



U.S. Department of Agriculture

FY 2004 Annual Reporting on Agency Technology Transfer

Release Date: December 21, 2004

U.S. Department of Agriculture Annual Reporting on Agency Technology Transfer¹

Agricultural Research Service (ARS)

Mission Statement:

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to:

- ensure high-quality, safe food, and other agricultural products;
- assess the nutritional needs of Americans;
- sustain a competitive agricultural economy;
- enhance the natural resource base and the environment; and
- provide economic opportunities for rural citizens, communities, and society as a whole.

Structure & Culture:

ARS is the U.S. Department of Agriculture's principal intramural scientific research agency. Agency goals are to find solutions to agricultural problems that affect Americans every day, from field to table, including (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, (f) keeping costs down for consumers, and (g) providing research support to other federal agencies.

ARS employs approximately 2200 permanent full-time scientists who conduct research in over 1200 projects (funded by Congressional Appropriations) at over 100 locations. Research projects are grouped into 22 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 manage the research quality, and the facilities 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 progress, evaluate the 5-year research proposal, and judge the qualifications and research capacities of the scientists and their laboratories. The process is designed to ensure quality, impact, and relevance of research.

I. Agency Approach and Plans for Technology Transfer

Tech Transfer Principles, Modes, and Plans

The ARS has been delegated authority by the Secretary of Agriculture to administer the patenting program for ARS, and the patent license programs for all intramural research conducted by the U.S. Department of Agriculture (USDA). 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 Patents Section of the USDA Office of General Council provides legal guidance.

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

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). Patent advisors in the *Patent Section* assist scientists in protecting intellectual property (IP), coordinate invention reports, prepare and prosecute patent applications, and oversee any patent applications prepared by contract law firms. The *Licensing Section* negotiates licenses for IP developed by USDA scientists, principally from ARS, 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 partnerships, provides answers to stakeholder questions on technology transfer activities in ARS, and ensures information about ARS research 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, other technology transfer agreements, and some licenses.

These objectives of technology transfer are accomplished through several mechanisms. These include written information—including reports to stakeholders, briefings, and other collateral materials—trade shows, technology showcases, meetings with industry organizations and universities, workshops, the ARS Information Staff, the National Agricultural Library, and electronic media.

Because our mission is to transfer technologies to the private sector for broad beneficial public use, we pursue patents and licensing only when IP protection facilitates technology transfer to the marketplace. This is usually the case when further research and development (R&D) investment by the private sector is necessary to commercialize a product, and patent protection is required to protect this investment. ARS holds periodic patent review committee meetings to review invention disclosures and make recommendations to the Assistant Administrator on whether a patent is necessary and practical (sufficient scope, enforceable, appropriate for the size of the market, etc.).

Information on Agency Plans for Strengthening its Performance Metrics

Performance metrics in technology transfer often are difficult to define for research agencies where outcomes may not be reflected in counts of patents and licenses. For example, outcomes may be articulated in terms of improving existing agricultural practices, releasing scientific information that allows a business sector to enhance competitiveness, preventing introduction of disease through increased awareness and interception of etiologic agents, or in publishing negative findings that appropriately prevents corporations and universities from expending their resources in unproductive research efforts. 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 Office of Technology Policy, Department of Commerce.

In FY 2002, USDA recognized the need for a more sophisticated database to facilitate development and monitoring metrics in performing technology transfer. The passage of the Technology Transfer Commercialization Act 2000 (P.L. 106-404) provided new authority for licensing unpatented, but “protectable,” technologies to private sector companies, yet ARS had no mechanism to catalogue and monitor such inventions. Additionally, the dynamics of global economies have created circumstances that may warrant protecting and licensing some plant technologies that traditionally have been placed in public domain. ARS had no formalized process to evaluate such circumstances.

In response, the Office of Technology Transfer restructured the patent and licensing database modules of the Agricultural Research Information System (ARIS) to allow development of portfolios of “technology families”. The Invention Disclosure process for determining suitability for patenting was expanded by adding two new modules for assessing Plant Material Inventions, and Biological Material Inventions. Collectively, this improved database with these disclosure forms create 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 2004. Currently, data migration and data integrity verification is ongoing, with full functionality anticipated for reporting FY 2005 metrics.

OTT also is exploring other metrics demonstrating benefits to the public and USDA missions arising from technology research partnerships with universities, other not-for-profit organizations (e.g., commodity groups, commissions, and foundations), and private sector companies. A second new module of ARIS, titled Extramural Tracking System (ETS), will provide a centralized database of other cooperative agreements (other than CRADAs) managed outside of OTT. Similarly, another new database module for Technology Transfer Coordinators (TTC module) has been developed for incorporation into ARIS that will capture outcomes involving transfer of knowledge and capabilities through transfer of research materials (Material Transfer Agreements), workshops, field days, scientific meetings, and working groups that assist customers and stakeholders in adopting ARS solutions to agricultural problems, or in furthering development of concepts developed by ARS. The TTC module was delivered to OTT (beta version) in the 3rd quarter of FY 2004 and full use is anticipated for FY 2005; subsequent revisions will be made in out years as new metrics are identified.

OTT continues to develop new ways and look for new opportunities to expand and improve upon its technology transfer activities. These include the following activities:

- 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. Our 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 partnerships.
- Technology Alerts (Tech Alerts) is a self-subscribing Web-based system that allows businesses to receive electronic notifications about ARS technology transfer opportunities. The OTT Marketing Section sends businesses firsthand information about new technologies that are available for licensing and/or cooperative research partnering. New subscribers are sought at tradeshows, industry meetings, workshops, and through targeted mailings. As a result of these efforts, the list now has nearly 2,000 subscribers consisting of both large and small businesses, university researchers, and state extension and economic agencies. In our efforts to continually improve our services, we have divided the list into more specific categories. The "Animal Technologies" list is now divided into five subcategories: Aquaculture, Cattle, Poultry, Swine, and Other Animals. This allows customers to get information tailored to their particular needs. OTT plans to expand on list options in the future. Many businesses have indicated interest in ARS technologies based on these notifications.
- The Marketing Section of the Office of Technology Transfer (OTT) conducted a survey from a sample of our existing customers. This is the first time OTT has sought this type of information. We randomly surveyed companies that have either an existing license or a CRADA with ARS. The Marketing Section will use this information to develop new products and services, as well as outreach mechanisms better suited to our customers' needs and wants. We wanted to find opportunities to reach new and existing customers. The information we gathered will also give us an idea of what we are doing right. The objectives of the survey were to gather intelligence; develop a new tradeshow, conference, and meeting schedule—we want to be where our customers are; deliver new products and services to our customers; target our information to forums/media our customers use most; strengthen/maintain mutually beneficial relationship with

our existing customers; identify missed opportunities and weaknesses in our information delivery systems; and increase our customer base for our Technology Alert e-mail service.

- 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. Our survey mentioned above revealed that the majority of our industry partnerships stemmed from contact with ARS scientists at meetings and workshops.
- The ARS research capacity is strategically positioned to help federal agencies meet preferred procurement of biobased technologies, as defined in the 2002 Farm Bill. To facilitate this, a Memorandum of Understanding was executed in mid-FY2004 with TechLink at Montana State University. TechLink has a history of interactions with NASA and the Department of Defense, providing assistance in both spin-out and spin-in technologies for these entities. During FY 2005, TechLinks interactions with ARS are expected to identify areas of cooperation between ARS, DoD, and NASA in the development of biobased technologies.

II. Performance in the Last Fiscal Year: Activities and Outcome

Collaborative Relationships for Research & Development

CRADAs and Other R&D

	FY 2001	FY 2002	FY 2003	FY 2004
● CRADAs , total active in the FY	219	225	229	205
- New, executed in the FY	49	59	55	44
▪ Traditional CRADAs, total active in the FY	217	213	212	185
- New, executed in the FY	49	58	48	36
▪ Non-traditional CRADAs, total active in FY	2	10	17	20
- New, executed in the FY	0	1	10	8
▪ Material Transfer - CRADA, total active in the FY	2	3	6	4
- New, executed in the FY	0	1	4	0
▪ Master, total active in the FY	1	1	1	2
- New, executed in the FY	0	0	1	1
▪ Multiple Cooperators, total active in the FY	N/A	8	10	9
- New, executed in the FY	N/A	N/A	3	3
▪ Foreign - CRADA, total active in the FY	N/A	N/A	5	5
- New, executed in the FY	N/A	N/A	3	3
● Amendments¹ , total in the FY		101	65	67
● Other collaborative R&D relationships , total active in the FY	106	526	529	1,826
▪ Confidentiality Agreements				
- New, executed in the FY				162
▪ Material Transfer Agreements				
- New, executed in the FY	N/A	436	355	498
▪ Other Agreements, total active in the FY ²	106	90	174	1,166
- New, executed in the FY	N/A	N/A	N/A	741

¹Amendments extend existing CRADAs for additional years to a maximum of 5 years, and/or change Statements of Work, and/or change funding levels.

²Includes Trustfund Agreements, Reimbursable Agreements, and non funded Cooperative Agreements; data incomplete for FY2001-2003.

Invention Disclosure and Patenting

Intellectual Property Management

	FY 2001	FY 2002	FY 2003	FY 2004
● New invention disclosures in the FY	118	151	121	142
● Patent applications filed in the FY	83	90	60	81
▪ Non-Provisional		68	43	59
▪ Provisional		22	17	22
● Patents issued in the FY	64	53	64	50

Licensing

Profile of Active Licenses¹

	FY 2001	FY 2002	FY 2003	FY 2004
● All licenses , number total active in the FY	255	267	270	296
▫ New, executed in the FY	32	26	27	29
▪ Invention licenses , total active in the FY	255	267	270	296
▫ New, executed in the FY	32	26	26	23
- Patent licenses, total active in FY	255	267	269	290
▫ New, executed in the FY	32	26	26	23
- Material transfer (invention), total active in FY	N/A	N/A	1	6
▫ New, executed in the FY ²	N/A	N/A	1	5

¹ "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.

² This represents USDA's first material transfer (invention) license.

Income Bearing Licenses¹

	FY 2001	FY 2002	FY 2003	FY 2004
• All income bearing licenses, number	241	265	268	294
▫ Exclusive	78 ²	179	183	200
▫ Partially exclusive	19 ²	37	41	41
▫ Non-exclusive	23 ²	49	44	53
▪ Invention licenses, income bearing	241	265	268	294
▫ Exclusive	78 ²	179	183	200
▫ Partially exclusive	19 ²	37	41	41
▫ Non-exclusive	23 ²	49	44	53
- Patent licenses, income bearing	241	265	267	288
▫ Exclusive	78 ²	179	183	200
▫ Partially exclusive	19 ²	37	41	41
▫ Non-exclusive	23 ²	49	43	47
- Material transfer (invention) licenses, income bearing	N/A	N/A	1	6
▫ Exclusive	N/A	N/A	0	0
▫ Partially exclusive	N/A	N/A	0	0
▫ Non-exclusive	N/A	N/A	1	6
• All royalty bearing licenses, number	56	67	75	82
▪ Invention licenses, royalty bearing	56	67	75	82
- Patent licenses, royalty bearing	56	67	75	82
- Material transfer (invention) licenses, royalty bearing	N/A	N/A	0	1

¹ FY 2001 data do not include the USDA, Forest Service.

² FY 2001 totals include only those licenses that actually *received* royalty income.

Licensing Management¹

	FY 2001 ⁵	FY 2002 ⁴	FY 2003 ³	FY 2004 ²
• Number of licenses				
▪ Invention licenses, total active in the FY	255	267	270	296
▫ New, executed in the FY	32	26	27	29
• Elapsed execution time, licenses granted in the FY				
▪ Invention licenses				
▫ average (months)	3.5	6.5	7.0	7.1
▫ median (months)	3.0	6.5	6.6	6.8

▫ minimum (months)	2.0	1.9	2.8	3.5
▫ maximum (months)	6.1	11.5	13.3	13.1
- Exclusive and partially exclusive invention licenses				
▫ average (months)	4.1	7.7	7.6	8.7
▫ median (months)	4.2	7.8	6.7	8.0
▫ minimum (months)	2.0	3.7	2.8	6.8
▫ maximum (months)	6.1	11.5	13.3	13.1
- Non-exclusive invention licenses				
▫ average (months)	2.1	5.3	5.9	6.2
▫ median (months)	2.1	5.3	5.8	6.0
▫ minimum (months)	1.9	1.9	3.5	3.5
▫ maximum (months)	3.7	9.0	9.9	11.5
▪ Patent invention licenses				
▫ average (months)	3.5	6.5	7.1	8.2
▫ median (months)	3.0	6.5	6.6	7.5
▫ minimum (months)	2.0	1.9	2.8	3.5
▫ maximum (months)	6.1	11.5	13.3	13.1
- Exclusive and partially exclusive patent invention licenses				
▫ average (months)	4.1	7.7	7.6	8.7
▫ median (months)	4.2	7.8	6.7	8.0
▫ minimum (months)	2.0	3.7	2.8	6.8
▫ maximum (months)	6.1	11.5	13.3	13.1
- Non-exclusive patent invention licenses				
▫ average (months)	2.1	5.3	6.1	7.8
▫ median (months)	2.1	5.3	6.6	7.1
▫ minimum (months)	1.9	1.9	3.5	3.5
▫ maximum (months)	3.7	9.0	9.9	11.5
▪ Material transfer (invention) licenses				
▫ average (months)	N/A	N/A	5.0	4.4
▫ median (months)	N/A	N/A	5.0	4.0
▫ minimum (months)	N/A	N/A	5.0	3.6
▫ maximum (months)	N/A	N/A	5.0	6.0
- Non-exclusive material transfer (invention) licenses				
▫ average (months)	N/A	N/A	5.0	4.4
▫ median (months)	N/A	N/A	5.0	4.0
▫ minimum (months)	N/A	N/A	5.0	3.6
▫ maximum (months)	N/A	N/A	5.0	6.0

• Licenses terminated for cause, in the FY				
▪ Invention licenses	1	3	0	1
▪ Patent invention licenses	1	3	0	1
▪ Material transfer (invention) licenses	N/A	N/A	0	0

¹ During FY 2004, USDA, ARS received 35 new invention license applications, for which 6 new licenses were granted. Of the remaining 29 applications, 4 applications were withdrawn by the applicants, 18 license agreements are currently in negotiation, and 7 applications are on hold by request of the applicants.

² 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.

³ 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.

⁴ 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.

⁵ FY 2001 data included only 6 records because ARS did not begin tracking this data until October 1, 2000. Records for which license applications were received prior to this date were not included. FY 2001 data do not include the USDA, Forest Service.

License Income

	FY 2001 ¹	FY 2002	FY 2003	FY 2004
• Total income, all patent invention licenses active in the FY	\$2,622,000	\$2,571,378	\$2,290,903	\$2,163,507
▪ Invention licenses	\$2,622,000	\$2,571,378	\$2,290,903	\$2,163,507
- Patent licenses	\$2,622,000	\$2,571,378	\$2,290,903	\$2,140,466
- Material transfer (invention licenses)				\$23,041
• Total Earned Royalty Income (ERI)	\$1,409,252	\$1,569,877	\$1,560,825	\$1,426,876
- Patent (and patent application) licenses, total ERI	\$1,409,252	\$1,569,877	\$1,560,825	\$1,423,835
▫ Median ERI	\$5,723	\$5,096	\$3,102	\$5,645
▫ Minimum ERI	\$78	\$79	\$159	\$124
▫ Maximum ERI	\$563,320	\$569,265	\$236,306	\$154,213
▫ ERI from top 1% of licenses	Not presented ²	Not presented ²	Not presented ²	Not presented ²
▫ ERI from top 5% of licenses	\$723,167	\$794,418	\$696,532	\$499,709
▫ ERI from top 20% of licenses	\$1,109,051	\$1,254,545	\$1,292,383	\$1,026,141
- Material transfer (invention licenses), total ERI	N/A	N/A	\$0	\$3,041
▫ Median ERI	N/A	N/A	\$0	\$3,041
▫ Minimum ERI	N/A	N/A	\$0	\$3,041
▫ Maximum ERI	N/A	N/A	\$0	\$3,041
▫ ERI from top 1% of licenses	N/A	N/A	\$0	\$3,041
▫ ERI from top 5% of licenses	N/A	N/A	\$0	\$3,041
▫ ERI from top 20% of licenses	N/A	N/A	\$0	\$3,041

¹ FY 2001 data do not include the USDA, Forest Service.

² Represents a single license.

Disposition of License Income

	FY 2001 ¹	FY 2002	FY 2003	FY 2004
• Income distributed ²				
▪ Patent Invention licenses , total distributed	\$2,621,900	\$2,463,240	\$2,586,583	\$2,274,043
- To inventors	\$681,700	\$543,336	\$540,399	\$380,916
- Salaries of some technology transfer staff	\$1,075,000	\$1,102,891	\$1,156,936	\$1,265,991
- Patent filing preparation, fees, and patent annuity payments	\$707,900	\$686,696	\$785,218	\$627,136
- Other technology transfer expenses	\$157,300	\$130,317	\$104,030	\$0
▪ Material transfer (invention) licenses , total distributed	N/A	N/A	\$0	\$23,022
- To inventors	N/A	N/A	\$0	\$9,011
- Salaries of some technology transfer staff	N/A	N/A	\$0	\$14,011
- Patent filing preparation, fees, and patent annuity payments	N/A	N/A	\$0	\$0
- Other technology transfer expenses	N/A	N/A	\$0	\$0

¹ FY 2001 data do not include the USDA, Forest Service.

² Some of the income distributed reflects income received in the prior fiscal year.

Downstream Outcomes from Technology Transfer Activities

Selected Examples of Tech Transfer Outcomes in FY 2004:



Detecting Mad Cow Disease. When the first case of bovine spongiform encephalopathy (BSE), a.k.a. “mad cow disease,” hit the United States, ARS researchers were ready to respond. A Canadian cow shipped to slaughter from a farm in Mabton, Washington, had come up positive for BSE in testing by the USDA Animal Plant Health Inspection Service (APHIS) APHIS, which has diagnostic responsibility and regulatory oversight for BSE issues. APHIS diagnosed the first U.S. case using immunohistochemistry (IHC), the gold standard used for any subsequent inconclusive cases in rapid testing. The IHC test uses an ARS monoclonal antibody in an automated system marketed by Ventana Medical Systems, now one of the licensed vendors for the monoclonal antibody. ARS experts conducted research to verify the presence of the disease in tissues from suspected BSE animals using the ARS-developed Western blot test. The researchers also assisted in determining the origin of the disease in exposed animals. ARS’s research results

confirmed that the BSE tissues were of bovine origin—most likely from the same animal.



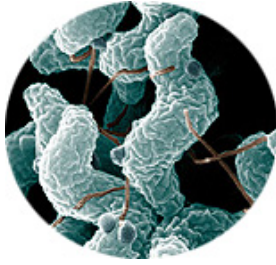
ARS provided scientific advice over a series of meetings to the U.S.-Japan BSE Technical Working Group involved with Trade negotiations with their Japanese counterpart. As part of this effort, an ARS scientist drafted a policy entitled Definition of BSE and methods of testing. In addition, ARS provided scientific advise on BSE testing methods as a member of the USDA's source selection panel for BSE test equipment.



Detecting and Preventing Soybean Rust. In November 2004, the first case of soybean rust was discovered in the United States. However, thanks to ARS research efforts that began back in 1998, the country was equipped to detect this fungal pathogen. Until recently, the airborne-pathogen had devastated soybean crops in Asia, Africa, South Africa, and South America. Today, the threat has become a reality and now jeopardizes the U.S.'s nearly 2.9 billion-acre industry. Early detection is critical for timely fungicide application to prevent plant defoliation and severe yield losses. On the defensive, ARS scientists filed for patent protection in 2001 on a method for identifying, detecting, and discriminating between the two fungal pathogens that cause soybean rust. The scientists designed a PCR (polymerase chain reaction) test that helps identify the pathogen. It is important to distinguish between the two pathogens, because the Asian type is more aggressive than the New World type. Soybean rust infects plant tissue. Heavily infected plants have fewer pods and lighter seeds. Market yields are even less due to poor seed quality. The disease is present in nine U.S. states. USDA's Animal

Plant Health Inspection Agency is using ARS's PCR technique to conduct official confirmations of soybean rust in the United States.

The U.S. Soybean Board funds research at ARS to conduct screening tests to identify rust-resistant soybean lines. Out of the 20,000 commercial lines and accessions from the USDA Soybean Germplasm Collection, ARS researchers have identified approximately 800 lines with potential rust resistance in preliminary evaluations. These lines are undergoing further evaluation to determine the extent and durability of the resistance. ARS has maintained information on these sources of resistance for about 30 years.



Monitoring Food Pathogens. ARS researchers and scientists from the United Kingdom's Institute of Food Research and Food Standards Agency have established the world's largest online database of predictive microbiology information. Predictive microbiology is a growing field that estimates behavior of microorganisms in response to environmental conditions, including food production and processing operations from the farm to the table. ComBase is designed to help make risk assessments and model development easier. Food pathogens such as *Listeria monocytogenes* or *Campylobacter* can be analyzed in ComBase and then converted to a model in the ARS Pathogen Modeling

Program, which estimates the effects of multiple variables on growth, inactivation, or survival of foodborne pathogens. The database can be found on the Web at: <http://wyndmoor.arserrc.gov/combase/>.

ComBase contains around 25,000 growth and survival data set records. The software lets scientists simulate a food environment by entering data—such as temperature, acidity, and available water—and then retrieves all records that match those search criteria. Microbiologists in academia, government, and industry are submitting data to ComBase, thus eliminating unnecessary repetition of experiments among laboratories, improving models, and standardizing data sources.



Providing Nutrition Information on the Go. ARS researchers developed two innovative products that bring quality nutrient data directly to the American public. These software applications allow data from the USDA National Nutrient database for Standard Reference (SR) to be searched and retrieved using a personal digital assistant (PDA) or a desktop personal computer (PC). ARS's Nutrient Data Laboratory is the recognized source of authoritative food composition information in the United States. It provides data for the National Food Survey, core data of commercial databases; and supplies data to health care professionals, researchers, public health policymakers, and the general public. ARS established a CRADA with HealthTech, Inc., a health-related software developer. Under the agreement, the team produced a software application for Palm® operating system

personal digital assistants. This application can be downloaded from the Web at:

www.nal.usda.gov/fnic/foodcomp. With this application, users can access data for up to 30 nutrients for more than 6000 foods in the USDA National Nutrient Database for Standard Reference.

The team also developed a Windows® search application that can be downloaded to a user's desktop personal computer (PC) and used without requiring a connection to the Internet. This application is well suited to individuals who need to frequently access the nutrient database in situations where the Internet may not be available. The downloadable personal computer search program provides data for all nutrients (approximately 118) that are contained in the National Nutrient Database. These two applications allow users to access data for user-specific portions, such as two apples or a half of an apple. To date, 46,810 copies of the PDA application has been downloaded from the site, as well as 44,649 copies of the PC application.



Developing Healthier Food Products. ARS technology developed over the past few years has reached expanded markets in fiscal year 2004. Kids meals at McDonalds now feature "Apple Dippers," as a healthy choice. Apple Dippers are presliced and peeled apple slices served with a cup of low fat carmel dipping sauce. Mantrose Hauser, a former CRADA partner and current licensee, produces the ARS-developed coating, which is used by apple processors to treat the apple slices. This U.S.- and foreign-patented technology uses a special blend of vitamin salts and

minerals to extend the shelf life of sliced fruits for up to 28 days under refrigeration without detectable changes in color, flavor or texture. This is the first available commercial product of its kind that doesn't have a bad aftertaste or residue. A product under the trade name NatureSeal® is being sold commercially to fresh-cut producers and food service industries. Sliced apples coated with NatureSeal® are currently being served in school lunch programs as well. Initially developed for sliced apples and pears, the technology has been extended for sliced avocados, celery, potatoes, carrots, and onions. This technology should enhance the already booming demand for fresh-cut fruits and vegetables, and benefit both producers and consumers.



Fighting Tick-borne Diseases. ARS researchers developed a “4-Poster” deer treatment bait station for controlling ticks on white-tailed deer. The self-treatment system topically applies tick-controlling chemicals to deer that come into contact with the device. The system is a simple, feeder-like bait station that is readily accepted and used by deer. It has been proven effective in controlling parasitic ticks that feed on white-tailed deer including lone star ticks, which cause ehrlichiosis (a bacterial disease) and blacklegged ticks, which transmit Lyme disease to humans.

C.R. Daniels, Inc. of Ellicott, MD and the American Lyme Disease Foundation, Inc. of Somers, NY have licensed the technology. ARS researchers worked extensively with C.R. Daniels to develop a polyethylene version of the device, which is currently available for sale. Since its official debut at a large convention in Las Vegas, NV during February of this year, approximately 200 units have been sold for use in the United States. Lyme disease is the leading cause of U.S. vector-borne illness. Nearly 250,000 cases of Lyme disease have been reported to the Centers for Disease Control from 1980 until 2004. The cost of diagnosing, treating, preventing and controlling Lyme disease in the U.S. exceeds \$2.5 billion. ARS scientists estimate that properly using the 4-poster technology can minimize or even eliminate tick-borne disease in the areas in which it is used. For example, in a study at the Goddard Space Flight Center in Maryland, 98% of nymphal ticks (ticks that feed during warmer months) were eliminated after three years of treatment. Thus, study demonstrates that this safe, low-cost technology could reduce the chance of contracting a tick-borne disease to near zero.



Helping U.S. Farmers. The Great Plains Framework for Agricultural Resource Management (GPFARM) is a computer software package designed for use as whole-farm or -ranch strategic planning tool. Potential GPFARM users include farmers, ranchers, agri-businesses, action agencies, and scientists. With GPFARM, users can evaluate alternative management strategies for cropping and range-livestock systems, and view the results of the strategies in both economic and environmental terms. ARS scientists took a grassroots approach to transferring this technology. They identified progressive producers (user-group) willing to try GPFARM and provide feedback to the technology transfer team. This feedback was used to improve the interface, output format, and reports for GPFARM.

Several of the producers in the user-group were also members of key commodity groups. Through these contacts, the Colorado Conservation Tillage Association asked to use GPFARM to answer specific questions and provide the results at their annual meeting. ARS made several presentations to the group over the last three years. Success with the Colorado Conservation Tillage Association and other contacts provided by the user-group lead to an agreement with the Colorado Association of Wheat Growers (CAWG) to provide GPFARM in its membership packet. Approximately 600 copies of GPFARM have been distributed by CAWG. ARS facilitated this activity and conducted several training sessions for the membership.





Improving Beef Production. ARS researchers developed a Beef Carcass Image Analysis Yield Classification System, which operates on-line in a beef packing plant to objectively determine the yield of saleable meat using computerized image analysis. ARS scientists developed and tested a prototype of the system and established a cooperative research and development agreement with IBP, Inc. (now known as Tyson Fresh Meats, Inc.) to further develop the technology. These efforts eventually led to a patent application (granted in June 2004) jointly filed by ARS, IBP, Inc., and an equipment vendor. To facilitate industry-wide implementation of the system, ARS scientists and IBP agreed to make the

technology widely available to industry. ARS scientists have published scientific papers on the system, and have provided data and reports about the system to packing companies, producer groups, and the meat science community.

Two of the four major U.S. beef packing companies are implementing this system and the other two are considering implementing this system. Additionally, one niche beef company has implemented this system. The beef packing industry has relied on human graders to subjectively assign yield grades to beef carcasses. However, because of the subjectiveness of human grading, the industry has been interested in implementing instrument-grading technologies for many years. Field testing has demonstrated that the ARS image analysis system can assess USDA yield grade—the industry standard for characterizing yield differences between carcasses—more accurately and precisely than can human graders. This system is expected to save the U.S. beef packing industry \$15 million dollars annually. Ultimately, this system should allow for more efficient cattle production, which will improve the profitability of beef production and the competitiveness of U.S. beef in the global marketplace.



Maintaining the World's Largest Publicly Available Culture Collection. This collection is the world's largest publicly available collection of microorganisms, containing 86,000 microbial strains. Beneficial bacteria, yeasts and blue-green molds are among thousands of microbes in the collection. ARS's collection is one of only two International Depository Authorities (IDAs) in the United States. IDAs (33 in the world) are responsible for storing and distributing patented microbes, cell lines and other biological materials in accordance with the Budapest Treaty of 1980. For the 2004 fiscal year, total of 2,814 strains have been accessioned into the general collection and 82 strains have been accessioned into the Patent Collection. A total of 3,236 strains have been distributed from the collection, including 376 to ARS scientists, 1,242 to non-ARS clients in the United States, and 1,618 to



foreign scientists. The savings to ARS for these distributions, compared to the cost of using another collection (average cost of \$195.00 per strain), is \$71,440.00—this does not include the patent deposits from ARS personnel, for which the \$500.00 fee has been waived. The ARS Culture Collection Web site has had 12,438 unique visitors from at least 73 different countries in the past year.



Bio-Powering Lady Liberty. ARS researchers developed a biodegradable hydraulic fluid made from soy oil, which is now being used to power the Statue of Liberty's elevator. Until recently, the Statue's elevator used mineral oil formulations derived from petroleum-based stocks. The National Park Service (NPS), contacted ARS scientists about developing a biobased fluid for use in the statue's elevator. The NPS wanted a product that was environmentally friendly; came from a renewable resource; was economical and nonpolluting; and met all industry standards for safety and performance, such as for viscosity, stability, and flame resistance. ARS researchers

already had the know-how to develop this technology. Though other vegetable oils will work, soy oil was chosen because of its low cost, chemical versatility, and availability as a renewable, home-grown resource. Soy is the nation's leading source of food-grade oil. Yet only 517 million pounds—3 percent of the total supply—are used for industrial purposes.



Controlling Invasive Plant Species. A multi-Department and multi-Agency team led by ARS developed, tested and delivered an environmentally friendly and cost effective new technology to control saltcedar. Saltcedar is a highly invasive exotic small tree that has spread throughout the western United States infesting over 1.2 million acres of valuable riparian habitat from Mexico to the Canadian border and from the central Great Plains to the Pacific Coast. Saltcedar reduces water supplies critical for agriculture and municipalities and causes great environmental damage to native species. Although effective, chemical control poses additional environmental hazards including non-target damage to native flora and fauna. The new USDA-ARS biological control technology delivered by this team controls saltcedar using natural processes at little or no cost to land managers or the general public, and is extremely safe for the environment.

The team identified a host-specific natural enemy, a leaf beetle from China, and oversaw its safety testing, approval and release in the United States, where it is effectively controlling saltcedar. In test sites across nine western states (CA, CO, MT, NM, NV, OR, TX, UT, & WY), this beetle has defoliated saltcedar over thousands of acres while allowing beneficial native and agricultural plants to flourish. Following this successful proof of concept, the ARS-led team has now effectively transferred this technology to state and Federal implementation teams that are now releasing millions of these biological control agents in fourteen western states. The ARS saltcedar team recently won the prestigious Secretary's Honor Award for this work.



Protecting Hawaii's Fruit Industry. ARS researchers have developed the first comprehensive area-wide fruit fly integrated pest management program for Hawaii. Beginning in the late 1800's, Hawaii's fruit and vegetable crops were devastated by four exotic fruit flies: melon fly, oriental fruit fly, Mediterranean fruit fly, and Malaysian fruit fly. Because these species pose an enormous threat to mainland agriculture, there is a ban on export of Hawaiian produce without stringent post-harvest treatments. ARS launched the Hawaii Fruit Fly Area-Wide Pest Management Program (AWPM) in 1999 as a 5-year program with the goal of suppressing fruit

flies below economic thresholds and reducing the use of organophosphate insecticides. ARS scientists partnered with University of Hawaii scientists and the Hawaii Department of Agriculture, which has implemented the AWPM program successfully on several areas on three islands in the state.

The team has conducted grower and community workshops, hands-on demonstrations, developed newsletters and Websites, held annual meetings and facilitated pending registration of fruit fly lures. Since the program began organophosphate usage has been significantly reduced, production of Hawaii-grown fruits and vegetables has increased, and a change in farmers' attitudes regarding fruit fly control has occurred. More than 285 cooperating growers, representing more than 6,000 acres, have already been able to cut organophosphate pesticide use by 75-90 percent. The team is working with international partners to transfer program components to other areas of the world. The program has resulted in the team receiving numerous national awards from the Federal Laboratory Consortium, ARS, and the Entomological Society of America.



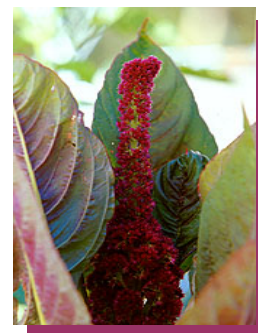


Protecting Peanuts Against Fungus. ARS researchers developed a biological pesticide that helps control the fungus, *Aspergillus flavus*, which causes aflatoxin in peanuts. The treatment is made from spores of a nontoxic strain of *Aspergillus flavus*. Circle One Global of Cuthbert, Georgia licensed the ARS-patented technology. This year, the company received U.S. Environmental Protection Agency registration for its product AFLAGUARD to control aflatoxin. Circle One Global produced enough AFLAGUARD to treat 4800 acres at an application rate of 20 pounds per acre for this year's dry land peanut crop. Initial results are excellent and the fungus appears to be working as predicted. Later this year, results will be known on how well it has worked to keep peanuts in storage warehouses aflatoxin free. Circle One Global is making plans for a much larger production of AFLAGUARD for 2005. ARS scientists continue to monitor the results of the actual field use of AFLAGUARD.



Maintaining the National Clonal Germplasm Repository. In calendar year 2003, the National Clonal Germplasm Repository in Corvallis, OR, which is operated by ARS, coordinated the distribution of 3,007 cuttings, runners, scions, rooted plants, in vitro cultures and seed packages to 257 recipients around the world. This is the largest number of accessions distributed in one year from the Corvallis Repository since establishment in 1981. This germplasm is used by breeders to develop new cultivars, by researchers to discover new genetic traits, by nurseries to expand the selection of plant materials available to the public, and by growers to expand the production of fruit and nut crops to new geographic areas or unusual environments. Pear was

the most requested crop in 2003 (20% of requests) followed by strawberry (18% of requests), raspberry and blackberry (11% of requests), currant and gooseberry (11% of requests), hop (10% of requests), and blueberry and cranberry (9% of requests).



Protecting Our Natural Resources. The SPAW (Soil-Plant-Atmosphere-Water) daily hydrologic model has been expanded to include an extensive wetlands analyses methodology. SPAW has been accepted by USDA's Natural Resources Conservation Service (NRCS) as their national wetland hydrologic assessment method. An ARS hydrologist with the Land Management and Water Conservation Research Unit, Pullman, WA, led the research and development of SPAW in cooperation with Washington State University and the NRCS Water and Climate Center, Portland, OR. Technology transfer was accomplished by development of computer software, a user's guides, training

sessions, a Web site, and inclusion in the NRCS national engineering package. The customers of the technology are government and private consultants who design wetlands to help maintain healthy waterway systems both in the United States and around the world. Design engineers in all 50 states are using SPAW as their primary wetland analysis tool.



Helping People with Peanut Allergies. ARS researchers in collaboration with Red River Commodities, Fargo, ND, developed a process for making a sunflower butter product, which resembles the flavor texture and nutty appearance of commercially available peanut butter. Sunflower seed is consumed in large amounts in Europe and other parts of the world, but U.S. consumption is limited. Chinese sunflower seed is being exported to Europe at prices below the

profitability range for U.S. farmers, and the United States is losing a major market for its sunflower seed. This technology will increase the value of U.S. sunflower seeds. Several previous attempts by others to develop a commercially acceptable sunflower butter had failed. ARS researchers developed a process of roasting, which eliminates most of the problems with developing a sunbutter product. This product smells, tastes, feels, and looks like peanut butter.

Red River Commodities created SunGold Foods, Inc. a company dedicated to commercializing the sunflower product, Sunbutter®. Since its initial launch and release of the original creamy version in 2002, SunGold Foods, Inc. has now released natural honey crunch, natural crunch, Atkins low carb, and high fiber versions of Sunbutter®. The product is being sold to some of the largest food companies in the United States, such as Ben & Jerry's, Hershey Foods, Keystone Foods, AZAR nuts, Stonefield Farms, and Dixie USA. Sunbutter® is currently being used in filled pretzels, is added to ice cream as a swirl, and is an ingredient in baked goods, yogurt, nutrition bars, healthy snacks, and extruded corn curls. In January 2004, Sunbutter®, which is an alternative to peanuts for people with allergies, was made an entitlement item and added to the official list of available commodities in the School Lunch program nationwide. This has accounted for a large boost in sales experienced by the company.



Eradicating Plant Diseases. ARS scientists led research vital to two plant disease eradication programs: citrus canker, a bacterial disease that has historically imperiled the Florida citrus industry; and plum pox virus, which threatens the stone fruit industry. Based on ARS research, in March 2002, Governor Jeb Bush signed into law the “1900-ft Rule” for use in the citrus canker eradication program in Florida. The effective use of the 1900-ft rule will cut numerous years off of the total duration of the eradication program, save money, and save countless commercial and residential trees. In addition, the USDA Animal Plant Health Inspection Service (APHIS) adopted the “sentinel tree survey method” for rapidly and efficiently surveying large urban areas for detecting citrus canker. The 1900-ft rule together with the sentinel tree survey method form the scientific basis for the citrus canker eradication program.

The sentinel tree survey method also serves as the basis for the “International Standards of Phytosanitary Measures” used by APHIS to protect the United States from exotic pests. Finally, a hierarchical sampling method for plum pox virus—a serious disease from Europe that has been discovered in Ontario, Canada and Pennsylvania. Control and eradication strategies based on ARS’s sampling method have been developed and adopted by the Canadian Food Inspection Service, Agriculture and Agri-Food Canada, the Pennsylvania Department of Agriculture, and APHIS.

