



**U.S. Department of Agriculture**

*FY 2006 Annual Reporting on  
Agency Technology Transfer*

**Cover Photo: An experimental pepper line  
developed at the Agricultural Research Service**

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## Table of Contents

Agricultural Research Service (ARS).....	2
Mission Statement.....	2
Structure and Culture .....	2
Animal Plant Health Inspection Service (APHIS) – Wildlife Services.....	3
ARS Approach and Plans for Technology Transfer .....	3
Tech Transfer Principles, Modes, and Plans.....	3
Information on ARS Plans for Strengthening its Performance Metrics .....	4
Metric Tables .....	9
CRADAs and other R&D .....	9
Invention Disclosure and Patenting .....	9
Intellectual Property Management.....	9
Licensing.....	10
Profiles of Active Licenses .....	10
Income Bearing Licenses.....	10
Licensing Management.....	11
License Income .....	12
Disposition of License Income .....	12
Downstream Outcomes of Technology Transfer Activities .....	13
Nutrition, Food Safety/Quality .....	13
Animal Production and Protection.....	17
Crop Production and Protection.....	19
Natural Resources and Sustainable Agricultural Systems .....	25
Animal Plant Health Inspection Service.....	29

*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 & Culture**

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 2200 permanent full-time scientists who conduct research in more than 1200 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 with 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

### Tech 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 appropriate activities that effectively transfer ARS technologies to the marketplace. The Patent Section of the USDA Office of General Counsel provides legal guidance.

ARS-OTT is centralized in policy and approval procedures, and decentralized in development and implementation. 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 targeted marketing strategies to facilitate technology transfer; distributes information on ARS technologies that are available for licensing or cooperative partnering; provides answers to stakeholder questions on technology transfer activities in ARS; and ensures information about ARS commercial successes is available to the public. 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 several mechanisms, such as written information—including scientific publications, reports to stakeholders, briefings, and other materials—CRADAs, patent licensing; participation at trade shows, technology showcases, meetings with industry organizations and universities, workshops; and through information distributed by the ARS Information Staff, the National Agricultural Library, and electronic media.

Because our mission is to transfer technologies to the private sector for broad public use, we pursue patents and licensing only when IP protection facilitates technology transfer to the marketplace. This is usually the case when further 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 useful (sufficient scope, enforceable, appropriate for the size of the market, etc.). For APHIS-WS, invention disclosures are deliberated within ARS patent review committees, which have been 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 also prepare, file, and prosecute WS inventions on behalf of APHIS, and coordinate patent application filings in other countries through a contractor.

### **Information on ARS Plans for Strengthening its Performance Metrics**

Meaningful performance metrics in technology transfer are often difficult to define for research agencies where outcomes are varied. For example, for ARS, outcomes may be expressed in terms of improved agricultural practices; scientific information that enhanced business competitiveness; increased awareness about pathogens, which helped prevent human and animal diseases; or in published findings that help corporations and universities to make informed decisions for allocating their research resources. Notwithstanding, USDA is continuing to work on defining better metrics with other federal research agencies under the guidance of the Interagency Working Group for Technology Transfer, convened monthly by the Department of Commerce's Office of Technology Policy.

In FY 2002, ARS recognized the need for a more sophisticated database for developing and monitoring metrics for technology transfer. The passage of the Technology Transfer Commercialization Act of 2000 (P.L. 106-404) provided new authority for licensing unpatented, but "protectable," technologies, yet ARS had no mechanism to catalogue and monitor such technologies. Additionally, changing global markets have created a need for plant protection for some new varieties. ARS had no formalized process to evaluate plant protection needs.

In response, OTT restructured the patent and licensing database modules of the Agricultural Research Information System (ARIS) to allow portfolio development of "technology families." The Invention Disclosure process for determining patent protection was expanded by adding two new modules for assessing plant material inventions and biological material inventions. Collectively, this improved the infrastructure necessary to track technology transfer outcomes in these important new areas—regardless of whether formal intellectual property protection is sought. The restructured database was delivered to OTT in September 2003 (beta version). These new modules were evaluated, tested for data integrity, and further modified during FY

2005. They were formally integrated into operations during FY 2006. Because licensing activities requires detailed information on USDA patents, the ARIS database now includes all inventions arising from FS and APHIS-WS.

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.

OTT continues to explore other metrics from technology research partnerships with universities, not-for-profit organizations (e.g., commodity groups, commissions, and foundations), and private sector companies. We developed a new ARIS module for the TTCs that captures information about Material Transfer Agreements, workshops, field days, scientific meetings, and working groups that assist customers and stakeholders in adopting ARS solutions to agricultural problems. The TTC module was delivered to OTT (beta version) in the 3rd quarter of FY 2004 and became a routine component of our operation in FY 2005. Beginning with the FY 2005 Annual Report, metric tables now include information from this database. In addition, all TTC activities 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 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 continues to be a part of OTT's marketing strategy to diversify and reach new target customers. They are an effective outreach mechanism that allows us to measure our results immediately. The benefits of attending industry conferences and tradeshows are many. 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 tool and a part of the total marketing mix used to get the word out about what ARS has to offer. They are a good way to build our customer base and make industry connections through face-to-face interactions with target groups. OTT alternates the types of tradeshows it attends each year. Shows are selected based on the types and number of technologies in a particular area needing commercial partners.
- The ARS-OTT Technology Alerts, developed and administered by the Marketing Section, continues to expand its membership. New members are sought through aggressive marketing strategies, which include personal invitations to company officials at tradeshow events, meetings, letters, and personal interactions. The current list membership is 2455—up by 11% from the past year. Strategic marketing plans continue to focus on providing specific targeted information to agency customers. The Marketing Staff continues to fine-tune its Tech Alerts list by expanding list options. The "Crop Production" list was divided into five subcategories in 2006. Further, a new list was created (Chemical Compounds/Misc), and another list was renamed and expanded (Biobased Products/Biofuels) to reflect a shift in the agency's focus on biofuels research as

part of the President's Bioenergy Initiatives. The list now includes: All Technologies; Animal Production Technologies; Swine Technologies; Cattle Technologies; Aquaculture Technologies; Poultry Technologies; Other Animals (every other animal, e.g. deer, sheep); Food, Safety and Nutrition Technologies; Biobased Products/Biofuels Technologies; Natural Resources Technologies; Biotechnology Technologies; and Crop Production Technologies; Corn Technologies; Cotton Technologies; Soybean Technologies; Wheat Technologies; Other Crops (other crops such as fruit crops, switch grass, barley, etc.). The Marketing Staff is developing plans for creating awareness about research partnering opportunities and expanding the Tech Alerts list membership in 2006.

- ARS laboratories across the nation continue to plan workshops, meetings and seminars designed to inform industry representatives about ARS research findings. The meetings include presentations and instruction from ARS scientists, as well as demonstrations on specific projects. The topics often address major industry problems, for example, teaching the animal industry methods for controlling pathogens in livestock, or instructing the dairy and veterinary industry on using new dairy feeding guidelines. Many of these interactions result in dialogue between ARS researchers and industry, and often lead to formal collaborative research projects.
- During the latter half of FY 2005, OTT piloted a new training/workshop process designed to enhance adoption of research outcomes of specific National Programs where protecting intellectual property is essential. Although OTT personnel routinely visit research sites and conduct general training of scientists and line managers, we co-convened a workshop with scientists working in the Animal Health National Program (NP 103) with the purpose of tailoring OTT presentations to specific needs of animal health research. This was timed to provide specific training on transferring technologies to the private sector in the areas of vaccines, diagnostics and therapeutics; successful companies also presented on what they need from the ARS researchers. Following the workshop, scientists prepared their 5-year research project plans with specific goals of developing technologies for private sector commercialization. Annual metrics will monitor their success in developing and properly protecting these technologies. This approach will be applied to other National Programs in ARS where protecting intellectual property is more likely to enhance commercialization.
- Given the increased emphasis during FY 2006 on our national reliance on petroleum, ARS will redefine and expand research on bioenergy, creating a new National Program (213) realigning and combining relevant components of previous National Programs. A coordinating workshop of ARS scientists conducting research in this area was convened in early December 2006. OTT and the National Program staff plan on conducting a technology transfer workshop in FY 2007 specifically addressing the processes necessary to adopt bioenergy research outcomes.
- 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 anticipates assisting USDA's Departmental

Administration with promoting the Biopreferred program to Federal buyers and industry producers. During FY 2006, the USDA Energy Council was established 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. It is anticipated that ARS and FS will convene a technology transfer partnership workshop in collaboration with Department of Energy's National Renewable Energy Laboratory (Golden, CO) to bring the public and private sectors together to forge partnerships.

- OTT has created a Web-based intranet using Microsoft SharePoint to improve customer service by enhancing internal communications and efficiency. For example, 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 our standard operating procedures. 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 issue of the 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). During FY 2006, OTT and WS developed policies and procedures for APHIS-WS technology transfer, initiated training sessions with WS scientists at NWRC, and provided CDs to WS scientists containing relevant technology transfer information, process descriptions, and generic forms. In FY 2007, further training sessions are planned for WS field scientists, as well as providing guidance in developing a brochure for broad distribution to customers and stakeholders.
- ARS is evaluating the role that Enhanced Use Lease (EUL) authority would provide to technology transfer efforts. In combination with Partnership Intermediary Agreements, EUL may aid in developing long-term partnerships with the private sector. As ARS increases research on biofuels, EUP 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 are being reviewed for possible realignment in FY 2007 to form national committees by discipline/subject matter to minimize time between submission and review, and to provide better consistency of decisions across the agency.
- OTT is creating 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.
- 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 were patented and licensed. Research related to plant systems has covered broad topics such as fermentation technology; biocatalytic conversions; gene expression systems, including plant promoter systems for broad public use; plant genetics, and natural biological control agents. Discoveries of new agricultural product uses include two patent families 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. Other research has centered on animal health. Animal technologies include genetic markers and other tools that are broadly used for improving animal production and animal health, such as identifying swine resistant to E. coli. Other animal health technologies include a number of animal disease vaccines for swine, poultry, sheep, and cattle that are in the final stages of development.

## Collaborative Relationships for Research & Development (R&D)

### CRADAs and Other R&D <sup>1</sup>

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● CRADAs, total active in the FY	225	229	205	199	211
- New, executed in the FY	59	55	44	55	74
▪ Traditional CRADAs, total active in the FY	213	212	185	171	165
- New, executed in the FY	58	48	36	45	45
▪ Non-traditional CRADAs, total active in FY	10	17	20	28	22
- New, executed in the FY	1	10	8	11	5
▪ Material Transfer - CRADA, total active in the FY	3	6	4	6	7
- New, executed in the FY	1	4	0	3	2
▪ Master, total active in the FY	1	1	2	1	1
- New, executed in the FY	0	1	1	0	0
▪ Multiple Cooperators, total active in the FY	8	10	9	17	7
- New, executed in the FY	N/A	3	3	4	1
▪ Foreign - CRADA, total active in the FY	N/A	5	5	9	7
- New, executed in the FY	N/A	3	3	4	2
● Amendments <sup>5</sup> , total in the FY	101	65	67	70	73
● Other collaborative R&D relationships, total active in the FY <sup>2</sup>	526	529	1,826	5,270	4,404
▪ Confidentiality Agreements					
- New, executed in the FY			162	242	227
▪ Material Transfer Agreements					
- New, executed in the FY	436	355	498	722 <sup>3</sup>	700 <sup>4</sup>
▪ Other Agreements, total active in the FY <sup>2</sup>	90	174	1,166	5,028	3,477
- New, executed in the FY	N/A	N/A	741	722	676

<sup>1</sup> Includes data from APHIS and FS (FY06 APHIS: 2 active CRADAs (2 new), 1 MTA; FY06 FS: 24 active CRADAs (20 new))

<sup>2</sup> Includes Trust Fund Agreements, Reimbursable Agreements, and Non-Funded Cooperative Agreements; data incomplete for FY 2001-2004.

<sup>3</sup> Includes 523 processed for outgoing materials, representing research outcomes of interest to other researchers and private sector companies.

<sup>4</sup> Includes 500 processed for outgoing materials, representing research outcomes of interest to other researchers and private sector companies.

<sup>5</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.

## Invention Disclosure and Patenting

### Intellectual Property Management <sup>1</sup>

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
● New invention disclosures in the FY	151	121	142	125	105
● Patent applications filed in the FY	90	60	81	88	83
▪ Non-Provisional	68	43	59	62	59
▪ Provisional	22	17	22	26	24
● Patents issued in the FY	53	64	50	27	39

<sup>1</sup> Includes data from APHIS and FS (FY06 APHIS: 1 patent application filed; FY06 FS: 7 patents issued, 4 patent applications filed.)

## Licensing

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

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
<b>• All licenses, number total active in the FY</b>	267	270	296	320	332
▫ New, executed in the FY	26	27	29	33	25
<b>• Invention licenses, total active in the FY</b>	267	270	296	320	332
▫ New, executed in the FY	26	27	29	33	25
- Patent licenses, total active in FY	267	269	290	309	316
▫ New, executed in the FY	26	26	24	28	20
- Material transfer (invention), total active in FY	N/A	1	6	11	16
▫ New, executed in the FY	N/A	1 <sup>2</sup>	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. Includes data from APHIS and FS. Data for FY 2003 and FY 2004 was corrected for typographical errors.

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

### Income Bearing Licenses <sup>1</sup>

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
<b>• All income bearing licenses, number</b>	265	268	294	318	330
▫ Exclusive	179	183	200	220	233
▫ Partially exclusive	37	41	41	37	32
▫ Non-exclusive	49	44	53	61	65
<b>• Invention licenses, income bearing</b>	265	268	294	318	330
▫ Exclusive	179	183	200	220	233
▫ Partially exclusive	37	41	41	37	32
▫ Non-exclusive	49	44	53	61	65
- Patent licenses, income bearing	265	267	288	307	314
▫ Exclusive	179	183	200	220	233
▫ Partially exclusive	37	41	41	37	32
▫ Non-exclusive	49	43	47	50	49
- Material transfer (invention) licenses, income bearing	N/A	1	6	11	16
▫ Exclusive	N/A	0	0	0	0
▫ Partially exclusive	N/A	0	0	0	0
▫ Non-exclusive	N/A	1	6	11	16
<b>• All royalty bearing licenses, number <sup>2</sup></b>	67	75	82	99	100
<b>• Invention licenses, royalty bearing</b>	67	75	82	99	100
- Patent licenses, royalty bearing	67	75	82	96	93
- Material transfer (invention) licenses, royalty bearing	N/A	0	1	3	7

<sup>1</sup> Includes data from APHIS and FS. FY 2001 data does not include the FS.

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

Licensing Management

	FY 2002 <sup>5</sup>	FY 2003 <sup>4</sup>	FY 2004 <sup>3</sup>	FY 2005 <sup>2</sup>	FY 2006 <sup>1</sup>
<b>• Number of licenses</b>					
• <b>Invention licenses</b> , total active in the FY	267	270	296	320	332
◦ New, executed in the FY	26	27	29	33	25
<b>• Elapsed execution time</b> , licenses granted in the FY					
• <b>Invention licenses</b>					
◦ average (months)	6.5	7.0	7.1	5.5	11.2
◦ median (months)	6.5	6.6	6.8	3.5	7.6
◦ minimum (months)	1.9	2.8	3.5	1.1	2.3
◦ maximum (months)	11.5	13.3	13.1	21.7	27.7
- <b>Exclusive and partially exclusive invention licenses</b>					
◦ average (months)	7.7	7.6	8.7	4.3	14.3
◦ median (months)	7.8	6.7	8.0	3.9	15.0
◦ minimum (months)	3.7	2.8	6.8	1.1	3.9
◦ maximum (months)	11.5	13.3	13.1	9.2	27.7
- <b>Non-exclusive invention licenses</b>					
◦ average (months)	5.3	5.9	6.2	6.8	6.7
◦ median (months)	5.3	5.8	6.0	2.9	5.9
◦ minimum (months)	1.9	3.5	3.5	1.7	2.3
◦ maximum (months)	9.0	9.9	11.5	21.7	12.1
• <b>Patent invention licenses</b>					
◦ average (months)	6.5	7.1	8.2	6.1	12.1
◦ median (months)	6.5	6.6	7.5	3.9	7.6
◦ minimum (months)	1.9	2.8	3.5	1.1	2.3
◦ maximum (months)	11.5	13.3	13.1	21.7	27.7
- <b>Exclusive and partially exclusive patent invention licenses</b>					
◦ average (months)	7.7	7.6	8.7	4.3	14.3
◦ median (months)	7.8	6.7	8.0	3.9	15.0
◦ minimum (months)	3.7	2.8	6.8	1.1	3.9
◦ maximum (months)	11.5	13.3	13.1	9.2	27.7
- <b>Non-exclusive patent invention licenses</b>					
◦ average (months)	5.3	6.1	7.8	8.6	4.8
◦ median (months)	5.3	6.6	7.1	5.8	5.9
◦ minimum (months)	1.9	3.5	3.5	2.6	2.3
◦ maximum (months)	9.0	9.9	11.5	21.7	6.3
• <b>Material transfer (invention) licenses</b>					
◦ average (months)	N/A	5.0	4.4	2.3	8.2
◦ median (months)	N/A	5.0	4.0	2.3	8.4
◦ minimum (months)	N/A	5.0	3.6	1.7	3.9
◦ maximum (months)	N/A	5.0	6.0	2.9	12.1
- <b>Non-exclusive material transfer (invention) licenses</b>					
◦ average (months)	N/A	5.0	4.4	2.3	8.2
◦ median (months)	N/A	5.0	4.0	2.3	8.4
◦ minimum (months)	N/A	5.0	3.6	1.7	3.9
◦ maximum (months)	N/A	5.0	6.0	2.9	12.1
<b>• Licenses terminated for cause</b> , in the FY					
• Invention licenses	3	0	1	0	0
• Patent invention licenses	3	0	1	0	0
• Material transfer (invention) licenses	N/A	0	0	0	0

<sup>1</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 25 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> 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>3</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>4</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.

<sup>5</sup> Based on 12 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>

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
<b>• Total income, all patent invention licenses active in the FY</b>	\$2,571,378	\$2,290,903	\$2,163,507	\$3,315,486	\$3,161,869
<b>• Invention licenses</b>	\$2,571,378	\$2,290,903	\$2,163,507	\$3,315,486	\$3,161,869
- Patent licenses	\$2,571,378	\$2,290,903	\$2,140,466	\$3,302,371	\$3,100,219
- Material transfer (invention licenses)			\$23,041	\$13,115	\$61,650
<b>• Total Earned Royalty Income (ERI)</b>	\$1,569,877	\$1,560,825	\$1,426,876	\$2,089,174	\$2,337,323
- Patent (and patent application) licenses, total ERI	\$1,569,877	\$1,560,825	\$1,423,835	\$2,083,059	\$2,301,172
◦ Median ERI	\$5,096	\$3,102	\$5,645	\$5,601	\$5,194
◦ Minimum ERI	\$79	\$159	\$124	\$49	\$18
◦ Maximum ERI	\$569,265	\$236,306	\$154,213	\$263,648	\$230,296
◦ 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	\$794,418	\$696,532	\$499,709	\$890,414	\$908,123
◦ ERI from top 20% of licenses	\$1,254,545	\$1,292,383	\$1,026,141	\$1,624,258	\$1,854,214
- Material transfer (invention licenses), total ERI	N/A	\$0	\$3,041	\$6,115	\$36,150
◦ Median ERI	N/A	\$0	\$3,041	\$1,925	\$2,645
◦ Minimum ERI	N/A	\$0	\$3,041	\$600	\$153
◦ Maximum ERI	N/A	\$0	\$3,041	\$3,591	\$17,053
◦ ERI from top 1% of licenses	N/A	\$0	\$3,041	\$3,591	\$17,053
◦ ERI from top 5% of licenses	N/A	\$0	\$3,041	\$3,591	\$17,053
◦ ERI from top 20% of licenses	N/A	\$0	\$3,041	\$3,591	\$17,053

<sup>1</sup> Includes data from USDA, APHIS and USDA, Forest Service. FY 2001 data does not include the USDA, Forest Service.

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

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

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
<b>• Income distributed<sup>2</sup></b>					
<b>• Patent invention licenses, total distributed</b>	\$2,463,240	\$2,586,583	\$2,274,043	\$2,661,184	\$2,534,208
- To inventors	\$543,336	\$540,399	\$380,916	\$821,677	\$982,756
- Salaries of some technology transfer staff	\$1,102,891	\$1,156,936	\$1,265,991	\$1,221,246	\$1,020,786
- Patent filing preparation, fees, and patent annuity payments	\$686,696	\$785,218	\$627,136	\$618,261	\$530,666
- Other technology transfer expenses	\$130,317	\$104,030	\$0	\$0	\$0
<b>• Material transfer (invention) licenses, total distributed</b>	N/A	\$0	\$23,022	\$14,556	\$27,073
- To inventors	N/A	\$0	\$9,011	\$9,698	\$15,286
- Salaries of some technology transfer staff	N/A	\$0	\$14,011	\$4,858	\$11,787
- Patent filing preparation, fees, and patent annuity payments	N/A	\$0	\$0	\$0	\$0
- Other technology transfer expenses	N/A	\$0	\$0	\$0	\$0

<sup>1</sup> Includes data from APHIS and FS. FY 2001 data does not include the FS.

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

## Downstream Outcomes from Technology Transfer Activities

Selected examples of Technology Transfer Outcomes in FY 2006:

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### *Nutrition, Food Safety/Quality*



Technician Examines  
*Salmonella* Colony

***Monitoring Food Safety and Animal Health.*** ARS, APHIS, and FSIS researchers have teamed up to tackle animal health and related food safety issues. The research effort is called the Collaboration in Animal Health and Food Safety Epidemiology (CAHFSE). The project provides a way to routinely track critical disease in food-animal production, and enhance overall understanding of bacteria that pose food safety risks on farms and in processing plants. CAHFSE was designed to enhance two existing USDA programs that periodically assess farm-animal health and antimicrobial resistance: the National Animal Health Monitoring System (NAHMS) and the National Antimicrobial Resistance Monitoring System (NARMS).

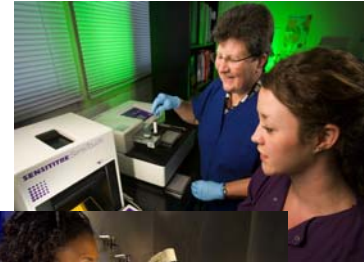
NAHMS conducts surveillance on selected meat or poultry commodity products once every five years, seeking to identify and address major animal health and food safety issues. NARMS monitors changes in antimicrobial susceptibility patterns in zoonotic bacteria (those that can transmit diseases from lower animals to humans) and in commensal bacteria (those that live within livestock or humans without causing illness). While both programs are critical to food safety, the key to CAHFSE is continual risk analysis conducted by USDA professionals on farms and in processing plants.



CAHFSE is establishing a national system to meet industry needs. The group has already undertaken swine as its first food animal examination. The National Pork Board and pork producers are excited about having additional science-based information to further support its policies and programs for the industry.

The collaborative program includes on-farm sample collection, data analysis, and risk assessment, which may ultimately have an impact on the nation’s food supply. The program also targets intervention strategies that could help improve food safety.

This program enables USDA scientists and regulatory officials to identify and implement strategies for animal health and food safety issues in a timely manner—averting adverse economic, animal health, and public health consequences. CAHFSE data is publicly available at: [www.aphis.usda.gov/cahfse/index.htm](http://www.aphis.usda.gov/cahfse/index.htm).



This is the only comprehensive program of its kind in the United States.



ARS Researcher Measuring the Fluorescence of Aflatoxins

**Monitoring Toxins in Agricultural Commodities.** ARS scientists in Peoria, IL developed an antibody-based test for detecting mycotoxins in agricultural commodities. ARS has entered into several biological material licenses for cell lines used to produce antibodies for use in commercial detection kits. Mycotoxins are naturally occurring chemicals made by fungi that can grow on corn, barley, wheat, and other commodities. An example of these toxic chemicals is aflatoxin, which takes a toll on U.S. corn production during years when there is extremely high temperatures and drought. To safeguard human food and animal feed, U.S. law prohibits the sale of corn—or any grain—for human consumption if it contains more than 20 parts per billion (ppb) of aflatoxin. For domestic non-milk-producing animals, the permissible level ranges from 100 to 300 ppb. To detect these minute levels, purchasers, suppliers, and regulators must have accurate, sensitive tests.

Another aflatoxin cell line, which was jointly developed by ARS and University of Illinois researchers, has also been licensed. This technology is highly important, since mycotoxins can impact international trade, result in economic losses due to lower food quality, and can impact livestock and human health.



**Protecting Poultry from Diseases.** A team of ARS and University of Arkansas scientists in Fayetteville, AR discovered “good” bacteria that could help protect poultry from pathogens such as *Salmonella* and *Campylobacter*, which can cause illness in humans who eat foods contaminated with either of these bacteria. The good bacteria can be fed to poultry as a probiotic treatment—a dietary treatment containing good bacteria. Probiotic treatments are a healthier, safer alternative to antibiotic treatments. The treatments help poultry resist harmful pathogens and grow more efficiently—leading to a safer poultry product for consumers. Probiotics reduce the opportunity for pathogenic bacteria (or bad bacteria) to become established in newly hatched poult when they are most susceptible to infection.

The team screened more than 8 million intestinal bacteria to come up with several promising probiotic combinations. They have developed multiple techniques for identifying potential probiotics—making probiotic production less expensive.

This technology led to the formation of a start up company in Arkansas, Sigrah-Zellet LLC. The company employs 5 people in Arkansas and 7 people internationally. The company uses a subcontractor that accounts for 2 full time employees and more than 80 sales and technical support staff distributing the product world wide. Sigrah-Zellet LLC specializes in probiotics and poultry health and production. The company licensed the patent-pending technology and is selling the treatment under the commercial name FloraMax-B11. The product was made available in 2004, making a profit the first year (~100 million birds treated). In 2005, the product was marketed in 16 countries, with more than 1 billion doses sold. The company expects a 50% increase in total usage in 2006. The product is being marketed in South Korea, Japan and Mexico, and six additional countries are in the final stages of acquiring import permits. The product increases meat yields, which translates to a greater than \$6 million increase in production yields for every 300 million birds treated in the United States annually.



This technology will increase poultry production efficiency, safety and profitability worldwide, and will likely be extended to other animal species. This new alternative antibiotic treatment could also help reduce the prevalence of food borne illnesses by reducing the presence of *Salmonella* and *Campylobacter* in commercial chickens. The Council for Agricultural Science and Technology estimated that as many as 9,000 deaths and 6.5-33 million illnesses in the United States each year are caused by eating contaminated foods.

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





Photo Courtesy of Origami Foods

**Commercializing Fruit and Vegetable Films.** In FY06, researchers with ARS's Processed Foods Research Unit in Albany, CA worked with a Cooperative Research and Development Agreement (CRADA) partner, Origami Foods of Pleasanton, CA to commercialize the ARS patent-pending, fruit and

vegetable-based films in a variety of final food product applications. One application uses the films as a healthy, colorful alternative to the seaweed wrap "nori" in a line of sushi-like fusion rolls, which are on sale now at Costco supermarkets. The global market for nori is approximately \$1.7 billion. Furthermore there are more than 6000 sushi restaurants in the United States and the market is growing significantly every year. Origami Foods anticipates taking advantage of this existing market and further expanding it in the future.

This year, the films were also introduced commercially on a wide variety of up-scale restaurant appetizers, entrees and desserts, as well as a healthy, flavorful glaze for hams and turkeys.

This year, the San Joaquin Revolving Loan Fund Committee approved a greater than \$1 million loan to assist Origami Foods in developing their small business. This Revolving Loan Fund supports urban development and is part of WorkNet, a government-funded program for creating jobs. Origami Foods' business will be located in an Enterprise Zone, which is another job creation program for high unemployment urban areas.

Recent research on the fruit- and vegetable-based edible films and coatings has further enhanced the properties of these healthy and colorful products by including natural antimicrobial compounds to improve food safety. These novel films and coatings are very effective against *E. coli* bacteria as reported in a recent ARS article appearing in the "*Journal of Agriculture and Food Chemistry*." These results are only the beginning of a three-year project funded by the USDA, Cooperative State Research, Education, and Extension Service in which a wide range of natural antimicrobial compounds will be tested for their efficacy in fruit and vegetable films and coatings. Food applications will also be tested during this project. Antimicrobial activity against not only *E. coli*, but also *Salmonella*, *Listeria* and *Bacillus Cereus* will be explored. New processing technologies are needed to increase use and consumption of fruits and vegetables by American consumers. This research also supports rural agricultural communities by adding value to crops and their co-products, as well as stimulating business development.



Fruit and Vegetable Films

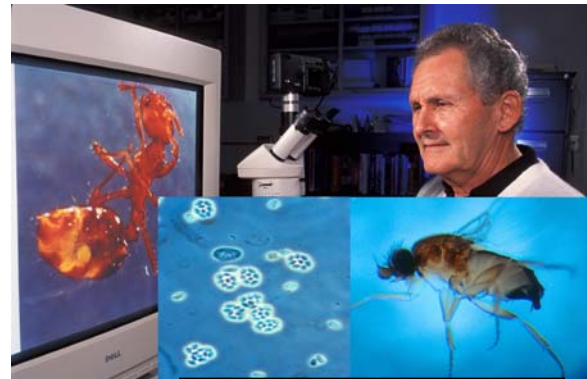
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## *Animal Production and Protection*



***Suppressing Fire Ants.*** A team of researchers led by ARS scientists in Gainesville, FL joined forces with federal, state and local officials to combat fire ants. The team developed and demonstrated an area-wide integrated pest management approach for imported fire ant suppression. Fire ants are thought to have spread to the United States from their native South America via contaminated ships in the early 1900s. This fiery pest now infests over 130 million acres in the southeastern United States including Puerto Rico. It has also recently become established in California, Arizona, New Mexico, and Maryland. ARS researchers believe fire ants have flourished in the United States because they have no natural enemies here—at least until now. The control techniques

used to suppress the pests include releasing several parasitic phorid fly species, distributing a fatal fire ant-specific pathogen (*Thelohania solenopsae*), and developing baits containing a quick acting toxicant and a growth regulator that stops egg production in the queen. Phorid flies are a highly specific, natural enemy of fire ants. The female phorid fly pierces a fire ant's head and deposits an egg. The egg quickly hatches into a fly larva that moves into the ant's head. When the maggot is mature, it releases an enzyme that causes the ant's head to fall off—decapitation.



**Fire Ant Infected with Pathogen.  
Inset: Pathogen and Phorid Fly**

*Thelohania* is a microorganism from South America, and infects fire ant colonies and causes disease. Fire ant workers transfer the pathogen to the queen by food exchange. As the disease slowly reduces the queen's weight, she lays fewer and fewer eggs—all infected with the pathogen, further weakening the colony. ARS scientists developed rearing and



Left: Baby Alligator Attacked by Fire Ants. Right: Human Stung by Fire Ants.

distribution techniques for both fire ant defenses—critical to the program's success. Fire ant populations have been reduced by more than 80% in demonstration sites. Sustainable biological control agents have been released in much of the ant infested area and phorid flies are well established in 8 states with over 100,000 square miles and 20,054,000 people impacted. The program's impact is critical since fire ants pose threats to humans and animals from their defensive stings. The pests also have an ecological impact, especially on endangered vertebrates and invertebrates. Fire ants harm endangered species like Stock Island tree snails, gopher tortoises, Florida grasshopper sparrows, salt marsh rabbits, and sea turtles that hatch their eggs on land.

This technology won a 2006 ARS Award for Excellence in Technology Transfer.

**Licensing Biological Materials.** ARS researchers continually develop biological materials, such as hybridomas, microbial isolates, cloned genetic material, etc., to assist them in their daily research efforts. Recognizing the value of such research tools, industry researchers have requested ARS biological materials to use in immunoassay test kits that identify harmful substances in food, water, soil, and commodities. Non-exclusive biological material license agreements are used to transfer biological materials to industry. As a result, a small portion of ARS's earned royalty income was generated from products sold under those license agreements.

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***Crop Production and Protection***



***Developing New Plant Materials.*** A key role of ARS is to provide new plant genetic resources that can combat potential crop losses due to pests, diseases, and environmental stress. Each year ARS makes many new plant materials available to plant breeders and growers. These materials may be entire collections of genetic stock for a particular commodity, multiple advanced lines of enhanced germplasm that are used by breeders to create new cultivars, or finished varieties that are ready for public use. In FY 2006, ARS made about 65 official public releases of plant materials.

The rice collection repository, called Genetic Stocks-Oryza (GSOR), which was established at the Dale Bumpers National Rice Research Center in Stuttgart, AR in August, 2003, has filled a void by making key rice genetic stocks available to breeders worldwide. These rice genetic stock collections help preserve materials that otherwise might be lost as agency researchers retire and/or grants terminate. Thus this collection fills that void, which has been recognized for at least a decade. The original GSOR collection was made up of 19 entries. In FY 2006 the collection reached 902 entries.

ARS researchers in Athens, GA developed and patented two new Bermuda turfgrass varieties that are specially designed for athletic and recreation fields. The grasses were initially popular on golf courses, but sports teams across the nation are now playing on these grasses, including professional sports teams, high school athletes, recreation department teams, and university leagues. As of FY 2006, TifSport has been planted on hundreds of lawns and athletic fields and on over 200 golf courses in the United States and abroad, and TifEagle has been planted on over 500 golf courses.

Texas A&M planted about 97,000 square feet of TifSport for its soccer team, while the NFL Tennessee Titans football team installed TifSport when Adelphia Coliseum was built. The new grasses tolerate drought and are primarily pest resistant—requiring fewer chemicals to control pests. Important in professional sports venue is greener, plusher grass. These new varieties are a uniform, deep, dark green color—offering ultimate playing field conditions. Additional features and benefits of these grasses include: aggressive establishment, earlier spring green-up, ability to tolerate frequent mowing, and cold resistance. ARS researchers developed the grasses to “take a beating.” They can stand up to the stress and demands of big-time sports, the wear and tear of football and soccer cleats, the punishment of baseball spikes, and constant heavy foot traffic.



**Improving Cotton Quality.** To support both cotton producers and processors, ARS researchers at Stoneville, MS released two cotton germplasm lines (MD52ne and MD90ne) in FY 2006 that are nectarless (does not require pollination) and have exceptional fiber quality. MD52ne has 10% higher fiber strength, 22% less short fibers, and 7% longer length than MD90ne. The genes that encode for improved fiber quality is dominant, making it easier for breeders to develop new varieties. Improved fiber quality is needed to make U.S. cotton more competitive in world markets and to improve U.S. textile mill efficiency. The nectarless trait reduces boll losses caused by tarnished plant bugs, which is the most destructive pest in the southeastern and mid-south cotton-growing regions. ARS has made seed of these two germplasm lines widely available to researchers, geneticists, and commercial cotton breeders.



Sugarcane

**Improving Sugarcane Varieties.**

Researchers at ARS's sugarcane Research Laboratory in Houma, LA developed two new superior yielding sugarcane varieties (HoCP 96-540 and Ho 95-988). Since their release to the Louisiana sugarcane industry in 2003 (HoCP 96-540) and 2004 (Ho 95-988), approximately 175,000 acres of the two varieties combined have been planted through 2006—valued at \$238 million for the 2007 harvest season. Prior to the ARS release, the sugarcane industry depended

solely on one high-yielding variety. Reliance on one variety is potentially threatening to the sugarcane industry, since new diseases or insects could wipe out an entire crop. New diseases and insect pests are associated with strain shifts and/or accidental plant and disease introductions related to natural phenomena such as hurricanes.

ARS researchers anticipate the two new varieties will comprise at least 40% of Louisiana's 450,000 acres of sugar production in 2007—offering additional plant genetic stock security to the industry. These new varieties are easier to harvest and tolerate freezing weather conditions. In 2007, the increased yield of these varieties will result in an increased value of between \$29,000,000 and \$43,000,000 over what the crop would have been worth to the Louisiana sugar industry with the previously planted variety. Louisiana produces approximately 6,000 pounds of sugar per acre. These new varieties have a 10-15% greater sugar yield, which increase sugar production an additional 600 pounds per acre or \$120 per acre.

This technology won a 2006 ARS Award for Excellence in Technology Transfer.



***Improving Sugarcane Processing.*** ARS researchers in New Orleans, LA industrially evaluated two methods that help improve sugarcane processing. The processes are used for clarifying sugarcane juice and have been adopted by all sugarcane factories in Louisiana and Texas, as well as factories in Florida. These two processes, an intermediate-temperature lime clarification and a hot lime clarification process, help remove

more impurities, including those from green leafy trash and debris. The processes also reduce expensive sucrose losses. After sugarcane has been harvested, it's pressed between rollers to extract the juice from the stalk. The juice is then clarified to remove impurities. Clarification affects sugar yield and raw sugar quality.

The traditional clarification process uses cold liming, where the juice is mixed in a tank at ambient temperature and lime is added to the mixture cold. Eventually impurities are filtered off and some sucrose is lost in the process. In hot liming, some or all of the cane juice is preheated and lime is added when the mixture begins to boil. This helps remove extra impurities without losing too much sucrose. With intermediate liming, some or all of the juice is preheated. Lime is added to the juice in a lime tank before it begins to boil. ARS's research has saved Louisiana sugarcane processors about \$3,800,000 in sucrose losses per season. ARS worked cooperatively with the American Sugar Cane League (ASCL), a trade association representing Louisiana sugarcane growers and raw sugarcane processors, to get the industry to adopt the technology.

This technology won a 2006 ARS Award for Excellence in Technology Transfer.



### **Improving Apple Quality.** ARS

researchers in Wenatchee, WA, spearheaded national and international efforts to improve apple storage quality while reducing fungicide use. Freshly-picked apples that receive no post-harvest treatments have a relatively short shelf life—a few weeks. Apple growers and distributors have customarily used expensive chemical treatments to extend apple storage capacity by preventing apple diseases, rot, and

accelerated softening. Chemical treatments to apples permit growers to maximize their returns, while still providing consumers relatively unprocessed apples year round. Prior to 2005, the standard chemical treatment used several fungicides and antioxidants, which could have downstream environmental effects.

ARS scientists evaluated a natural compound (1-MCP) for its fruit preservation properties. Because of ARS's efforts, the Food and Drug Administration granted a GRAS (generally recognized as safe) label in 2002 for the compound, and an Environmental Protection Agency registration for commercial use was secured shortly thereafter. Since the registration was granted, commercial distribution of 1-MCP took off, and sales and distribution of the compound have been expanded both domestically and internationally.



The use of this compound has reduced chemical and fungicide use. Additionally, the use of this technology has saved the apple industry in several parts of the United States. It provides the most innovative technology in the last 50 years for maintaining postharvest quality of fresh fruits and vegetables.

This technology won a 2006 ARS Award for Excellence in Technology Transfer.



***Saving American Agriculture.*** The honey bee is an important beneficial insect. In addition to the \$300 million honey, beeswax, and other hive products produced annually, crop growers rent more than two million honey bee colonies every year to assist in pollinating a wide variety of crops with an added market value exceeding \$15 billion. American foulbrood disease is a highly contagious disease among honey bee larvae. The only approved antibiotic for treating this

devastating disease was oxytetracycline (marketed as Terramycin). In 1999, reports of bacterial resistance started to surface. New and effective controls were urgently needed to ensure honey bee availability for pollination and honey production.

ARS scientists in Beltsville, MD initiated a laboratory screening program to identify a suitable antibiotic alternative. Their research indicated tylosin tartrate, an antibiotic marketed as Tylan—which was already approved for use in chickens, turkeys and swine—is also highly effective in inhibiting foulbrood disease in bees.

Tylan Soluble, produced by Elanco Animal Health of Greenfield, IN, was approved by the U.S. Food and Drug Administration in 2006—following a review of research data compiled by ARS scientists. From conception, design and research, through drug approval and labeling, ARS scientists played a crucial role in answering customer and stakeholder needs.

Agriculture and Agri-Food Canada has also requested ARS’s research findings to support Canadian registration of this product. ARS researcher efforts have made it possible to protect nearly four million bee colonies at risk in North America. While the value of these colonies can be modestly estimated at about \$1 billion—the impact to U. S. crop production is far broader.

The California almond industry, for instance, requires more than a million bee colonies annually to pollinate a crop worth about 1.5 billion dollars. From apples in Washington to Florida citrus and numerous other fruit, vegetable and seed crops, ARS’s research efforts have contributed to maintaining the vitality of U.S. agriculture.



**Breeding Versatile Vegetables.** Research conducted under a Cooperative Research and Development Agreement (CRADA) between two ARS labs in Beltsville, MD—the Floral and Nursery Plants Research Unit and the Vegetable Laboratory—and PanAmerican Seed of Elburn, IL resulted in a new pepper that can be used for both ornamental and culinary applications. Black Pearl was released in 2005, and already received accolades. It was honored in 2006 as an All-America Selections award-winner, which recognizes new flower and vegetable varieties that demonstrate “superior garden performance” in trials conducted throughout the country. The eye-catching ‘Black Pearl’ was also awarded the 2005 Fleuro Select Quality Award. The plant retains the novel black foliage and produces glossy fruit that ripens from black to red under a wide range of environmental conditions. U.S. Plant Variety Protection was applied for, and PanAmerican Seed licensed the technology. Over 3,000,000 seeds were sold during the 2006 growing season worth an estimated \$6 million to the nursery industry. Black Pearl is not only robust and attractive, but it is also tasty—having a spicy flavor.



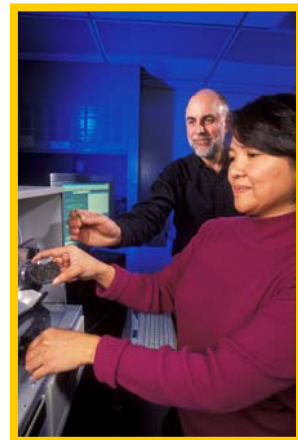


Maize Weevil Feeding on Corn Kernels

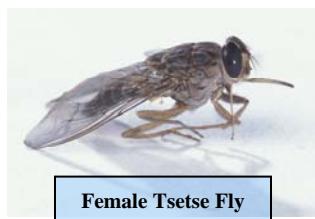
**Detecting Insect Pests.** ARS-developed near-infrared (NIR) spectroscopy technology used to measure grain quality characteristics now has expanded research applications. The single kernel NIR (SKNIR) technology was commercialized through a Cooperative Research and Development Agreement (CRADA) with Perten Instruments (Springfield, Illinois) in 1999, and was first

commercially used in 2002. Prior to this research, automated technology for measuring grain quality attributes using NIR sensors did not exist. The system was modified in 2002 by incorporating low-cost sorting technology. Perten Instruments developed a new commercial SKNIR system through a second CRADA with ARS researchers.

The SKNIR system developed through the second CRADA is now being used for grain and non-grain applications. Breeders and researchers in several states are using the system to study hardness and waxy characteristics in wheat. These attributes are critical for developing wheat for specific new domestic and foreign markets. There are also systems in Australia and Germany for proprietary grain research, and a system will soon go to the Canada Grain Commission. The National Wheat Improvement Committee and National Association of Wheat Growers have recognized how this technology will impact U.S. breeding programs and have included this research area as one of their three legislative priorities for their 2006 Federal budget.



The technology was used to identify wheat contaminated with Karnal bunt. APHIS uses ARS-developed procedures as part of their Karnal bunt national survey. About 80 countries will not import wheat if there is a possibility it contains Karnal bunt, thus rapid and accurate surveillance made possible with this technology is critical to keeping our \$1 billion-plus U.S. export markets open.



Female Tsetse Fly

The International Atomic Energy Agency (IAEA) has purchased a SKNIR system to separate male and female tsetse fly pupae, which was previously not possible and was a hindrance to implementing tsetse Sterile Insect Technique (SIT) eradication programs. SIT was developed by an ARS entomologist and used to eradicate screw worm flies in the United States in the 1950's. Separating males from females is

important, because males are sterilized and released into wild populations. When females mate with sterilized males they die without producing offspring. Tsetse flies transmit sleeping sickness that kills hundreds of thousands of people and animals each year, and causes over a billion dollars in losses in underdeveloped countries. The system is also being further tested to detect and study other human insect pests, like mosquitoes—to test and control malaria, West Nile virus, and other human-health threatening diseases.

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*Natural Resources and Sustainable Agricultural Systems*



**Improving Biofuel Production.** The U.S. President and others have an increasing interest in improving the nation's energy security by replacing imported oil with domestically-produced fuel alternatives. However, the cost of producing such alternatives is an obstacle in gaining momentum in the fuel industry—making renewable fuel non-competitive with petroleum-based gasoline. ARS researchers are looking at converting biomass—living plant matter, such as switchgrass—into biofuel products, such as ethanol. This typically is a costly process. ARS engineers and scientists at several laboratories working under the ARS Bioenergy and Energy Alternatives National Program have developed new sophisticated techniques using enzymes and other natural organisms for converting biomass into ethanol, which are more adaptive to harsh industrial environments, and are more efficient and economical. These findings will aid in commercializing new industrial products for producing renewable fuels and other products—ultimately reducing the Nation's dependency on imported petroleum.



**Suppressing Melaleuca in Florida.** Melaleuca trees were first brought from Australia in the early 1900s and planted in Florida in an attempt to dry up marshes and swamps. This fast-growing weed quickly spread beyond areas where it was intentionally planted. By 1993 melaleuca covered more than 488,000 acres in south Florida. Mature melaleuca trees produce millions of brownish-black seeds every year. Even if only a few of these seeds sprout, melaleuca saplings can quickly crowd out native plants. In 2001, ARS launched The Area-wide Management and Evaluation of Melaleuca (TAME Melaleuca) project as a cooperative effort led by researchers at ARS's Invasive Plant Research Laboratory in Ft. Lauderdale, FL.

The TAME Melaleuca project is designed to promote using biological controls and biologically-based integrated melaleuca management using ARS-developed techniques. In early 2005, the TAME Melaleuca team hosted a series of workshops at project demonstration sites to educate land managers on how to successfully implement melaleuca management techniques. One of the techniques included using the tree's natural enemies from Australia—including the melaleuca weevil—to manage the weed. The natural enemies are specific to melaleuca and do not harm other native plant species. Land, resource, and vegetation managers from over 40 agencies, organizations, and businesses, who control more than 1.4 million acres, attended the event.

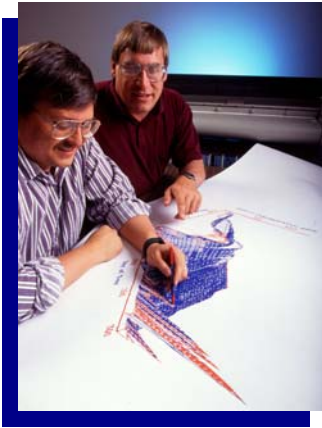
Since TAME Melaleuca's inception, over one million melaleuca biological control agents have been released in south Florida, and more than 75,000 acres of melaleuca have been managed using the team's biologically based tactics. As a result of ARS's efforts, land managers in some melaleuca-infested regions do not consider melaleuca a threat anymore, thus shifting their control efforts to other invasive weed species.

This technology won a 2005 ARS Award for Excellence in Technology Transfer.

***Preserving Our Land.*** Conservation tillage adoption in U.S. Southeastern states has typically lagged behind other U.S. states. In the early 1990's total U.S. adoption was 26%, while in the south it was 21%. Adoption rates in Alabama and Georgia were even worse, at 15% and 18% respectively. Due to team efforts led by ARS in Auburn, AL, adoption rates have improved rapidly with 48% and 34% in Alabama and Georgia, respectively. ARS researchers have developed several conservation tillage strategies, including evaluating which cover crops work best for specific crops. Cover crops can suppress insect pests, reduce soil erosion, add nutrients to the soil, reduce reliance on chemicals, and provide a variety of other benefits.

Thanks to ARS researchers working with farmers and growers to implement conservation tillage practices, an increase of more than 300,000 acres is being farmed using conservation tillage, and now almost 2,000,000 acres are being farmed using conservation tillage in Alabama and Georgia. Using a conservative estimate of \$20/acre in fuel and labor savings, producers in both states have an additional \$40,000,000 in annual profits resulting from conservation tillage practices. Conservation tillage benefits more than farmers, positive environmental impacts from reduced soil erosion, reduced agricultural chemical run-off, and improved soil and water quality benefit all citizens and help preserve our land for future generations. Estimates of off-site benefits are as high as \$103/acre in the southeast.





***Evaluating Water Quality.*** ARS researchers in Fort Collins, CO developed the Root Zone Water Quality Model (RZWQM) as a comprehensive model that helps monitor water quality, soil water storage, and water use. It is an integrated physical, chemical, and biological process-based model that simulates management practices and scenarios, such as no-tillage and residue cover crops versus conventional tillage; rates, methods, and timing of water application, fertilizers, manures, and various pesticide formulations; and different crop rotations up to 100 years. The model has undergone extensive evaluation, refinement, and validation since its first release in 1992.

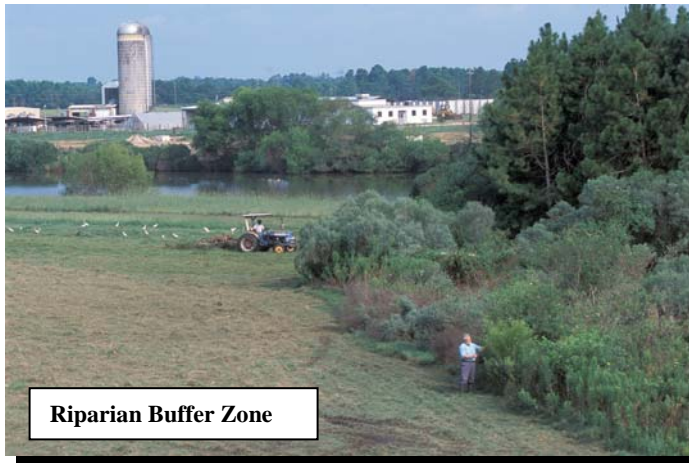
In response to increased user demands over the last 3 years, ARS scientists have made major enhancements in the model. They linked RZWQM to specific crop growth models used all over the world to improve plant growth simulations. In addition, the researchers also improved simulations of the no-tillage and crop residue effects on soil water and temperature. Another enhancement was made specifically for the pesticide industry and the U.S. Environmental Protection Agency (EPA) to monitor organic matter flowing into the water system. EPA recently selected RZWQM as a means for estimating pesticide concentrations in areas where groundwater is particularly vulnerable to pesticide contamination. EPA's use of RZWQM represents a significant change in the way the agency performs its pesticide risk assessments. EPA's use of RZWQM provides for a more scientific pesticide exposure assessment. In 2005, a Science Advisory Panel (SAP) approved EPA's use of RZWQM.



Data Gathered from Weather Stations is Critical to RZWQM's Accuracy

Other improvements were made to increase the model's efficiency targeted to various users. Bayer CropScience used the results from the model to register a pesticide with EPA. The latest version of the model RZWQM2 is now being used by water quality experts and regulatory officials worldwide for evaluating the effects of agricultural and management practices on water, water quality, and production. In the last 3 years, the team has provided training to numerous users from EPA, the U.S. Geological Survey, and field scientists worldwide. Also, over the last 3 years, more than 465 copies of the RZWQM2 model have been downloaded from the Website (<http://arsagsoftware.ars.usda.gov>).

This technology won a 2006 ARS Award for Excellence in Technology Transfer.



**Protecting Our Land.** ARS places a priority on conducting research that has real-world payoffs for USDA stakeholders and customers, including other Federal agencies, commercial producers, state and local research facilities, and citizens. Key strategies developed by ARS scientists for natural resource management are now used by Natural Resource Conservation Service (NRCS)

specialists to conserve and enhance the Nation's soil, water, and air. In 2006, NRCS successfully completed drainage water management projects using ARS techniques, which affected some 7,000 acres. One of these methods involves building wetlands—a technique used decades for municipal wastewater treatment—around agricultural fields to remove suspended solids and nitrogen from field runoff before it drains into nearby waterways. ARS also identified the benefits of vegetated drainage ditches, which can remove excess nutrients in field runoff. Vegetative drainage can also act as a kind of natural treatment for pesticides in runoff—results NRCS has applied in its drainage water management projects. In addition, ARS scientists in Maryland and Georgia have conducted long-range studies on the benefits of buffer zones for protecting watersheds. NRCS has used this research to protect local waterways from agricultural runoff containing phosphorus and nitrogen by creating vegetative riparian buffers, including forest buffers; in 2006, NRCS protected over 70,000 acres using techniques derived from ARS research on riparian buffers.

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*Animal and Plant Health Inspection Service (APHIS)*



**Controlling Canada Geese.** Researchers at APHIS-WS National Wildlife Research Center in Fort Collins, CO in collaboration with Innolytics, LLC of Rancho Santa Fe, CA developed new technology designed to humanely reduce the growing Canada geese population in the United States. WS researchers developed a “birth control” bait that when fed to geese, prevents eggs from hatching. Canada geese can lay 2 to 9 eggs each per breeding season. The OvoControl™ bait has regulatory approval from the

U.S. Environmental Protection Agency (EPA) to help reduce geese populations during breeding season. USDA, EPA and Fish and Wildlife Services officials were instrumental in evaluating the bait for safety and effectiveness. The baiting design limits exposure to other birds. Also, the effects on future bird hatches are fully reversible and the product does not harm the geese. According to the Humane Society’s Urban Wildlife Program in Washington, DC the new technology provides a safe and humane means of controlling certain bird populations, which can pose increased risks to aircraft and conflict with people at parks, golf courses, and other public areas.

Geese are fed treated bait during their breeding season in March and April by trained technicians from licensed pest control companies and Wildlife Services to prevent eggs from hatching. An over population of Canada geese the last few years has become an increasing nuisance to community residents. This new technology should provide a solution to the nuisance Canada geese problem.

A registration application for similar technology in pigeons is pending EPA approval.



## Capturing Wild Birds Without Using Explosives

Net traps have traditionally been used to capture large numbers of waterfowl and other birds for research and management purposes. However, safety concerns limit the use of these nets, which are projected by launchers that use high explosive charges or rocket propellant.

WS and Missouri Wildlife Services Operations partnered with Martin Engineering, Neponset, IL to design and develop a new air cannon net system for capturing wild birds. The new design relies on compressed air instead of explosives to launch four 5-pound projectiles attached to a 40 x 60 foot net. In field evaluations, the new net system captured more than 95% of California gulls and red-winged blackbirds that were within 12-18 feet of the air cannon. The air cannon net system can deploy various net sizes by adjusting the air pressure. The new system shoots a typical 40 x 60 foot heavy net farther and faster than the traditional cannon net system that relies on explosives. The system is mobile and easy for one person to handle, and does not require the extensive training required to use explosives.

WS currently is using the air cannon net system to capture birds and determine the distribution of avian influenza in populations of wild birds. Other federal, state and private organizations are using the net system to capture waterfowl, shorebirds and turkeys for research purposes. Martin Engineering currently is manufacturing and marketing the air cannon net system under the name, “Big Blaster Net Launcher.”

