU) in Lubbock, TX, has developed a new hydromulch (a wet slurry of mulch and seed) from cotton gin waste. Utilizing the precleaning equipment already present in a cotton gin, the team retrieved three separate streams of waste material that are ideally suited as raw materials for various new products. One such product is a hydromulch, which has much better soil coverage than conventional wood hydromulch used in green houses or nurseries. Commercial partners and ARS personnel set up a pilot plant in Centre, AL, to make enough of the new mulch product to evaluate. The process and product were refined, and based on results from the various studies, and a commercial test product produced.



The technology was developed through a Cooperative Research and Development Agreement (CRADA) with Summit Seed, Inc., an Illinois based company. Summit received support from a USDA Small Business Innovation Research (SBIR) grant. To provide a source of gin wastes, ARS and Summit Seed worked with Cotton Incorporated and Mulch & Seed Innovations of Centre, AL.

A unique cotton hydromulch product is now being sold nationwide as Cotton Fiber Matrix™ for use by state departments of transportation, commercial landscapers, contractors and homeowners. It is ideal for controlling erosion and helping establish vegetation in environmentally sensitive areas, hard-to-reach areas, and on uneven surfaces and steep slopes. The innovative process developed under the CRADA resulted in a patent application.

The hydromulch product is applied with a spraying mechanism, and forms a honeycomb seal over the soil, protecting topsoil and seed. Cotton's porous, absorbent and biodegradable qualities provide an environment that is ideal for controlling erosion and establishing seed. Application of the hydromulch to soils requires less labor and is three times faster than using traditional erosion control blankets. The mulch is an all-natural, cotton-fiber matrix that fits the contours of uneven surfaces of the earth to immediately protect soil against heavy wind and rain, even on steep slopes. This technology has been proven to be 99.6% effective at controlling soil loss. It quickly establishes germination and serves as a vegetative medium that promotes growth for permanent protection. This product provides an economical means of processing gin waste that allows cotton gin operators to turn a waste product into a revenue stream.



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## Animal Production and Protection

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### Controlling Animal Diseases



**Breeding scrapie out of sheep** -- Scrapie is an incurable and fatal chronic wasting disease in sheep. This transmissible spongiform encephalopathy (TSE) is a high priority disease for the sheep industry. Some sheep are more susceptible than others because of the animal's genetic code. Sheep with a gene called a diplotype of ARR/ARR are most resistant, while sheep with the VRQ/VRQ diplotype are the most susceptible. Selective breeding for the resistance diplotype can greatly reduce the risk of the disease and eventually eliminate it from all sheep.

An ARS researcher at the Animal Disease Unit, in Pullman, WA, originally discovered the resistant gene, while ARS researchers at the U.S. Meat Animal Research Center in Clay Center, NE, developed and transferred to the USDA Animal and Plant Inspection Service (APHIS) and industry a genotyping test that tells breeders whether or not sheep have the resistance diplotype. In 2004, APHIS certified two companies and the Colorado Department of Agriculture Rocky Mountain Regional Animal Health Laboratory for scrapie testing. In 2006, 99% of the scrapie genetic testing ordered by APHIS was done at these sites using the ARS developed technology.

The new test is at the center of the APHIS ten year scrapie eradication program. Eradication of the disease in the U.S. will save U.S. producers an estimated \$20 million annually and open more export markets to U.S. sheep products. Furthermore, the new test will save APHIS more than \$1 million because they can accelerate their eradication program. The technology is allowing APHIS to do somewhere between 40,000 and 50,000 tests a year -- nearly five times more sheep than before -- while reducing cost by about 40%.

Not only are U.S. producers using the test to eliminate scrapie in their herds, but U.S. companies are profiting from the test. One U.S. company won contracts to genotype all the sheep in Greece and half the sheep in Cyprus. These contracts generated nearly \$2 million in revenue for the company and saved the nations of Greece and Cyprus nearly \$4 million in testing costs.

## **Bio-based Animal Products**

**Shrinkproof wool** -- Consumers are always on the lookout for fine woolen fabrics that won't shrink or itch. USDA/ARS researchers at the Eastern Regional Research Center (ERRC) in Wyndmoor, PA, have made this search much easier by inventing a lightweight, washable wool or wool/blend material with shrink-resistant properties using environmentally friendly enzymes. The ARS process involves bleaching, biopolishing, and shrinkproofing wool. Conventional wool bleaching technology uses an environmentally harsh chemical (i.e., alkaline peroxide), consumes a lot of energy, and produces yellowish and weakened wool. In contrast, the ARS process bleaches wool to a high degree of whiteness in 30 minutes at close to room temperature conditions. The new ARS method is a two-step process involving first bleaching the surface of wool and then applying an enzyme to selectively digest the surface scales of the wool fiber, known to be the source of shrinkage.



The initial market for this technology may be the U.S. Army, which is manufacturing undergarments made of this exceptionally comfortable, non-itchy product. Currently, 3,000 troops have been outfitted with all-wool ARS-processed underwear, tops and bottoms in several stages of field trials. Another likely market segment is the “first responders” for fire and emergencies. Because wool is self-extinguishing when exposed to fire, it has an advantage over synthetics that are combustible or melt, causing injury to the wearer.

## **Optimizing Animal Production Systems**

**Improving catfish hatcheries** -- Researchers at USDA/ARS Catfish Genetics Research Unit (CGRU) in Stoneville, MS, have conducted several studies to determine the optimal oxygen requirements for channel catfish eggs and very young fish, which are known as “fry.” The researchers found that dissolved oxygen concentrations should be maintained near air-saturation (8.1 mg/L at 26° C) as eggs approach hatching. At lower oxygen concentrations, development of the embryos is impaired, resulting in increased death. Equipped with this information, ARS researchers developed a set of practical recommendations that would help improve the efficiency of the nation's commercial catfish hatcheries.



The National Warmwater Aquaculture Center (NWAC) surveyed a sample of commercial hatcheries and found that only 27% of the commercial catfish hatcheries maintained a dissolved oxygen concentration high enough to maximize hatch rate and survival. USDA/ARS and NWAC helped modify the oxygen management of several commercial hatcheries. It is estimated that an additional 200-300 million fry (from approximately 2 billion eggs brought into the hatchery) were produced as a result of improved oxygen management during the

2007 spawning season. With an average value of  $\frac{3}{4}$  cent per fry, this means these hatcheries increased net profits by about \$2 million in 2007.

**New information helps produce better birds --**

ARS scientists at the USDA/ARS Poultry Research Unit, Mississippi State, MS, have spent years researching the ideal ventilation and nutrition guidelines for chicken broilers grown to heavy weights. These guidelines have increased the overall profitability of the broiler industry and have led to healthier birds. The guidelines include new air velocity recommendations, which were virtually unheard of only three years ago, but are now being applied in almost every tunnel ventilated broiler



house in the United States. New poultry houses are being designed at even higher air velocities to maximize cooling. By upgrading housing specifications based on ARS ventilation guidelines, one commercial broiler company is already saving \$0.0125 for each bird marketed.

The USDA/ARS research team has also delineated the dietary energy and amino acid requirements to increase breast meat yield, total meat yield and to improve the utilization of feed by poultry. Specifically, they demonstrated that if dietary amino acid needs are not met, breast meat yields are limited by as much as 0.5% per bird. In addition, the USDA/ARS researchers demonstrated that feeding a higher energy diet to heavy broilers results in an improvement in performance, beyond the cost of feeding the improved diet. For one broiler company located in the southeastern U.S., adoption of ARS recommendations has improved weekly profits by approximately \$1 million.

The Poultry Research Unit scientists collaborated with faculty from Auburn University and Mississippi State University, as well as representatives from integrated broiler companies to ensure that this research addressed industry needs and was transferred effectively to end users. As a result, the USDA/ARS guidelines for ventilation and nutrition have had a positive impact on the U.S. poultry industry of an estimated 67 million dollars annually.

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## Crop Production and Protection

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### Enhancing Trade



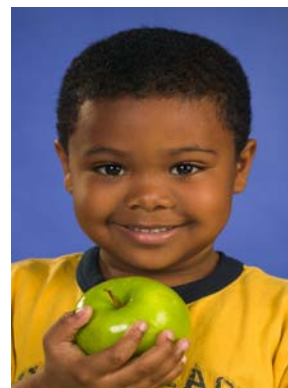
**New, effective method for protecting fruits and vegetables** -- In 2006, based on extensive data provided by ARS, the USDA Animal and Plant Inspection Service (APHIS) began allowing a consistent dose of irradiation to be used on large numbers of types of fruits and vegetables, as a post-harvest treatment to control insect pests. Irradiation therefore became available as a phytosanitary control measure for a wide variety of quarantine insect pests and commodities. APHIS also adopted generic quarantine irradiation treatments for broad groups of insects without further need of specific efficacy data for each target species and potentially infested commodity. This decision marked the first time APHIS used the generic dose approach to commodity protection.

This important regulatory decision was rooted in research stemming from the USDA/ARS Pacific Basin Agricultural Research Center, Post Harvest Tropical Commodities Research Unit, in Hilo, HI. In 2003 an ARS researcher in Hilo proposed to APHIS that fruit flies (family Tephritidae) could be controlled with a dose of 150 Gy and suggested that most other quarantine insects could be safely controlled with an irradiation dose of 400 Gy. At that time, Hawaii was irradiating all its exported fruit at 250 Gy for fruit flies. ARS showed that that the 250 Gy dose was excessive and could be lowered to 150 Gy. This led the way to a generic treatment for fruit flies.

On January 27, 2006, USDA APHIS published a final rule in the *Federal Register* recommending a generic irradiation dose of 150 Gy for all tephritid fruit flies. Lowering the irradiation dose for fruit flies is reducing costs and increasing capacity in Hawaiian treatment facilities by decreasing the required treatment time. This allows for treatment of more crops and has helped Hawaiian small farmers expand exports of sweet potato and tropical exotic fruits and other vegetables to the U.S. mainland and other countries. In addition to the new U.S. rule on generic treatments, the publication of an international standard on irradiation by the International Plant Protection Organization using the ARS data has stimulated interest worldwide in irradiation as a phytosanitary treatment.



**Japan accepts U.S. apple exports** -- A USDA/ARS researcher at the Tree Fruit Research Laboratory in Wenatchee, WA, has successfully helped open the Japanese market to U.S. apple exports. Japan had blocked these exports from entering their country because of possible contamination with fire blight, a common serious bacterial disease of apple. The ARS researcher in Wenatchee developed various assays and a treatment protocol to show that particular apple shipments are extremely unlikely to be a vector for the disease, and therefore eligible for export to countries that are members of the World Trade Organization (WTO). Japan is a member of the WTO.



The government of Japan initially resisted changing its regulations on the importation of apples from the United States for fear of fire blight. A WTO non-compliance panel was established to determine the value of U.S. apple imports that were effectively being blocked by Japan's refusal to adopt standards based substantially on ARS technology. The WTO determined that the annual value of these apple imports were more than \$143.4 million dollars (from Washington State apple growers alone) and compensatory tariffs in that amount were authorized against imported Japanese goods. After this finding, Japan accepted the finding and opened its markets to Washington State apple exports.

Opening this important, lucrative market for U.S. producers required extraordinary cooperation among ARS and other U.S. government agencies, including the USDA Foreign Agricultural Service, APHIS, and the U.S. Trade Representative. Opening the Japanese market for apples also allows Japanese consumers to enjoy wonderful Washington State products.

*Rodney G. Roberts, Pacific West Area, Wenatchee, WA won a 2007 Superior Effort ARS Technology Transfer Award for this work.*

### ***New Cultivars for Farmers***

***New green southernpea reaches market*** --Southernpea, which is also known as cowpea, crowder pea or black-eyed pea is widely used by the frozen food and canned vegetable industries. In the past, southernpea was harvested fresh and then processed as a fresh vegetable. However, in recent decades the food processing industry has shifted entirely from using fresh peas to a dry-harvested raw product. The shift to a dry-harvested product has significantly reduced the quality of the processed product, and resulted in the loss of the green color of fresh peas.



To provide a better quality product, researchers at the USDA/ARS U.S. Vegetable Laboratory in Charleston, SC, have developed a pinkeye-type southernpea cultivar, Charleston Greenpack, which exhibits a persistent green seed color. This new pea is comparable to other leading pinkeye-type cultivars and can be produced in the southeast during the spring, summer and fall seasons. After seven years of development and evaluation, the technology was transferred through a CRADA with Western Seed Multiplication, Inc. in Island, SC. ARS protected

Charleston Greenpack under the Plant Variety Protection Act, and the CRADA partner was granted an exclusive license to market it.

Western Seed Multiplication, Inc. is already marketing seeds of Charleston Greenpack to commercial growers, and Charleston Greenpack peas are quickly being accepted by the frozen food industry. The utilization of Charleston Greenback peas has helped the frozen food industry to differentiate its product, the "high quality" pack, from the canning industry's product. Since Charleston Greenpack peas are blended with traditional pinkeye-type peas to increase the overall appearance of the frozen pack, it is estimated that at least 40% of the frozen packages of pinkeye-type southernpeas currently being sold in the U.S. contain a significant portion of Charleston Greenpack peas.

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## Natural Resources and Sustainable Agricultural

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### Managing Modern, Sustainable, Production Systems



**Little planes provide farmers with quick crop management information** -- Today's farmers have an important new tool to help manage their crops thanks to a Cooperative Research and Development Agreement (CRADA) between the ARS Hydrology & Remote Sensing Lab in Beltsville, MD and IntelliTech Microsystems and its subsidiary, Aero View International, both of Bowie, MD. The result of the CRADA is a remote sensing platform for low-cost, high-resolution imagery using a radio-controlled unmanned aerial vehicle (UAV) called AgScanner.

AgScanner is designed specifically for precision agriculture-based crop management. It is battery powered and can take off and land safely in remote locations without a runway. The system uses newly developed calibrated sensors to determine the nitrogen status of crops using digital color cameras. The UAV provides the farmer and farm manager with quick information that allows them to efficiently and effectively manage and measure nitrogen fertilizer applications. The images also can detect plant stress caused by disease and insect infestations. As a result, farmers can access through Aero View International images that help them detect problems before they spread. Funding for this research was provided by the Maryland Technology Development Corporation (TEDCO).

**New CD helps farmers plan their crop rotations** -- Growing only potatoes in the same soil year after year dramatically increases disease levels, increases soil erosion, and reduces soil organic matter. Consequently, the top research priority of Maine's potato industry is finding crop rotations that are profitable and that benefit potato yield, tuber quality, disease control, and soil quality. An interdisciplinary team of USDA/ARS scientists from the USDA/ARS New England Plant, Soil, & Water Laboratory in



Orono, ME, evaluated 14 different cropping systems for their impacts on potato yield and quality, nutrient availability, plant diseases, soil microorganisms, potential profitability, economic risk, and other factors. The resulting information from these extensive studies is being transferred to end users via a Potato Systems Planner Decision Support CD. The CD contains extensive, easy-to-use and readily accessible information that aids potato farmers in planning crop rotation.

Cropping systems are highly complex. To reduce this complexity for the farmer, simple phrases summarizing each research result were developed for scores of research observations. These research summaries were then organized into an easy to use format. The CD was designed so that different levels of scientific detail can be accessed by simply clicking on a research summary. Hypertext-linked research summaries are provided for up to 15 properties of each cropping system. Summarizing research observations into simple statements proved highly effective for communicating the main message without overwhelming the customer. Providing customers with the option of obtaining more information by clicking on the research summary gives access to more detailed observations for those users wishing to further evaluate the research results. The "Economics Calculator" portion of the CD was designed to incorporate loan application requirements of the USDA Farm Service Agency, so that growers can use the same information for deciding what crop to grow as they use when applying for a loan.

The Potato Systems Planner Decision Support shows that growing canola before potato can reduce soil-born diseases by 20-50%. As a result, growers from CO, NY, ME, WA, and WI have changed their small grain-potato rotations to canola-potato to reduce soil-born diseases and improve potato quality. The Agricultural Bargaining Council reports that potato growers in Maine are now producing 5000-7000 acres of canola. The USDA Farm Service Agency is now interested in using the Potato Systems Planner Decision Support for assessing loan risk and for guiding loan applicants in selecting profitable rotation crops. A new collaboration between ARS and the USDA Agricultural Marketing Service has been established to coordinate market driven research strategies across agencies, with the Potato Systems Planner serving as an important example and tool for achieving this goal. Since its release in 2005, over 1100 copies of the CD have been requested by growers and scientists from 26 states, 8 Canadian provinces, and 28 countries.

*This technology won a Regional 2006 Federal Laboratory Consortium Technology Transfer Award.*

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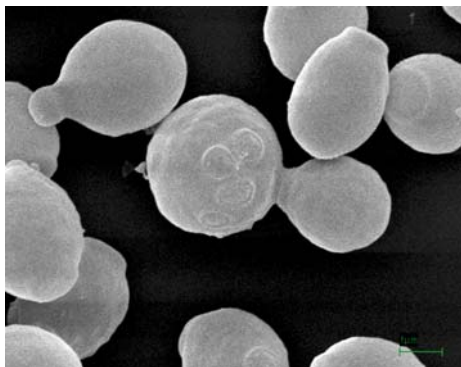
## Forest Service Outcomes

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### ***Biofuels for the Future***

***New technology for the fermentation of hemicellulosic sugars to biofuels*** -- USDA Forest Service researchers from the Institute for Microbial and Biochemical Technology, at the USDA Forest Products Laboratory (FPL), in Madison, WI, have found an improved method of producing biofuels from hemicellulose – a compound that is common in paper, pulp and agricultural processing waste streams. The Forest Service team developed genetically engineered yeast strains for the improved production of xylitol and ethanol from hemicellulosic sugars. To approach this goal, the Madison researchers obtained the complete genomic sequence of the xylose fermenting yeast, *Pichia stipitis*, through collaboration with the Department of Energy Joint Genome Institute (JGI) and worked with the USDA/ARS National Center for Agricultural Utilization Research (NCAUR) in Peoria, IL, which provided valuable culture collection services and collaborated in gene expression analysis.



The Forest Service team used the information gathered from their research partners to conduct large-scale assessments of gene expression. They also developed efficient genetic transformation technology that would enable them to engineer the target yeast organism. The researchers assessed which genes and other genetic factors could be rate limiting to the overall fermentation and then altered the expression of those genes to improve the desired metabolic activities. To do this they had to know which of about 200 different genes contribute most to xylose utilization and ethanol production. Generally no one gene determines a complex trait of this sort. Instead, various genes need to be regulated in a concerted manner to achieve optimal metabolic activity. Multiple gene expression in a stable manner is essential for commercial development.

The new technology was transferred through major presentations at number of conferences that focus on biotechnology for renewable fuels and through publications in a number of peer-reviewed journals such as *Applied and Environmental Microbiology*, *Nature Biotechnology* and *Applied Microbiology and Biotechnology*. Potential beneficiaries include companies in the pulp and paper industry that are interested in producing ethanol from pulp waste streams, and companies in the grain ethanol processing industry that are interested in making better, more economical use of cellulosic and hemicellulosic agricultural residues.



However, the ultimate beneficiary of this technology will be the public because commercialization will provide many new jobs in rural areas while providing a sustainable, clean-burning fuel for transportation. In 2006, the grain ethanol industry supported the creation of 160,000 new jobs while producing 5 billion gallons of ethanol from grain. The President's goal of producing 35 billion gallons of ethanol per year by 2017 can only be met if a substantial fraction of that total is derived from cellulose and hemicellulose.

### ***Controlling Pests***

#### ***A new environmentally friendly insecticide for termites --***

Researchers at the USDA/ARS Southern Regional Research Center, in New Orleans, LA, and the USDA Forest Service's Forest Products Laboratory (FPL) in Madison, WI, have collaborated to find a new way to control termites using a chemical called Napthalhydroxylamine (NHA). NHA was originally developed at the FPL as a wood preservative against fungal decay and termite damage. The ASR researchers built on this development by combining the NHA-compound with a cellulose matrix that would attract termites. This new termite control compound was patented, and an exclusive license was granted to Waterbury Inc. of Connecticut.



Any property threatened by Formosan and native subterranean termites can be protected by this nonrepellent insect bait. Termites cause billions of dollars in damage to structures in the United States, and this new termiticide can be used to combat that destruction. Because the bait is effective at low doses and contains no heavy metals, it is environmentally friendly. It is also more economical than most other treatments on the market, costing just \$1 per gram compared to up to \$50 per gram for other available treatments.