

# **U.S. Department of Agriculture**

## **FY 2003 Annual Reporting on Agency Technology Transfer**



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# U.S. Department of Agriculture Annual Reporting on Agency Technology Transfer<sup>1</sup>

## I. Agency Approach and Plans for Technology Transfer

### Tech Transfer Principles, Modes, and Plans

The Agricultural Research Service (ARS) has been delegated authority by the Secretary of Agriculture to administer the patent and license programs for 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.

To accomplish this, OTT is organized into four areas. The *Administrative/Headquarters Section* conducts day-to-day operations, coordinates technology transfer policy development, and signs 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 ARS IP 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.

These objectives are accomplished by 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. ARS has

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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).

seven Technology Transfer Coordinators (TTCs) 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.

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 is essential for technology transfer. 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.).

ARS has other unique mechanisms that help its technology transfer efforts. ARS's Information Staff generates a wide variety of electronic products, several in both English and Spanish, and has more than 9,000 subscribers to these products, an increase of 63 percent over last year. The products include a daily news service in English (ARS News Service) and Spanish (El Servicio Noticiero); a weekly news summary in English (ARS Newslink) and Spanish (Enlace); the Food and Nutrition Briefs; the Healthy Animals newsletter; and our children's Web site, Science 4 Kids, and its Spanish counterpart, Ciencia Para Niños. An estimated 1,200-plus news organizations, more than 300 Extension agents, farmers, scientists, educators, corporations, non-profit organizations, and students subscribe to the ARS News Service. Most, if not all, of ARS's major stakeholders (such as commodity groups and scientific organizations) receive information from ARS on a regular basis.

In addition, ARS staff writes and produces its own videos and video news releases. These video products focus on new scientific research projects and findings that are relevant to our customers. The videos are designed specifically for broadcast media to help them develop and disseminate feature news stories to the public in a timely manner.

ARS research also continues to have worldwide interest. Agricultural Research magazine, ARS's monthly science publication written in layman's language, is distributed to more than 40,000 people nationally and internationally, with many copies sent to classrooms as teaching tools. ARS's news services have subscribers in at least 60 foreign countries.

Other mechanisms of technology transfer include publishing research findings, releasing germplasm to the public, and conducting public field days at various ARS locations. Our policy is to allow researchers and breeders to use any ARS technology and

germplasm freely and without license for research purposes.

OTT has expanded its technology transfer base through several new initiatives and programs during this fiscal year:

- ⌘ Tech Alerts is a self-subscribing Web-based system that allows businesses to receive electronic notifications when new technologies are available for licensing. 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 tradeshow, industry meetings, workshops, and through targeted mailings. As a result of these efforts, the list now has more than 970 subscribers consisting of both large and small businesses, university researchers, and state extension and economic agencies. A new biotechnology category has been added to the list, extending users' abilities to get information more tailored to their particular needs.
- ⌘ This year, the OTT marketing section launched a new feature, "Partnering Opportunities," on its Web site. These opportunities feature research areas where there is a need for extramural research partnering to help solve a particular agricultural problem. In addition, OTT has worked extensively with our agency to add a comprehensive new "Partnering Page" to the agency's new home page launched this year. This should help businesses find and identify technology transfer staff, products and services, including partnering opportunities.
- ⌘ ARS continues to hold periodic technology showcase exhibitions at selected ARS locations. These one-day events provide a venue for corporations and federal scientists to meet and discuss research projects where a private sector partnership is desired and for businesses to view selected technologies available for licensing. They also offer businesses the opportunity to see a particular technology first hand. Several CRADAs have resulted from these showcases this year.
- ⌘ ARS laboratories across the nation plan workshops, meetings and seminars designed to inform industry representatives about recent 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. ARS scientists also routinely assist and collaborate with industry on diagnostic testing for major diseases—including during outbreak situations—and provide reagents for diagnosing major animal diseases.

- ⌘ This year ARS entered into its first Biological Material License (also referred to as a Material Transfer [Invention] License) with Neogen Corporation for two hybridoma cell lines that produce monoclonal antibodies for detecting wheat gluten. Neogen receives the agency's Technology Alerts, and also routinely searches the Web site and agency publications for technologies that may have commercial potential. This demonstrates the effectiveness of OTT's marketing efforts on transferring technologies to industry.

## **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 has been 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 research 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. Currently, data migration and data integrity verification is expected by January 2004, with full functionality anticipated for reporting FY 2004 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) is being developed for incorporation into ARIS that will capture outcomes involving transfer of knowledge and capabilities through transfer of research materials, 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. A first phase of the TTC module is expected to be in place during FY 2004, and subsequent revisions will be made in out years as new metrics are identified.

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

### Collaborative Relationships for Research & Development

#### CRADAs

	FY 2001	FY 2002	FY 2003
<b>Active</b>			
Total	219	225	229
Material Transfer - CRADA	2	3	6
Master		1	1
3-Way		8	10
<b>New</b>			
Total	49	59	55
Material Transfer - CRADA	0	1	4
3-Way			3
Foreign - CRADA			3
<b>Amendments<sup>1</sup></b>			
Total		101	65

<sup>1</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.

#### Other Types of Collaborative R&D Relationships

	FY 2001	FY 2002	FY 2003
Other Agreements	106	90	174
Material Transfer Agreements		436	355

### Invention Disclosure and Patenting

#### Intellectual Property Management

	FY 2001	FY 2002	FY 2003
Inventions Disclosures	118	151	121
Patent Applications Filed	83	90	60
• Non-Provisional		68	43
• Provisional		22	17
Patents Issued	64	53	64

## Licensing

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

	FY 2001	FY 2002	FY 2003
● All licenses, number total active in the FY	255	267	270
□ New, executed in the FY	32	26	27
■ Invention licenses, total active in the FY	255	267	269
□ New, executed in the FY	32	26	26
- Patent licenses, total active in FY	255	267	269
□ New, executed in the FY	32	26	26
- Material transfer (inventions), total active in FY	N/A	N/A	1
□ New, executed in the FY <sup>2</sup>	N/A	N/A	1

<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.

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

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

	FY 2001	FY 2002	FY 2003
● Invention licenses which are income bearing, total number	241	265	268
□ Number exclusive licenses	78 <sup>2</sup>	179	183
□ Number partially exclusive licenses	19 <sup>2</sup>	37	41
□ Number nonexclusive licenses	23 <sup>2</sup>	49	44
- Patent licenses which are income bearing	241	265	267
□ Number exclusive licenses	78 <sup>2</sup>	179	183
□ Number partially exclusive licenses	19 <sup>2</sup>	37	41
□ Number nonexclusive licenses	23 <sup>2</sup>	49	43
- Material transfer (invention) licenses which are income bearing	N/A	N/A	1
□ Number exclusive licenses	N/A	N/A	0
□ Number partially exclusive licenses	N/A	N/A	0
□ Number nonexclusive licenses	N/A	N/A	1
● Invention licenses which are royalty bearing, total number			
- Patent licenses which are royalty bearing	56	67	75
- Material transfer (invention) licenses which are royalty bearing	N/A	N/A	0

<sup>1</sup> FY 2001 data do not include the USDA, Forest Service.

<sup>2</sup> FY 2001 totals include only those licenses that actually **received** royalty income.

### Licensing Management <sup>1</sup>

	FY 2001 <sup>4</sup>	FY 2002 <sup>3</sup>	FY 2003 <sup>2</sup>
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● Elapsed execution time, invention licenses granted in the FY (in months)			
□ average	3.5	6.5	7.0
□ median	3.0	6.5	6.6
□ range	2.0 to 6.1	1.9 to 11.5	2.8 to 13.3
● Elapsed execution time, exclusive and partially exclusive invention licenses granted in the FY (in months)			
□ average	4.1	7.7	7.6
□ median	4.2	7.8	6.7
□ range	2.0 to 6.1	3.7 to 11.5	2.8 to 13.3
● Elapsed execution time, nonexclusive invention licenses granted in the FY (in months)			
□ average	2.1	5.3	5.9
□ median	2.1	5.3	5.8
□ range	1.9 to 3.7	1.9 to 9.0	3.5 to 9.9
● Number of invention licenses terminated for cause in the FY	1	3	0
● Elapsed execution time, patent invention licenses granted in the FY (in months)			
□ average	3.5	6.5	7.1
□ median	3.0	6.5	6.6
□ range	2.0 to 6.1	1.9 to 11.5	2.8 to 13.3
● Elapsed execution time, exclusive and partially exclusive patent invention licenses granted in the FY (in months)			
□ average	4.1	7.7	7.6
□ median	4.2	7.8	6.7
□ range	2.0 to 6.1	3.7 to 11.5	2.8 to 13.3
● Elapsed execution time, nonexclusive patent invention licenses granted in the FY (in months)			
□ average	2.1	5.3	6.1
□ median	2.1	5.3	6.6
□ range	1.9 to 3.7	1.9 to 9.0	3.5 to 9.9
● Number of patent invention licenses terminated for cause in the FY	1	3	0
● Elapsed execution time, material transfer (invention) licenses granted in the FY (in months)			
□ average	N/A	N/A	5.0
□ median	N/A	N/A	5.0
□ range	N/A	N/A	5.0 to 5.0
● Elapsed execution time, nonexclusive material transfer (invention) licenses granted in the FY (in months)			
□ average	N/A	N/A	5.0
□ median	N/A	N/A	5.0
□ range	N/A	N/A	5.0 to 5.0
● Number of material transfer (invention) licenses terminated for cause in the FY	N/A	N/A	0

<sup>1</sup> During FY 2003, USDA, ARS received 36 new invention license applications, for which 4 new licenses were granted. Of the remaining 32 applications, 2 applications were withdrawn by the applicants, 23 license agreements are currently in negotiation, and 7 applications are on hold by request of the applicants.

<sup>2</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>3</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

<sup>4</sup> 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	FY 2002	FY 2003
● Total income received, all patent inventions licenses active in the FY	\$2,622,000	\$2,571,378	\$2,290,903
● Total Earned Royalty Income (ERI)	\$1,409,252	\$1,569,877	\$1,560,825
- Patent (and patent application) licenses			
□ Median ERI	\$5,723	\$5,096	\$3,102
□ Minimum, Maximum ERI	\$78 to \$563,320	\$79 to \$569,265	\$159 to \$236,306
□ ERI from top 1% of licenses	Not presented <sup>2</sup>	Not presented <sup>2</sup>	Not presented <sup>2</sup>
□ ERI from top 5% of licenses	\$723,167	\$794,418	\$696,532
□ ERI from top 20% of licenses	\$1,109,05	\$1,254,545	\$1,292,383
- Material transfer (invention) licenses			
□ Median ERI	N/A	N/A	\$0
□ Minimum, Maximum ERI	N/A	N/A	\$0
□ ERI from top 1% of licenses	N/A	N/A	\$0
□ ERI from top 5% of licenses	N/A	N/A	\$0
□ ERI from top 20% of licenses	N/A	N/A	\$0

<sup>1</sup> FY 2001 data do not include the USDA, Forest Service.

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

Disposition of License Income (all fees, royalties, and reimbursement of expenses)

	FY 2001	FY 2002	FY 2003
● Income distributed			
■ Patent invention licenses, total distributed			
- To inventors	\$681,700	\$543,336	\$540,399
- Salaries of some technology transfer staff	\$1,075,000	\$1,102,891	\$1,156,936
Patent filing preparation, fees, and patent annuity payments	\$707,900	\$686,696	\$785,218
- Other technology transfer expenses	\$157,300	\$130,317	\$104,030
■ Material transfer (invention) licenses, total distributed			
- To inventors	N/A	N/A	\$0
- Salaries of some technology transfer staff	N/A	N/A	\$0
Patent filing preparation, fees, and patent annuity payments	N/A	N/A	\$0
- Other technology transfer expenses	N/A	N/A	\$0

<sup>1</sup> FY 2001 data do not include the USDA, Forest Service.

<sup>2</sup> Some of income distributed reflects income received in FY 2002.

## Downstream Outcomes from Technology Transfer Activities

Selected Examples of Tech Transfer Outcomes in FY 2003:

- ⌘ **An ARS-developed rapid avian influenza diagnostic test** was used to help control a disease outbreak of this virus in an emergency situation. This rapid, sensitive, polymerase chain reaction (PCR) test was used in March 2002 during an avian influenza outbreak in turkeys and chickens in Virginia. This is the first time a PCR diagnostic test was used to help control a major animal disease outbreak in the United States. Concerns about the virus becoming highly pathogenic and potentially disrupting poultry trade led the state to make a decision to eradicate the virus by identifying and destroying infected flocks.

The existing detection method used to identify infected birds was time consuming, and required daily handling of eggs. The emergency situation called for a more efficient alternative. ARS's real-time PCR test, which allowed for quick testing of birds versus eggs, was compared to the other method through a cooperative effort with Animal and Plant Health Inspection Service staff and animal health officials from Virginia. Results showed that ARS's test provided similar sensitivity and specificity for the particular strain of avian influenza as the other test. With the ARS PCR test, results could be obtained within 3 to 24 hours, compared to several days with the old test method. The Virginia situation

generated widespread interest nationwide, and ARS scientists have facilitated the use of this test by veterinary diagnostic labs in more than 10 states. In addition, ARS researchers are working with international partners in Chile, Hong Kong, Canada, Peru, Mexico, and South Korea to teach them how to use and implement the test to help control the virus in those countries.

- ⌘ **NWAC103**, the first USDA fish germplasm release, is making a huge splash with commercial catfish producers. Catfish producers have long awaited development of a new higher performing catfish variety. Now, thanks to this joint release effort between ARS and Mississippi Agricultural and Forestry Experiment Station researchers, producers are now stocking NWAC103 fingerlings. In 2002, 141 million catfish fry were produced which was an increase of 281 percent over the amount produced during 2001. Other catfish varieties usually require 18 to 24 months to reach market size, but the new catfish line grows up to 20 percent faster in the pond so it can be marketed sooner. NWAC103 catfish consume 10 to 20 percent more feed and can grow 9 percent faster than other commercial catfish lines currently in use. They also tend to mature earlier and produce more eggs. The NWAC103 catfish are the first line to be certified using DNA fingerprinting methods developed by ARS scientists.
  
- ⌘ **100% Natural Fruit Bars**. ARS researchers have patented (Patent Number 6,027,758) and transferred technology for forming 100% fruit bars. Fruit puree is the primary ingredient used in forming these fruit products. One fruit bar is the equivalent of two servings of fruit. The bars are flavorful, nutritious and convenient. For these reasons, ARS's technology should help consumers meet USDA daily dietary recommendations. The invention has been licensed to HR Mountain Sun, Hood River, OR. The company has constructed a manufacturing plant in North Bonneville, Washington—an area with 30 percent unemployment. Ninety new jobs have been created. They are selling three types of pear bar products—a plain pear bar, a blueberry bar, and a cranberry bar. Several grocery chains are selling the **Gorge Delights™** bars, including Rosauer's, Albertsons, Thrifty, and some U.S. Commissaries. The bars are now being sold in over 400 Albertsons stores and have received international interest from businesses in Malaysia, South Korea, Jamaica, South Africa, Italy and many other foreign countries. They are also being distributed through the Washington school lunch program. This technology started from a grass roots effort for pear growers to add-value and create new markets for pear products, and has recently expanded beyond pears into other fruits and vegetables. This research is part of an overall ARS effort to develop technologies that will permit year round processing of seasonal crops by making value-added products from bulk processed ingredients such as fruit and vegetable purees. Fruit and vegetable products are limited because technology for processing them is restricted to relatively few forms (canning or freezing) which must be done immediately after harvest. Processing systems such as this enable large amounts of materials to be partially processed

into stable forms within the short harvest season, and then made into a variety of products throughout the year.

- ⌘ **VerifEYE™**, a new optical detection system that inspects meat for fecal contamination, should help the industry meet Pathogen Reduction and Hazard Analysis and Critical Control Point (HAACP) regulations. These regulations require meat and poultry plants to implement a system to improve the safety of their products, and ultimately prevent fecal contamination of meat food products. Fecal contamination can carry pathogenic bacteria such as *Escherichia coli* 0157:H7, and these bacteria can cause foodborne illness in people. The new technology, developed cooperatively by ARS and Iowa State University researchers, uses specific color wavelengths to detect even minute amounts of fecal matter on meat during processing. Light emitted from the carcass is electronically analyzed to check for contamination. If contamination is detected, the carcass is identified for further sanitization. Current inspection methods rely heavily upon visual inspections, but fecal matter undetected by the human eye may still be present.

This new technology offers the industry a more reliable method for ensuring a safe food product. The patented (Patent Number 5,914,247) technology is licensed to eMerge Interactive Inc., a technology company located in Sebastian, Florida. The company is currently marketing a hand-held version of the technology in North America and distributors in The United Kingdom and New Zealand are marketing the technology in the European and Australian market. A full-carcass scanning device has also been developed and tested in collaboration with Excel Corporation. Excel has leased the system for installation in their beef processing plants. Additional patents on variations of the technology are also being sought.

- ⌘ **A safe, effective alternative to broadcast fumigation** could help reduce an over reliance on methyl bromide, which is scheduled to be phased out in the United States in 2005 due to its status as an ozone depleting compound. Soil fumigants are used to disinfest agricultural soils of pathogens, nematodes, and weeds; and they have traditionally been applied by injecting them directly into the soil. Some alternative fumigants do not move as readily through the soil as methyl bromide when injected into the soil, thus reducing efficacy. A team of ARS scientists developed methods for applying soil fumigants using drip irrigation systems, which enhance the distribution of the alternative fumigants in the soil. This makes the alternative fumigants more acceptable as methyl bromide replacements and helps reduce the potential for alternative fumigants to escape into the atmosphere. ARS scientists entered into a Cooperative Agreement with the California Strawberry Commission to conduct tests and demonstrate the effectiveness of ARS's drip irrigation technology for strawberry production. Because of the team's success in communicating their results, manufacturers

quickly developed suitable new chemicals and registered these products with federal and state agencies.

Western growers of fruits and vegetable such as strawberries, melons, tomatoes, and peppers have rapidly adopted this technology and are benefiting significantly from it. Growers were able to adopt the technology without changing their production systems. EPA label registrations have been granted for three drip-applied fumigant formulations—Telone EC, InLine, and Chloropicrin. In 2002, nearly 10 percent of U.S. commercial strawberry crops were grown on land using ARS's technology, as well as nearly 2000 acres of tomatoes, peppers, and melons. In addition to U.S. growers, the technology is receiving international interest from growers in Italy and Spain.

- ⌘ **National Phosphorus Indexing (P Index).** A national effort that includes ARS scientists, as well as scientists from other USDA agencies, the Environmental Protection Agency, various universities, and extension specialists has led to the development and implementation of a standard for managing and assessing the risk of phosphorus loss on agricultural fields and water ways. Phosphorus is an essential nutrient for crop and animal production, but excess phosphorus runs off into nearby water systems—degrading water quality. The team developed scientific standards for a Phosphorus Index, which addresses real world environmental concerns in an effective and practical way. The tool helps users to identify and prioritize alternative management options available to them, thereby providing flexibility in developing remedial strategies for managing phosphorus loss.

Team members are working extensively with federal, state, and local government agencies, agricultural organizations, and environmental organizations to educate them on the issues involved, and on how best to implement this strategy. More than 1000 field agents and nutrient management consultants across the United States have received training on how to use the P Index. In addition, overseas researchers and advisors from Brazil, Finland, Ireland, New Zealand, Norway, and the United Kingdom have adopted and modified versions of the P Index to apply the approach to their own countries' needs. This work will benefit all Americans because it will help maintain a cleaner, healthier environment.

- ⌘ **NuSun**, a new ARS-developed sunflower germplasm, has had a profound impact on the sunflower industry. NuSun is a hybrid sunflower plant that produces higher amounts of oleic acid than traditional sunflower plants. Oleic acid is believed by some scientists to have substantial health benefits, including lowering blood cholesterol levels. ARS scientists worked closely with representatives from the snack food industry, oil refiners, crushers, seed company breeders, public researchers, and growers to develop and test the

NuSun plants. Favorable test results led to rapid industry acceptance of NuSun oil, which is now being used by restaurants and the snack food industry. Earlier this year, Frito-Lay announced it would use NuSun oil in its new “All Natural” line of snack food products; and the products are now in stores.

In 2002, U.S. production of NuSun oil seed sunflower was approximately 850,000 acres, which accounted for 40 percent of the total U.S. oilseed sunflower production. The oil from the plant has superior cooking qualities and lasts longer in frying vats. In addition, NuSun oil does not require hydrogenation—a process that produces trans fatty acids, which are known to be detrimental to human cardiovascular health. Recent Food and Drug Administration industry requirements to label food products containing trans fatty acids underscores the importance of NuSun and its continued impact on the food industry and health-conscious consumers.

- ⌘ **Honey bees resistant to *Varroa destructor* (*V. destructor*)**, a parasitic mite of honeybees, are now available to beekeepers. *V. destructor* infestations have been devastating to the U.S. beekeeping industry. Since its arrival in the United States in 1987, beekeepers have fought the mite—which can wipe out an entire bee colony, sometimes during the course of the summer—using miticides. Over the years, however, the mites have developed resistance to each new chemical control. In addition to *V. destructor*, *Acarapis woodi*, another parasitic honey bee mite, has become a problem for the bee industry. This mite infests the trachea or breathing tubes of honey bees resulting in colony losses, reduced pollination ability, and reduced colony production. This mite has also developed resistance to chemical control methods.

A team of ARS researchers led the effort to select, test and breed Russian honey bees that would be naturally resistant to both mites. The team also selected for high honey production to assure the value of the stock. ARS scientists entered into a Cooperative Research and Development Agreement with a beekeeper to breed and gather information on honey bee queens for commercial production. Now, thanks to ARS’s efforts, it is estimated that nearly 40 percent of the Nation’s 2.5 million commercial honey bee colonies are currently stocked with Russian honey bees—producing an annual honey crop valued at about \$85 million, and pollinating crops valued at \$ 6 to \$8 billion. Beekeepers are also happy with the Russian honeybees, because they typically produce about 10 percent more honey per colony, and they can they survive northern winters. Treatment savings for beekeepers using the new bees totals about \$17 million a year.

- ⌘ **ARS-developed cropping system technologies** are improving economic and environmental sustainability of agriculture in the Palouse region of Washington, Oregon, and Idaho. These integrated systems include continuous reduced tillage

and no-tillage, direct-seed organic systems, perennial polyculture, and restoration of native prairies. ARS scientists have transferred these research results directly to growers at a major industry tradeshow, annual field days, workshops and during field research tours organized by ARS. A survey conducted by an ARS researcher documented that 61 percent of the growers surveyed are currently using technologies from ARS, yielding significant benefits to them and to the region's environment.

- ⌘ **Hop Powdery Mildew Infection Risk Forecaster.** Currently, 75 percent of hop acreage in the Pacific Northwest is using this ARS-developed forecasting model for detecting powdery mildew, an important hop disease in that region. Four years of research culminated in the public release of this model on the Internet, which provides growers with a two-week history of infection risk, the current day's risk, and a forecast of infection risk for the next five days. ARS research defined critical temperatures influencing infection frequency and host susceptibility. Once ARS researchers created and validated the infection risk model, they partnered with FieldWise and Fox Weather to develop 5-day forecasts for each weather station using proprietary algorithms and historical site-specific weather data. This increased the risk index's utility. In 2001 and 2002, growers using ARS's model to assist in fungicide applications reported using 1.5 fewer fungicide applications, while suffering 55 percent less powdery mildew infection in their hop crops. Combining the model with other cultural practices has helped reduce hop production costs related to powdery mildew control from \$460 per acre to \$196 per acre.
- ⌘ **A new method for collecting ram semen.** This method has a worldwide impact on preserving animal germplasm. The method uses a vial, which is placed in the ewe's vagina to collect semen, allowing for easy semen recovery. The semen can then be extended, frozen, transported, and used to artificially inseminate large numbers of ewes or stored in germplasm banks. This innovation has the potential to replace the artificial-vagina method for collecting semen, which has been in use for more than 60 years and requires a considerable training period for rams. ARS researchers transferred this technology to scientists and technicians at the U.S. Meat Animal Research Center (USMARC). USMARC personnel have used the procedure to collect semen from large numbers of untrained rams that represent defined genetic lines of sheep. Approximately 10,000 units of semen from these rams have been added to the Animal Germplasm Preservation Program in Fort Collins, Colorado.
- ⌘ **Conservation system technologies.** ARS researchers in the southern U.S. region have played an active role both nationally and internationally in promoting conservation tillage systems using a combination of face-to-face farmer interactions, publications, Web site development, personal interactions, meetings, and conferences. Statistics indicate that no-tillage cotton in the



Southern states grew from 627,000 acres in 1998 to more than 1,938,000 acres in 2002, a threefold increase. A 2003 National Cotton Council of America survey reported that 57 percent of the total cotton acres in the Southeast was in no-tillage. Annually, conversion of over 1.31 million acres of cotton in the Southeast to no-tillage saves 10.6 million tons of soil worth \$198 million in on-farm and off-site impacts, and \$39 million in fuel and labor costs.

- ⌘ **Cotton gin schools.** As part of a unique technology transfer effort, ARS annually participates and helps sponsor gin schools, which are designed to transfer ginning technology directly to the users. At these schools, cotton ginners learn firsthand from ARS scientists and our Cotton Technology Transfer Extension Coordinator the latest information about preserving fiber quality and increasing gin efficiency using the latest ARS-research results. In addition, ARS hosts a Textile Manufacturing Symposium and a Cotton Ginning Symposium at gin and textile labs to benefit county extension agents in cotton producing states.