



U.S. Department of Agriculture Annual Report on Technology Transfer FY2014

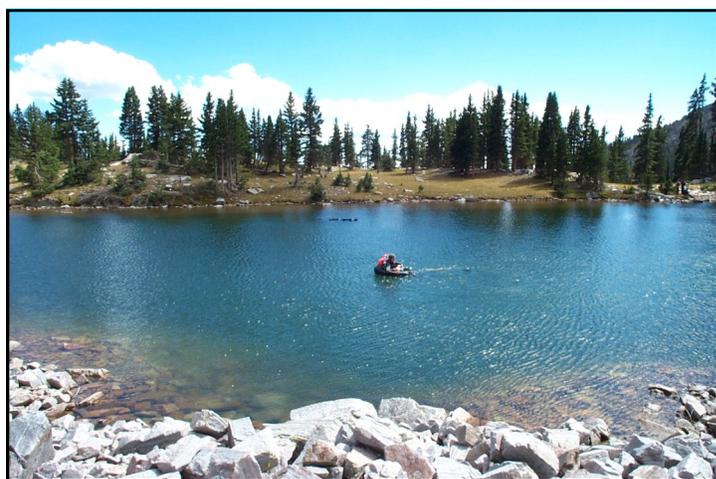
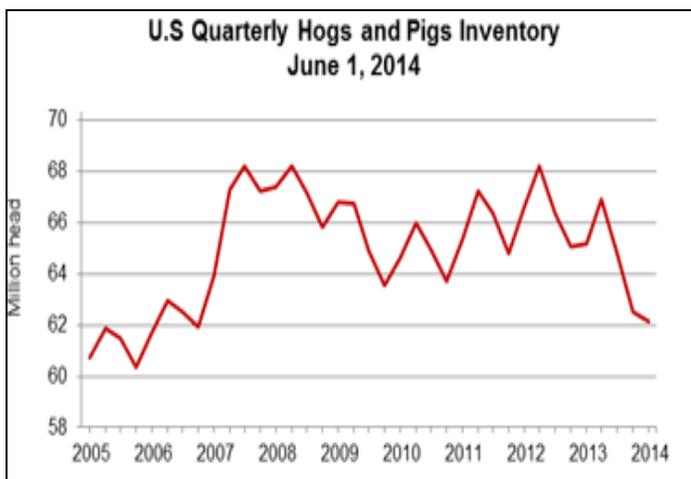


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INTRODUCTION

President Abraham Lincoln coined the phrase “the People’s Department” acknowledging the role of the Department of Agriculture in solving problems that benefits all people every day. Thus, well before the coining of the modern day phrase of “technology transfer,” it was the culture of USDA to deliver solutions to the people of the United States. Today, USDA broadly defines technology transfer as the adoption of research outcomes (i.e., solutions) for public benefit. A seemingly simple statement, the process of adoption is complicated, requiring integration of many assets from disparate sources in the successful delivery of solutions. “Public benefit” is achieved through many mechanisms including public release of information, tools, and solutions (e.g., germplasm, plants and other materials), adoption and enhancement of research outcomes by partners through collaborative research, formal cooperative research and development agreements (CRADA) authorized by the Federal Technology Transfer Act (1986), direct federal, state, or local technical assistance, or through licensing of biological materials or protected intellectual property directly to not-for-profit entities and for-profit private sector firms. Additionally, successful adoption of USDA knowledge and research outcomes typically requires complementary assets and services provided by multiple agencies in USDA, including agencies that are not primarily engaged in direct research in the physical and life science arenas.

Private sector involvement in technology transfer adds the benefits of creating new or expanded businesses, jobs, and economic prosperity. Science-based innovations from USDA intramural research --- often developed through public-private partnerships (PPPs)- create new or improved technologies, processes, products and services that benefit the nation by increasing productivity, increasing efficiency (keeping costs low) and enhancing global competitiveness for the U.S. agriculture sector. Thus, technology transfer functions are critical to accelerating utility of public R & D investments, creating economic activity, and in job creation and sustainable economic development.

The Agricultural Research Service (ARS) has been delegated authority by the Secretary of Agriculture to administer the patent program for ARS, and to review CRADAs and administer technology licensing programs for all intramural research conducted by USDA. These activities are housed in the Office of Technology Transfer.

On October 28, 2011, following a series of reports identifying the status of technology transfer from federal funds and federal laboratories, the White House issued the Presidential Memorandum – “Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses.” Issuance of this Memorandum provided an unprecedented opportunity for unifying technology transfer across USDA S&T agencies as the mechanism to deliver these outcomes for public good. In the USDA’s response to the Presidential Memorandum (<http://www.nist.gov/tpo/publications/upload/USDA-Tech-Transfer-Plan.pdf>), several initiatives were identified to promote technology transfer and commercialization. These initiatives will usher in a new era of unprecedented collaboration among agencies of USDA to enhance services and opportunities to the customers and stakeholders of the Department. This Report describes progress in implementing these initiatives.

This report also covers technology transfer activities and metrics for the Agricultural Marketing Service (AMS), Animal and Plant Health Inspection Service (APHIS), Agricultural Research Service (ARS), Economic Research Service (ERS), Foreign Agricultural Service (FAS), Food Safety and Inspection service (FSIS), Forest Service (FS), Grain Inspection, Packers and Stockyards Administration (GIPSA), and National Institute of Food and Agriculture (NIFA).

COMBINED METRIC TABLES FOR ALL USDA AGENCIES

Table 1: Invention Disclosures and Patents from APHIS, FS and ARS.

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
	Invention Disclosures					
1	Number of new inventions disclosed	149	158	160	191	117
	Patents					
2	Number of patent applications filed	113	124	122	157	119
3	Number of patents received	45	49	69	65	83

Table 2: Income Bearing Licenses from APHIS, FS and ARS.

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
	Income Bearing Licenses					
4	Number of income bearing licenses	340	354	379	397	412
5	Exclusive licenses	248	257	277	291	299
6	Partially exclusive licenses	16	16	14	13	15
7	Non-exclusive licenses	76	81	88	93	98
	Elapsed Amount of Time for Granting Licenses					
8	Average (months)	6.6	5.9	5.8	3.5	5.9
9	Minimum (months)	0.7	0.6	0.3	0.4	.9
10	Maximum (months)	18.5	18.2	19.7	12.5	21.5

Table 3: Licensing Income from ARS.

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
	Earned Royalty Income					
11	Earned Royalty Income from top 1% of licenses	N/R	N/R	N/R	N/R	N/R
12	Earned Royalty Income from top 5% of licenses	\$1,493,458	\$1,932,199	\$1,752,369	\$1,969,157	\$2,048,317
13	Earned Royalty Income from top 20% of licenses	\$2,540,103	\$2,672,416	\$2,604,010	\$2,892,798	\$3,103,143
14	Minimum Earned Royalty Income	\$2	\$6	\$44	\$5	\$32
15	Maximum Earned Royalty Income	\$331,674	\$630,847	\$757,219	\$856,987	\$575,753
16	Median Earned Royalty Income	\$4,911	\$4,748	\$5,000	\$3,609	\$3,232

Annual Reporting on Technology Transfer in USDA, FY 2014

	Disposition of Earned Royalty Income					
17	Total amount of Earned Royalty Income received	\$3,075,199	\$3,136,813	\$3,059,989	\$3,353,876	\$3,610,774
18	Percent of Earned Royalty Income distributed to inventors	25%	25%	25%	25%	25%
19	Percent of Earned Royalty Income distributed to the agency or laboratory	0%	0%	0%	0%	0%
20	Licenses terminated for cause	0		0	0	0

N/R, data is not reported due to its proprietary nature.

Table 4: CRADAs from APHIS, FS and ARS.

		FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
	CRADAs					
21	Number of active CRADAs	273	292	274	259	267
22	Number of newly executed CRADAs	92	102	65	86	60
23	Active CRADAs with small business involvement	N/A	N/A	130	117	102
24	Number of small businesses involved in active CRADAs	N/A	N/A	130	117	102
	Traditional CRADAs					
25	Active traditional CRADAs	219	207	211	211	193
26	Newly executed traditional CRADAs	66	68	45	54	39
	Non-traditional CRADAs					
27	Active non-traditional CRADAs	54	85	63	48	74
28	Newly executed non-traditional CRADAs	22	21	14	21	21

Response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business

USDA 1: New metrics proposed for standard annual reporting in addition to those required by Circular A-11 instructions on annual reporting of technology transfer

This initiative was completed in FY2013 and the new metrics are now a standard component of the metric tables.

USDA 2: Update Policy and Procedure (P&P) 141.2 “Technology Transfer in ARS”

An update is necessary to reflect statutory changes since 2000, and to reflect changes in structure and operation of the National Patent Committees, and to include licensing of biological materials and use of the ARP network. A Technology Transfer Process Working Group with representatives from the core functions involved in the technology transfer process was established. As a result of this group, changes were made in the invention disclosure review process, as well as the development of an outline for determining a strategic and tactic technology transfer plans for research projects. Based upon these changes, a new P&P is expected to be written in FY 2015.

USDA 3: Expand Agricultural Technology Innovation Partnership (ATIP) efforts to enhance access to complementary assets by USDA partners

New Title: Expand Agricultural Research Partnership (ARP) Network efforts to extend the impact of ARS research

The ATIP Network was redesigned and renamed the Agricultural Research Partnerships (ARP) Network. The mission of the new ARP Network is to extend the impact of ARS research by supporting a sustainable and competitive agricultural economy. To further this mission, the ARP Network will assist ARS in creating new partnerships and in supporting existing partnerships to advance ARS research and development (R&D) and subsequent utilization, including commercialization. This expanded mission required a broader membership base. The membership base was increased to include any organization interested in agriculture-based economic development. The ARP Network includes all players in an innovation ecosystem and has members spanning the U.S. with a shared vision to grow and sustain a competitive agricultural economy. Members include ARS and stakeholders interested in agriculture-based economic development such as, but not limited to rural agribusiness; urban, community and/or economic development groups; organizations that support farmers, agritourism and/or food processors; and capital programs for business attraction and acceleration. Membership in the ARP Network is formalized through non-funded Trust agreements executed by the Office of Technology Transfer. There are currently 33 ARP Network members. We will continue to add members as appropriate.

USDA 4: Expand outreach efforts in technology transfer to scientists in ARS

OTT worked with Office of National Programs to connect ARS scientists' research capabilities and technologies with a number of different companies. This was done through the ARP Network, responding to public solicitations, responding to industry scouting, and through webinars conducted by Federal Laboratory Consortium. This outreach has resulted in several agreements as well as ongoing discussions between ARS and commercial partners in a number of areas.

ARS introduced its intranet site (Axon). OTT started developing a technology transfer page on Axon that will be more fully developed in FY2015. Scientist training materials, brochures, documents, and templates that are currently on the OTT website are being migrated to Axon.

OTT has begun the development of standard technology transfer training modules for ARS employees. To date two PowerPoint modules have been prepared (“Tech Transfer: Introduction” and “Tech Transfer: Agreements”) and two are currently in preparation (“Tech Transfer: Patenting” and “Tech Transfer: Licensing”). In FY2015, voice will be added to the four modules. When completed the training modules will be upload to the ARS intranet site Axon and be made available on the USDA e-training program, AgLearn.

USDA 5: Encourage other S&T agencies to adopt OTT’s approach to technology transfer

In the past, OTT has provided technology transfer services (policy advice, agreement review, patenting / licensing services, etc.) to the USDA-Animal and Plant Health Inspection Service (APHIS) Wildlife Services, USDA Forest Service (FS), Department of Interior’s Bureau of Reclamation (BoR). In FY 2014, these services were expanded to include APHIS’s Wildlife Services, Plant Protection and Quarantine, and Veterinary Services), as well as the FS’s Forest Products Laboratory. In addition, the BoR agreement was modified to include the Department of Interior’s (DoI) U.S. Fish and Wildlife Service.

USDA has a role in helping to develop Federal government technology transfer policy through OTT’s active participation on the Interagency Working Group on Technology Transfer and the White House to Lab-to-Market Working Group. In FY2014, the Lab-to-Market Working group established cross agency goals (Developing Human Capital, Empowering Effective Collaborations, Opening R&D Assets, Fueling Small Business Innovation, and Evaluating Impact). OTT took the lead in developing the white paper Co-Funding and Philanthropic Partnerships under Empowering Effective Collaborations.

USDA 6: Explore expanded use of Enhanced Use Lease (EUL) authority as technology transfer tool to promote longer term relationships with key customer groups

Under the 2008 Farm Bill, the Secretary was given the authority to establish a pilot project at the Beltsville Agricultural Research Center (BARC) to lease non-excess property to any private or public entities. The EUL Project was used as a technology transfer tool designed to provide longer term public-private partnerships than can be done through existing technology transfer partnership instruments. The pilot authority was used to develop a process to identify underutilized laboratory resources that could be used by the private sector to commercialize ARS research outcomes. Prospective lessees needed to establish either a licensing partnership or research collaboration with ARS. In exchange, EUL terms provide the lessee 20 years of use of the facility to develop its business. EUL authority proved to be a very successful strategy to leverage resources for entrepreneurial activities. USDA’s first lessee (Plant Sensory Systems) was a small business that in FY 2013 was awarded a \$1.8 million ARPA-E grant (Better Biofuel Feedstock from Beets) based on the success of the research project conducted using BARC laboratory facilities. Access to these facilities was essential, because this small business did not have sufficient capital to build the facilities needed for this research project.

This pilot authority for BARC was reauthorized in 2014 Farm Bill. BARC is in the process of identifying new EUL opportunities.

USDA 7: Beginning in FY 2012 / 2013, roll out a nationwide series of regional forums to identify issues and deliver solutions

The goal of the regional forums is to provide technology-based solutions to regional agricultural problems for farmers and businesses. The fora use a multistep approach: (1) a series of regional listening sessions comprised of businessmen, farmers, economic development organizations, regulatory and extension personnel are held to identify a broad list of regional issues; (2) from the list of issues, those with an existing research-based solution, or a researchable issues that could be addressed by ARS, local universities, cooperative extension, state agencies or agricultural businesses are selected as potential topics for a forum; and (3) finally, a forum is convened as a

roundtable discussion on the potential solution(s) and their implementation. Participants in the forum may include farmers, growers, agri-business professionals, university and ARS researchers, extension service personnel, rural development personnel, NIST Regional Manufacturing Extension Partnership (MEP) staff, funding and regulatory agency personnel, as well as ARS technology transfers professionals.

Collaborated with ARP members, USDA Rural Development, and University Extension to organize listening sessions and forums in:

- Mississippi on renewable energy and bioproducts;
- Oklahoma on the control of aflatoxin contamination in crops;
- Maryland on crop production in plastic high –tunnels. The Maryland event was video-taped, edited into several modules, and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).
- Ohio on bioproducts, soybean and wheat research. The sessions in Ohio were by webinar. The webinars were edited and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).

In addition a technology showcase was held in Fresno, CA. The purpose of the Showcase was to advertise partnering opportunities for local businesses interested in commercializing broad-band water management technologies developed by ARS and Lawrence Livermore National Laboratory scientists. This Showcase was also part of the USDA Rural Development's (RD) *Strong Cities, Strong Communities* Fresno pilot project which is focused on increasing capacity for use of broad-band technologies to support and develop the rural economy. One of the outcomes of the Fresno Showcase was identifying the need for better water management technologies to address drought conditions within the California Central Valley. As a result, ARS and RD held a series of meetings and workshops with companies, economic development entities, venture capitols and others on water issues. One of the results of these meetings is the collaboration of the Santa Ana Watershed Project Authority, the USDA-Forest Service, RD and ARS to shift management of the forest-water shed towards the specific objective of increased water generation. The goal of the collaboration is to add the "third dimension" to forestry management (fire risk reduction, water generation, & bio-energy). Removal of trimmed woody biomass is a remaining challenge. An ARS patented technology on a new mobile fast pyrolysis system for converting brush into bio-oil will be used to address this remaining challenge.

USDA 8: Provide opportunities for applicants to the USDA Small Business Innovation Research (SBIR) program to partner with ARS scientists to further develop science necessary for business success

In FY2014, a new collaboration between the USDA's National Institute of Food and Agriculture (NIFA) Small Business Innovation Research Program (SBIR) and the USDA's Agricultural Research Service (ARS) was established that encouraged SBIR applicants to license ARS technologies and be considered for a SBIR grant. The relevant language in Section 5.1 of the "Request for Application" states: "Additional factors that will be considered in the review process include whether an application involves a CRADA with a USDA laboratory, or a license to a USDA technology, or is a resubmission. In the event that two or more applications are of approximately equal merit, the existence of a CRADA with a USDA laboratory or a license to a USDA technology will be an important consideration. If one application is a resubmission, this will also be an important consideration. A list of available technologies for licensing and CRADAs that may be considered as projects under the SBIR program can be found at the **USDA Office of Technology Transfer (OTT) website**. Each of these technologies would be appropriate for one of the topic areas in section 8.0 of this program solicitation. If an applicant is interested in proposing a research project that addresses one of these technologies, the applicant should contact the OTT office at 301-504-6905 or on the **OTT Website** to discuss the possibility of signing a

licensing agreement and possibly also a CRADA agreement prior to submitting the proposal to the SBIR program.”

USDA 9: Provide Cooperative Research and Development Agreement (CRADA) partners opportunity to link to local Manufacturing Extension Partnership (MEP) resources to assist in commercialization efforts

When appropriate, ARS CRADA partners are provided a contact in their regional National Institute of Standards and Technology’s Hollings Manufacturing Extension Partnership (MEP) office to provide manufacturing assistance. OTT works with MEP headquarters to identify those contacts.

When a particular ARS Regional Forums (see USDA 7 initiative) has a manufacturing component, the regional MEP field staff is invited to provide an overview of the resources they have available to assist in manufacturing.

USDA 10: Partner with the University of Mississippi’s “Insight Park” for extraction, chemical analysis, and scale up of natural products for production agriculture and pest / pathogen / disease vector management

***New Title:* Work with regional incubators to identify opportunities for ARS scientists and ARS commercial partners**

This initiative directly addresses Section 4 of the Presidential Memorandum in establishing joint partnerships with university research parks, incubators, and other state / community economic development organizations. Since we have not yet been able to identify a project for the specific use of the University of Mississippi incubator’s facilities, we expanded this initiative to include other incubators besides the one at University of Mississippi.

OTT is working with the Federal Laboratory Consortium (FLC) to provide outreach to incubators on opportunities for partnering with federal laboratories. The FLC has an ongoing project to identify incubators throughout the country. In FY2014, the FLC identified the incubators in the midwest and will be identifying those in the farwest in FY2015.

USDA 11: Partner with the National Cancer Institute (NCI) on “Enhancing translation of nutrition science from bench to food supply”

***New Title:* Establishment of the “Branded Food Products Database for Public Health” Public-Private Partnership**

This initiative has evolved from the initial discussions with NCI. Since NCI as an agency is no longer a partner in this project, the title has been changed to more accurately reflect the initiative. Individuals within NCI still participate in the discussions. In FY 2013, ARS, the ATIP Foundation, and the International Life Science Institute North America (ILSI North America) established a public-private partnership to enhance the public’s health through increased knowledge of the nutritional content of the nation’s food supply. This will be accomplished by obtaining comprehensive food composition data from the food industry and making it available to government, industry, the scientific community and the general public through an enhanced National Nutrient Database, developed and maintained by the ARS Nutrient Data Laboratory in Beltsville, MD.

The Partnership convened two listening sessions in Cleveland, OH and Washington, DC to engage a broader group of stakeholders. The purpose of the listening sessions was to communicate about the Partnership, gather input regarding current and potential usage, and opinions on proposed criteria to the USDA National Nutrient Database, specifically from existing user groups and food manufacturers. During the listening sessions, a number of comments identified the various current uses for the USDA National Nutrient Database, such as for early stages

of product development; to educate consumers; for developing enhanced 3rd party proprietary nutrition guidance software; evaluating competition; calculating nutrition values for recipes; and for clinician use to counsel patients. Comments also included a need for a one-source database with a robust search engine and downloadable data; data that reflects what people are truly eating (updated at least annually, reflects variability and includes products from retail stores, restaurants, food service); more current oils, trans fatty acid information; phytonutrients; date stamp to facilitate changes in products and diet over time; nutrients of public health concern; and descriptive information of ingredients declared on the label (Nutrient Facts Panel, Ingredient list and when provided Expanded Facts Panel Data). Again, the appeal for a single-source for comprehensive, high quality, current database was expressed. Further results of the listening sessions can be found on the ATIP Foundation website at <http://static.squarespace.com/static/5102f4bce4b091e9d61659f2/t/53ea32a0e4b04b3e2c7f3418/1407857312486/ATIP+Website+Report+on+Combined+Listening+Session+Discussion+Notes.pdf>

USDA 12: Evaluate various options for reducing license negotiation transaction costs

Several proposals for establishing standard pre-commercialization license terms for all CRADA Subject Inventions were reviewed. Possible benefits included: creating business certainty for CRADA partners; providing an additional incentive to enter into a CRADA; and reducing transaction costs for both the CRADA partner and USDA.

This initiative is now completed with the pre-negotiated license language as an option in the CRADA template to be used in situations where a CRADA partner has indicated that they would like to lock in the royalty rate before proceeding with the CRADA.

USDA 13: Develop Material Transfer Research Agreement (MTRA) as a new instrument to promote development and commercialization of materials from USDA

USDA scientists create new materials that may have value in further research and development with the private sector. Current Material Transfer Agreements (MTA), widely used by USDA, only allow for the transfer of materials, but not engagement in joint research between the provider and the recipient of the materials. In order to enable some collaborative research with the material, in FY 2012 by combining the Material Transfer Agreement and the Trust Fund Cooperative Agreements authorities the MTRA was created. MTRAs are now reported as a metric in the Collaborative Relationships for Research and Development Table.

USDA 14: Accountability of Scientists and Engineers in Technology Transfer Accomplishments

In 2012 the annual performance standards for scientist evaluations were revised to include technology transfer elements. In FY2014, two new performance metrics were employed to measuring the number of technology transfer units performed at each station. These new Performance Accountability Measures are Science Delivery Products and Science Delivery Activities. Science Delivery Products are products developed to enhance the usefulness of scientific information, including synthesized information from a wide range of disciplines that are delivered to clients in clear and accessible formats. Science Delivery Activities are activities undertaken to enhance the usefulness of scientific information that are delivered to clients in clear and accessible form. Information about these products and activities are recorded by Stations in the Research Information Tracking System (RITS), and are retrieved by WO R&D staff for accomplishment reporting.

USDA 15: New uniform metrics for Forest Service Outcomes

During FY 2014, ten new performance metrics were put into use, five existing metrics were revised, three metrics were retired, and ten existing metrics were not changed. This occurred after a review and reevaluation of all performance metrics was performed during FY 2013 with the intent of standardizing performance reporting

across units. In addition to the metrics review and the development of new metrics, major changes were made to the Research Information Tracking System (RITS) to make it more effective, accurate, and uniform in the way accomplishments are reported. The revisions to RITS not only provided for more standardized reporting among stations, it provided easier access to accomplishment data by leadership and staff in the Washington office and in the field.

Starting in 2014, only information entered into RITS was considered for inclusion in some of the metric accountability estimates. Also, definitions were revised and new metric categories were developed to better define metric categories and this improved accuracy in reporting. In addition, this new process for reporting reduced the reporting burden in the field and provided an effective way for employees and leadership to quickly produce performance reports tailored to each need.

During 2014 two metrics for scientific publications were re-defined:

- Formally refereed publications are published scientific papers or similar documents, usually in journal or similar quality outlet, that are the result of material support from FS R&D, and on which the decision to publish is based on the results of a formal peer review and independent editorial decision
- Informally refereed publications are the number of published scientific papers or similar documents that are the result of material support from R&D, and on which the decision to publish is made after peer reviews that are not independently commissioned (reviewers are selected by author or line officer).

Also during 2014, new metrics were used to better define the information that sometimes was listed as publications.

- Science delivery products are products based on original research that are developed to enhance the usefulness of scientific information, regardless of durable delivery format, that are delivered to clients in clear and accessible formats.
- Science delivery activities are activities based on original research that are undertaken to enhance the usefulness of scientific information and that are delivered to clients in clear and accessible formats.

Regarding the patent process, new metrics were developed in 2014 to better quantify the entire patent process. These additional metrics describe accomplishments from the first step of application through licensing.

The current metrics being used for this purpose include:

- Patents issued that are assigned to USDA, on a five year rolling average.
- Patent licenses executed based on Forest Service discoveries, developments and applications to industrial interests, universities, or other entities, on a five year rolling average.
- New patent applications filed which have been assigned to USDA, on a five year rolling average.
- New invention disclosures received from Forest Service scientists and engineers, on a five year rolling average.

In 2014, performance accountability for three of the performance metrics was calculated using queries from the RITS to generate the estimate. As was done in 2013 the estimate for Invasive Species tools was generated this way, and in 2014 that metric and two additional metrics involving fire science (fire science output efficiency index and the fire science quality index) were calculated that way.

To better account for the funding provided to universities and other organization, additional performance metrics were developed to bring to twelve the number of metrics used for reporting funding to other organizations. These metrics are:

- Federal research funding provided to institutions of higher learning

- Federal research funding provided to Historically Black Colleges and Universities (HBCUs)
- Federal research funding provided Hispanic Serving Institutions (HSIs)
- Federal research funding provided to minority serving institutions
- Federal research funding provided to HBCUs, TCUs and HSIs
- Federal research funding provided to Tribal Colleges and Universities (TCUs)
- Federal research funding provided to 1862 land grant colleges and universities
- Federal research funding provided to 1890 land grant colleges and universities
- Federal research funding provided to 1994 land grant colleges and universities
- Federal research funding provided to non-academic institutions
- Total amount of grants and agreements awarded to other organizations and institutions
- Leveraged funds from Grants and Agreements

The third “Chief’s Science Delivery Award” was presented in February 2014 for a FS employee’s work in the area of ecology and specifically work with amphibians and reptiles.

Forest Service is currently reporting the number of citations of Station scientist’s publications as indices of the impact of Forest Service science. These indices are the average number of times FS scientists’ papers are cited in the Science Citation Index during the previous 10-year period beginning two years after publication. These include the average annual number of high impact papers (papers cited more than 20 times) and the average annual number of very high impact papers (papers cited more than 50 times). As reported in the Web of Science, over the period from 2005 through October 2014, publications authored by FS R&D scientists were cited in peer reviewed scientific journals an average of 12,410 times per year for a total of 136,515 citations over the ten year period. There were 1,815 high impact papers and 536 very high impact papers. This was a 4% increase in citations, 8% increase in high impact papers, and an 18% increase in very high impact papers for FY2014 compared to FY2013.

FY 2014 marked the fifth year of operation for the Forest Service Research Data Archive (<http://www.fs.usda.gov/rds/archive>). It added 34 research data sets to its catalog in FY 2014, and now offers 137 research data sets to the public and global science community. The catalog is also searchable via science.gov (using its new ‘Data’ tab). Twelve of the new data sets resulted from the archive’s service agreement with the Joint Fire Science Program (<http://www.firescience.gov>). Over 1,680 people downloaded a published data set in FY 2014 (> 50 percent increase relative to FY 2013); 70 percent of the data sets have been downloaded by a customer at least once. The archive expects to begin tracking citations of its published data sets in FY 2015 using the digital object identifiers (DOIs) it assigns to each data set.

USDA 16: New metrics on research outcomes related to intellectual property (patents)

FS R&D developed and implemented the RITS, which became the official FS reporting vehicle for all science publications in FY 2010. RITS improves the quality and consistency of data, provides transparency to the public, and reduces the need for burdensome data calls. The newest version of RITS incorporates patent data which is connected to related publications on specific technology focus areas. Patent data in RITS has now been updated to include the last 20 years of information. Going forward, patent data will be entered in RITS annually. Additional updates to improve the patent portion of RITS are planned for future releases.

Facilitating Adoption Through Partnerships

As part of the USDA, the Forest Service Patent Program has enjoyed a close working relationship with ARS and the Office of Technology Transfer (OTT) for many years. This partnership has grown and expanded to include FS access to the Agriculture Research Information System (ARIS) database for patent and license tracking, inclusion in OTT teleconferences, and ARS Licensing Associates assisting the FS Patent Program with license negotiations.

USDA 17: Explore additional ways FS and ARS can work together on intellectual property and related matters

Cooperative Research and Development Agreements (CRADAs) are widely used within the FS to enable researchers to work with university partners and industry leaders and are drafted by the FS Grants and Agreements Specialists. Recognizing efficiencies that could be gained by having standardized agreement language and procedures, FS has used ARS as a CRADA resource in FY 2014 to assist with CRADA questions. The ARS Partnership Liaison and Deputy Assistant Administrator, Office of Tech Transfer, held an in-person training session on CRADAs for FS Grants & Agreements Specialists in FY 2014.

Further collaboration on various technology transfer agreements, such as Material Transfer Agreements (MTAs) and CRADAs is planned for the next FY, as are collaborations involving jointly owned inventions and patent prosecution matters.

USDA 18: Enhance education and extension outreach efforts

FS R&D has a focused effort to educate children about science, technology, engineering, and mathematics (STEM), ecology, and conservation of natural resources. In partnership with the Cradle of Forestry in America Interpretive Association (CFAIA), the Forest Service has created and distributed two *Natural Inquirer* monographs in celebration of the Wilderness Act's 50th anniversary. Additionally with CFAIA and the U.S. Geological Survey, FS R&D created and distributed a "Scientific Models in Adaptive Management" *Natural Inquirer*. In FY2014, close to 80,000 journals were distributed to students and home schools. In partnership with CFAIA, the FS distributed 200,000 scientist cards to student participants at the 2014 National Science and Engineering Fair. These cards, which are similar to baseball trading cards, feature Forest Service scientists and introduce students to natural resource science careers.

USDA 19: Enhance FS interactions with entrepreneurship activities at educational institutions

During FY2014, ten performance metrics were used to evaluate the level of interaction the Forest Service has with activities at educational institutions. Prior to 2014 we measured the amount of funding provided to: all institutions of higher learning; minority institutions; historically black colleges and universities; Hispanic serving institutions; and Tribal colleges and universities. Also the percent of Forest Service funding going to colleges and universities was tracked. Starting in FY 2014, additional performance metrics were employed to track funding to Land Grant Colleges and Universities; 1862 Land Grant Colleges and Universities; 1890 Land Grant Colleges; and 1994 Land Grant Colleges and Universities.

During FY2014, colleges and universities were provided more than \$35 million, with almost \$1million going to minority colleges and universities. Funding to colleges and universities accounted for 2.6% of the total Forest Service budget.

USDA 20: Increase awareness in WS of technology transfer mechanisms, leading to increased pace of effective technology transfer and commercialization.

WS NWRC has traditionally been active in transferring technology and scientific information through use of outreach to collaborators, including WS operational personnel and through publications. Successful outcomes may include improved wildlife damage management practices, scientific information that enhances U.S. competitiveness by protecting crops and property, or increased awareness about wildlife diseases that threaten health of livestock or humans. Most of these outcomes do not require a patent and license for implementation. This initiative is designed to increase awareness among WS personnel about the importance of both formal and informal technology transfer.

In FY 2014, the Manager of WS NWRC's Technology Transfer Program provided one-on-one technology transfer trainings to six scientists, increasing the general knowledge and raising the awareness of scientists as to the power of partnerships, importance of developing intellectual property, and the array of technology transfer agreements available to facilitate their research. In addition, WS NWRC's Technology Transfer staff continued to

reach out to WS Operations on technology transfer and intellectual property issues. WS Operations staff contacted WS NWRC's Technology Transfer Program for regulatory advice on two potential patents, one related to feral swine trapping and the other for regulatory review of a confidentiality agreement related to hunter take of feral swine.

WS continues to emphasize the importance of collaborative agreements with stakeholders to offset diminishing discretionary funding, while increasing relevance of research to stakeholders, such as the private sector. WS, as part of the annual report table, continues to track the number of agreements it maintains each year, including cooperative agreements, cooperative service agreements, MOUs, and interagency agreements. In addition, WS will track numbers of specific technology transfer agreements, including CAs, MTAs, and CRADAs. In FY 2014, WS NWRC maintained 9 active CRADAs. One new CRADA was signed in 2014. This CRADA is with SenesTech, Inc. (Flagstaff, AZ), and provides \$75,000 for laboratory testing of an oral contraceptive for rodents and further development of a liquid delivery system for using the product in the field. In addition, WS NWRC is currently partners in 59 CAs, 9 of which were new in FY 2014, and 71 MTAs, 18 of which were new in FY 2014.

USDA 21: Increase knowledge of WS and NWRC and their impact in preventing wildlife conflicts, leading to increased development of collaborative research and more effective use of public resources.

WS NWRC has committed to increasing the amount of information disseminated to the general public and stakeholders on research, collaborations and products provided by the Program. The WS NWRC works closely with APHIS public affairs staff in the preparation and dissemination of information on WS NWRC research and collaborations, as well as WS's role as the premier organization for managing human-wildlife conflicts.

As part of continued efforts to increase local and regional community awareness of the WS NWRC, in FY 2014, the Center hosted tours to more than 200 students, visiting scientists, business and agency partners, and USDA employees. It also partnered with representatives at Colorado State University and the Centers for Disease Control and Prevention to coordinate and host 4 seminars as part of the Foothills Infectious Diseases Seminar Series. Center representatives hosted booths at university career fairs to inform students of potential job opportunities with the WS NWRC. Through the USDA's blog site, twitter site, and GovDelivery system, WS NWRC notified various stakeholders of research activities, accomplishments, and upcoming events. WS NWRC responded to approximately 100 media and community requests for information and published 10 brochures, factsheets, press releases and reports for the general public.

USDA 22: Increase the pace of WS technology transfer and commercialization activities.

To accomplish this objective, WS NWRC will increase its efforts to obtain partners for technologies ready to be commercialized by working with ARS and by utilizing the ATIP Program.

WS will continue maintaining existing products and registering new products with the Environmental Protection Agency and the Food and Drug Administration for use by WS personnel and the public. In FY 2014, APHIS WS maintained 15 Section 3 registrations with the Environmental Protection Agency and made 1 new pesticide registration application submission. A total of 26 Section 24c (Special Local Need) pesticide registrations were maintained and three new labels were obtained; 1 Experimental Use Permit was in place. In addition, APHIS WS maintained 2 Investigational New Animal Drug permits with the Food and Drug Administration.

USDA 23: Enhance Collaboration Efforts in Pest Detection and Management

PPQ's scientific support focuses on improving and developing pest detection and management tools to discover new invasive species early and respond quickly, better identify and target offshore pest threats, develop diagnostic

tools and techniques, and transfer technology to cooperators and impacted industries.

Goal 1. CPHST provided new diagnostic and pest detection methods to Ports of Entry.

- Piloted the CANARY detection assay and training plant inspection station staff to conduct the assay for *Ralstonia solanacearum* on Pelargonium interceptions at the Linden, New Jersey and Atlanta, Georgia Plant Inspection Stations. S&T worked with field staff to successfully conduct union negotiations for phase 2 studies in FY 2015, which will finalize data needed for an implementation plan.
- Assisting with pilot studies to identify insect thrips using DNA sequence data and DNA analysis methods to identify intercepted fungi in the genus *Colletotrichum* at plant inspection stations.
- Cooperating with Customs and Border Protection (CBP) to identify intercepted wood boring beetle larvae in solid wood packing material through rearing to adulthood and molecular tools.
- Provided critical support to Field Operations to implement a new risk-based sampling method for plant inspection stations that provides statistically supported guidance to port staff on sampling protocols.
- Revised guidelines for commodity import risk analyses that reduces the time required for analyses for improved efficiency, and provides more accurate assessment of pest risks.
- Delivered pest risk analysis training for PPQ, state, and international plant protection staff.
- Continued to work with the citrus industry and Master Gardeners in Texas to implement a biological control program for ACP in urban areas in south Texas with public support.
- Engaged and trained phytosanitary irradiation industry stakeholders to support the wider use of this method in agricultural trade and provide an alternative to methyl bromide fumigation. Working with U.S. phytosanitary irradiation facilities to validate their procedures, resulting in a letter of appreciation from Senator Cochran for work to allow port of entry irradiation at the Gateway America facility in MS.
- Worked with the International Atomic Energy Association to collaborate on research to remove artificial trade barriers to irradiated commodities.
- S&T scientists have provided ongoing scientific support since 2010 related to negotiations to export U.S. potatoes to Mexico. This has involved extensive discussion with the North American Plant Protection Organization and Mexico counterparts on phytosanitary issues. As a result of this work, in March 2014, Mexico published a new global potato regulation that allows U.S. tablestock potato exports to Mexico and APHIS published a final rule to allow the harmonized importation of tablestock potatoes from Mexico. Undersecretary Avalos visited Raleigh to personally express his appreciation to the scientific staff that contributed to this project.
- Examined solid wood packing materials to identify pests. Pest larvae cannot be identified with current tools in the ports of entry. To date, S&T analysis has identified 185 specimens, many of which are known to be damaging exotic pests, demonstrating that regulatory noncompliance is an issue in this pathway.
- Executed an interagency agreement with the Agricultural Research Service Office of Technology Transfer (OTT) to assist in PPQ technology transfer needs.

Goal 2. Strengthened PPQ's partnership with the Dept. of Homeland Security (DHS) by developing advanced technologies for pest detection and identification, commodity treatments, and decontamination and disposal.

- Completed phase 1 of a DHS/PPQ project funded by DHS to develop the requirements from PPQ and CBP for notional detection technology to detect plant pests. Delivered a report to DHS/PPQ on the joint initiative to assess promising pest detection technologies for potential deployment in port inspections. Other initiatives included risk analysis and potential ag-bioterror agents.
- Completed data analysis from a DHS/PPQ field trial of volatile organic compound detection devices to detect methyl bromide in fumigated wood. The most sensitive devices could detect and confirm methyl bromide treatment 5 months after fumigation.

- Initiated a DHS funded project to identify volatile compounds for wood boring beetles and khapra beetle that could assist CBP and PPQ in detection of beetles in cargo and passenger baggage. DHS committed \$200,000 for further detection tool development.
- Collaborated with DHS Depopulation, Decontamination, and Disposal team to evaluate technologies and demonstrating efficacy of alkaline digester and disinfectant treatments.
- Delivered online multi-media pest identification tools for scales and Lepidoptera (moth) larvae, and completing the beta version of *image ID*, a website containing over 31,000 pest images to aid in pest identification.
- Delivered an on-line, multi-media, identification tool (keys, images, fact sheets, glossary, illustrations, etc.) to pest scales (<http://idtools.org/id/scales/>).

Goal 3. Provided leadership on the Port Environs initiative to understand which ports of entry pose the highest risks.

- Established the Port Environs Working Group and established conceptual definitions of port environs.
- Analyzed top ports of entry by water, air, and other pathways, to assist in ranking the state by importance as a major port of entry.
- Conducted preliminary analysis of the port environs for Texas, with emphasis on the southern U.S. border.
- Analyzed U.S. state, county, and 10 kilometer grid cell ranking of likelihood of plant pest entry.
- Delivered final geospatial delineation of port environs for the U.S. These data will serve as the foundation for pest, pathway, commodity, and economic analyses to support resource allocation decisions.

Goal 4. Better identify and target offshore pest threats.

- Completed 21 pest risk assessments for potential commodity imports, including six for plants for planting (Q-37), a pest risk analysis for cotton treatments, and a revision and update of the pest risk assessment for lemons from Argentina based on publication of relevant research.
- Completed two high importance weed risk assessments for genetically modified corn and soybeans.
- Completed a very large and very complex pest risk assessment for citrus from China in a greatly shortened time frame of less than three months. This supported posting of a draft rule for approved access in FY 2014.
- Drafted guidelines for a new risk element, Likelihood of Survival and Reproduction at the Arrival Site which should strengthen risk assessments.
- Completed 38 export risk assessments including an assessment to expand market access of U.S. potatoes beyond a 26-kilometer border zone inside Mexico.
- Analyzed 40 new pests and pests of imminent threat under the New Pest Advisory Group (NPAG), and completed 23 full NPAG reports.
- Completed 20 reports on pests recommended for deregulation at ports of entry.
- CPHST supported the creation and implementation of PestLens, an innovative phytosanitary early-warning system that applies technology to enhance PPQ decision-making, provides a basis for organizational and process improvements, and increases efficiency of communications. *PestLens is a PPQ product that is the result of the merger of two previously existing PPQ systems—Exotic Pest Information Collection and Analysis (EPICA) and the Offshore Pest Information System (OPIS). PestLens embodies the principle of accountability: detailed performance metrics are available to all of PPQ through the PestLens web-system. The development of PestLens has been highly cost-effective (<https://pestlens.info/>).* Several CPHST scientists technically support the development of PestLens products.

USDA 24: Provide Timely Scientific and Technical Support for Emergency Response and Management

PPQ must develop and maintain a high level of expertise to support preparedness in the areas of science, technical support, and technology transfer for rapid response efforts.

- Developed two economic commodity models for orange and pear sectors to improve the estimation of pest impacts to support PPQ decision-making.
- The National Plant Protection Laboratory Accreditation Program continued to support a national network of labs that can conduct regulatory diagnostics. Provided quality management best practices guidance and diagnostic training to laboratory partners in the NIFA National Plant Diagnostics Network and to federal and state regulatory partners.

Goal 1. CPHST contributed to the long-term goal of eradicating European grapevine moth (EGVM) from California.

- Provided the technical information to complete an EGVM operational plan for eradication.
- Leading a technical working group to provide the scientific basis for trapping and mating disruption and pesticide control requirements for eradication and eventual deregulation. This work has contributed to the eradication of EGVM in Solano County, and portions of Napa and Sonoma Counties.
- Overseeing studies in Italy and Portugal to evaluate novel mating disruption formulations and characterize lure performance. This has led to improved ability to detect EGVM in areas under mating disruption control treatments.
- Collaborating with the Agricultural Research Service (ARS) to develop an effective phosphine fumigation treatment that will be an environmentally improved alternative to methyl bromide fumigation for imported grapes.
- Completing initial development of irradiation schedules for sterilizing EGVM and rearing methods for sterile insect technique control.
- Initiating work to evaluate controlled atmospheres and radiation as alternative regulatory treatments for EGVM.
- In addition to meeting the performance requirements, initiated a spatial analysis project to evaluate the effectiveness of the area-wide management program. Application of treatments, surveillance data, and regulatory actions along with pathway analysis, cropping patterns and climatic variables will be evaluated to determine the effectiveness of the area-wide program and to identify areas that may harbor residual populations or are at risk of reinvasion.

Goal 2. CPHST contributed to the long-term goal of preventing citrus greening disease (*huanglongbing*, HLB) from California.

- Transferring risk-based survey models developed with ARS collaboration to California. As a result, the CA Department of Food and Agriculture can focus limited resources for survey in areas of highest risk for HLB. Current Asian citrus psyllid trapping data is incorporated into the model to build increasingly accurate tools. In addition, ARS models for managing ACP populations are being deployed by APHIS in California to support area-wide management in the San Joaquin Valley.
- Reared and released over 756,000 biological control wasps (*Tamarixia radiata*) along the Texas/Mexico border to control the Asian citrus psyllid (ACP) which transmits the disease. Immature psyllids in south Texas have been reduced by 51.9%, with average parasitism rates of 54.9%. Immature psyllids in Mexico have been reduced by 36.1%, with average parasitism rates of 70.3%. Production goals were exceeded by 25%. The Texas Asian Citrus Psyllid-Huanglongbing Management Team, led by PPQ S&T, received an APHIS Administrator's Award for their contributions to control HLB in December 2013.
- Transferred bio-control in-field rearing methods to mass rearing personnel in Texas, Arizona, and California to allow cooperators and a private insectary to establish a robust greenhouse and field cage based rearing program. California produced over 1 million parasitoids in 2014 and a private insectary has established a new operation to support the bio-control program. The combined production by these mass-rearing operations will result in production of > 2 million parasitoids in 2015 to widely establish *T. radiata* across Southern California. Cooperators in Texas have released over 240,000, and in Arizona have released over 40,000 psyllids in FY 14 as

a result of this work.

- Identifying spinosad compounds as an effective pesticide option for organic citrus growers. This treatment is compatible with bio-control agents if they are released at least a week after treatment.
- Developed a novel Hot-Spot Cluster Analysis that predicts areas which may contain an HLB infected plant based on the proximity of positive psyllid samples. This is helping to focus resources for HLB detection in the field.
- Developed two new diagnostic assays to improved molecular diagnostic tests for citrus greening that resolves and reduces the number of inconclusive results.
- Providing the scientific management and administrative processing for the Huanglongbing Multi-Agency Coordination Group that was established by the USDA Secretary in December 2013. The HLB-MAC is chaired by APHIS PPQ Policy Management with PPQ, ARS and other representatives to coordinate \$20 million for research projects to combat this disease by offering growers solutions in 1-2 years. S&T established a web-based project submission and review system to efficiently manage this work.

Goal 3. Provide scientific methods to the fruit fly program.

- Validating STATIC ® Spinosad Methyl Eugenol (ME), a safer and more effective eradication tool, for fruit fly eradication program use. This technology replaces a restricted use pesticide that requires stringent worker safety protection.
- Delivered a systems approach for interstate movement of tomatoes from areas regulated for Medfly, and drafting the protocols for movement of cherries regulated for Oriental fruit fly and citrus regulated for Mexican fruit fly. These protocols reduce the regulatory burden on industry, but still allow for safe movement of commodities without spreading invasive fruit flies.
- Supporting fruit and vegetable imports/exports by conducting studies to develop generic cold and fumigation schedules for multiple fruit fly species. As a result, a proposed cold treatment for multiple fruit fly species in China citrus has been developed.
- Delivered a modified diet formulation that saves \$90-200,000 each year in Mexican fruit fly rearing costs and recommended remodeling changes to rearing facilities to improve rearing practices.
- Demonstrated that fruit fly bait stations provide effective protection from Mediterranean fruit fly infestation for up to 60 days and are equivalent to weekly treatments using bait sprays. Bait stations are organically approved and are now being tested for preventing Mexican fruit fly infestations in Texas. This method has the potential to be a cost effective and environmentally safe way to manage exotic fruit flies.
- Participate on the Food and Agriculture Organization Technical Panel for Phytosanitary Treatments which recommended adoption of three cold treatments for Tephritid fruit flies; one irradiation treatment for mealybugs; two fumigation treatments for insects and nematodes; one treatment using dielectric heating for wood products; and one vapor heat treatment for fruit flies.
- Delivered fruit fly host list references for Mediterranean fruit fly and guava fruit fly that are the basis for regulatory decisions in trade affected by exotic fruit flies.

USDA 25: Improve Communications between CPHST and its Customers to assure Market Relevance

CPHST aims to establish and maintain an effective dialogue with its customers to ensure development activities are useful and applicable to customer needs.

- S&T participated in 11 industry and public outreach events, 5 educational outreach events, led activities for students in APHIS' AgDiscovery program, and hosted an intern through the USDA Agricultural Ambassadors Program funded by the USDA Hispanic-Serving Institutions National Program.
- Provided scientific and technical expertise to support a Seed Health Summit with industry stakeholders, which will assist PPQ in developing future seed health program plans.

- Supported a major PPQ initiative to review the diverse portfolio of Agricultural Quarantine and Inspection (AQI) activities, which resulted in formation of an AQI board to manage these activities.
- Championed a cross-functional Treatment Programs Analysis Group that completed a report providing recommendations on treatment staffing, program changes, and management changes.
- PPQ participated in the four annual Regional Plant Board meetings and in the annual National Plant Board annual meeting. In FY2014 PPQ and the National Plant Board formed a strategic alignment to “*utilize our respective state and federal authorities, assets, and expertise to safeguard plant health and enable safe trade*”. (<http://nationalplantboard.org/collaborative-documents/>)
- In FY2014 CPHST commissioned and completed a CPHST Laboratory Review that involved 136 in-depth interviews with CPHST staff and CPHST customers and stakeholders to obtain input on CPHST’s functions and capacity to support PPQ needs, and determine areas where improvements may be needed.
- Established a monthly CPHST seminar series held by webinar to improve scientific connections between labs and is open to PPQ staffs to provide communication on projects.
- S&T subject matter experts represented PPQ and provided extensive technical expertise to International Plant Protection Convention and North American Plant Protection Organization technical panels. This work ensured that the U.S. put forward the best available scientific and technical expertise and information to guide the development of international standards and help PPQ achieve its strategic objectives related to facilitating the safe expansion of trade.
- Participated in APHIS Commodity Sector Meetings to obtain industry stakeholder input on APHIS programs.

USDA 26: Improve the CPHST Work Plan Development and Project Prioritization Process to Assure High Quality Outcomes for Customers / Stakeholders

CPHST will continue to develop a process with PPQ operations to produce mutually acceptable work plans that ensure appropriate product quality.

- Delivered employee training and guidance to all project leaders managing cooperative agreements to ensure high quality work plans and knowledge of administrative requirements.
- Provided quality management training and guidance to PPQ staff and state cooperators.
- Commissioned and completed a CPHST Laboratory Review, conducted by APHIS’ Policy and Program Development, Program Assessment and Accountability division, to review the CPHST network of laboratories and assess how well the organization is positioned to support PPQ’s scientific and technical needs. This independent review concluded that CPHST is meeting current PPQ needs, is adequately positioned to meet future needs, and provided recommendations for enhancements that will be the basis for CPHST strategic planning.
- Provided oversight on nearly 250 cooperative agreements with domestic and international researchers and organizations with a total value of nearly \$19 million (> 25% increase in agreement funds managed from FY13). This includes successfully obtaining and administering \$11.9 million in additional Farm Bill funding to expand CPHST’s ability to support PPQ programs.
- Completed the purchase and acquisition of a Laboratory Information Management System to improve sample diagnostic processing and documentation.
- Approved a transition to a new project management and tracking system utilizing an existing web-based platform (Salesforce) that will be completed in FY15. Project Information and Work Request tracking is also planned for implementation in early 2015 which will provide stakeholders the ability to request needed work and monitor the progress of key projects.

USDA 27: New Metrics (beginning FY 2014) on NIFA outcomes:

Efforts to develop procedures for requesting information from NIFA awardees are in progress. Information will be collected on: 1) number of new jobs created by a small business as the result of receiving SBIR grant funds; 2) increase in sales of technology or services developed by a small business as the result of receiving SBIR grant funds; and 3) sale to other businesses of licenses to technology developed by a small business as the result of receiving SBIR grant funds.

The data on the patents issued based upon Competitive NIFA Funding has been collected for FY2014 and is now being reported (see Table 1).

Table 1. Patents Issued in FY2014 based upon Competitive NIFA Funding.

Institution Name	Award Number	Patent Number	Issue Date	Invention Description
University of California	97-35304-4657, 98-35100-6150	8,704,044	4/22/2014	Nucleic Acids that Encode ERS1 from Maize and Their Uses
Louisiana State University	2007-35204-05420, 2009-35204-05200	8,877,211	11/4/2014	Bovine Herpes Virus Vaccine with Multiple Mutations
University of Missouri-Columbia	2006-34113-17139	8,692,064	4/8/2014	Quantitative Trait Loci Associated with Soybean Cyst Nematode Resistance and Methods of Their Use
University of Missouri-Columbia	2006-34113-17139	8,771,934	7/8/2014	Inorganic Pyrophosphate and Uses
University of Wisconsin-Madison	2001-35204-10184	8,535,685	9/17/2013	H3 Equine Influenza A Virus
University of Wisconsin-Madison	2001-35204-10184	8,697,089	4/15/2014	H3 Equine Influenza A Virus
University of Wisconsin-Madison	2001-35204-10184	8,784,838	7/22/2014	H3 Equine Influenza A Virus
University of Wisconsin-Madison	04-CRHF-0-6055, 2004-35204-14209, 2004-35605-14243	8,758,773	6/24/2014	Vaccine Candidates Against Johne's Disease
University of Wisconsin-Madison	05-CRHF-0-6055	8,569,574	10/29/2013	Mutations in the STAT5A Gene are Associated with Embryo Survival and Milk Composition in Cattle
University of Wisconsin-Madison	2006-35503-16998	8,734,878	5/27/2014	Method to Separate Lipids From Cheese Whey and Fat-Free Whey Protein Product Formed
University of Wisconsin-Madison	2006-35503-16998	8,771,772	7/8/2014	Method to Separate Lipids From Cheese Whey and Fat-Free Whey Protein Product

				Formed
University of Wisconsin-Madison	05-CRHF-0-6055	8,802,420	8/12/2014	Construction of Quadruple Enterotoxin-Deficient Mutant of Bacillus Thuringiensis
University of Wisconsin-Madison	09-CRHF-0-6055	8,871,494	10/28/2014	Over-Production of Secondary Metabolites by Over-Expression of The VEA Gene
University of Wisconsin-Madison	12-CRHF-0-6055	8,647,819	2/11/2014	Association of the Progesterone Receptor with Fertility
University of Wisconsin-Madison	09-CRHF-0-6055	8,790,875	7/29/2014	Methods and Compositions for Improved Federalization of Embryonic Survival
University of Wisconsin-Madison	11-CRHF-0-6055	8,834,704	9/16/2014	Electrochemical Detection of Beta-Lactoblobulin
University of Massachusetts	2005-35503-12296, 2005-35503-16164	8,603,566	12/10/2013	Enzymatically cross-linked biopolymer interfacial complexes for improved lipid particle stability

USDA 28: Partner with ARS and the Animal and Plant Health Inspection Service (APHIS) at USDA on the National Plant Diagnostic Network, and the National Animal Health Laboratory Network

There are two goals for NIFA in this area.

- 1) Develop competitive funding opportunities to include ARS scientists in the development of diagnostic assays and validation protocols that are needed to support APHIS regulatory surveillance efforts for foreign and emerging plant and animal diseases. In FY 2015 the Food Security RFA will promote this objective.
- 2) Coordinate APHIS regulatory and ARS research efforts with relevant components of the Cooperative Extension Service in order to better identify producer needs and the transfer of relevant technology. Plans for FY 2015 are still being developed.

USDA 29: ERS is making wider use of social media and new technologies (such as mobile phone applications) to widen and expand the reach of our information services to the general public.

ERS is implementing wider use of social media and new technologies (such as mobile phone applications and open data methodologies) to widen and expand the reach of our information services to the general public. ERS has been a leading innovator in support of the Administration’s Digital Strategy and Open Data initiatives, providing a wealth of products—including data and resources—designed to enhance delivery of information and services. In FY 2014, ERS used several new tools designed to help consumers more easily access critical programs and stimulate further innovation:

- **Responsive Design:** ERS has been working to optimize the website for mobile users, including developing a digital “eZine,” built with Responsive Design principles to automatically render on multiple devices/screen sizes, providing efficiencies in design/production (versus developing multiple style sheets for individual devices/platforms).

- **Web content APIs** (Application Programming Interface), offering digital professionals a machine-readable option for accessing publications, charts, and other website content. This allows external customers to integrate ERS information into their own website content.
- **APIs for select data and geospatial/mapping applications**, enabling researchers and developers to build applications using ERS data and process for additional insights.

The new products and tools extend and expand access to ERS research findings, market outlook, and data making the Agency's information more readily available to the general public. These items were a first among USDA (and many government agencies), enabling USDA to meet its 12-month Digital Government Strategy goals to ensure high-value services and systems are available anywhere, any time, and on any device. The work also supports the President's Management Agenda to improve efficiency, share data with entrepreneurs and businesses, and stimulate job growth.

USDA 30: ERS is exploring new methods for evaluating economic impacts of research collaboration and partnerships between public agricultural research institutions and the private sector.

ERS began in 2012 a multi-year project to develop metrics to quantify the impact of economic social science research and analysis, including measurements of impact of ERS research as evidenced by media citations, briefings for senior policy officials, citations of ERS research in the scientific literature, and customer use of information published on the ERS website.

USDA 31: Engage in consultation with the Agricultural Technology Innovation Partnership program (ATIP) to assist in establishing U.S. commercial partners with foreign entities.

***New Title:* Engage in consultation with the Agricultural Research Partnerships Network to assist in establishing U.S. commercial partners with foreign entities.**

The Agricultural Research Partnerships (ARP) Network succeeded the Agricultural Technology and Innovation Partnership (ATIP) Program as a primary structure for transfers and commercialization of USDA technologies. In 2014 FAS provided updated talking points to the ARS/Office of Technology Transfer to disseminate information about FAS to ARP Network members that were interested in establishing commercial partners with foreign entities. In addition, FAS continued direct consultations with the Center for Innovation (Arlington, TX) about concepts for potential collaboration on international capacity building for transfer and commercialization of USDA technologies.

USDA 32: Provide assistance to ATIP members and their U.S. business clients in finding export opportunities for goods and services arising from USDA innovations.

***New Title:* Provide assistance to ARP Network members and their U.S. business clients in finding export opportunities for goods and services arising from USDA innovations.**

As noted above, the ARP Network succeeded the ATIP Program as a primary structure for transfers and commercialization of USDA technologies. ARS scientists and two U.S. land-grant universities continued collaborating with FAS in a technical assistance project that showcases collaborative demonstration projects in Colombia and Panama to accelerate agricultural production and usage of biomass for clean energy. In addition, FAS and the Center for Innovation continued exploring opportunities to showcase and potentially transfer USDA innovations to East African partners to mutually benefit local food and agriculture systems in the region.

1. Agricultural Marketing Service (AMS)

<http://www.ams.usda.gov/AMSV1.0/>

1.1. Mission Statement

The mission of AMS is to facilitate the strategic marketing of agricultural products in domestic and international markets, while ensuring fair-trading practices, and promoting a competitive and efficient marketplace to the benefit of consumers of U.S. food and fiber products. This includes distributing market information, developing grade standards—many of which are used in the voluntary grading programs funded by user fees—protecting producers from unfair marketing practices, random testing of commodities for pesticide residues, granting intellectual property rights protection to new plant varieties, and oversight of industry funded programs to promote agricultural products and research.

1.2. Nature and Structure of Program

The Agricultural Marketing Service (AMS) is a service-oriented organization that provides a vast array of marketing services to the agricultural industry. Its mission is derived from 50 statutes aimed at facilitating the marketing of food and fiber commodities in domestic and international commerce, commodity grade standards, and voluntary certification and inspection programs and laboratory testing. The challenge for AMS is to adapt these programs to changing marketing practices and technological advances and be responsive to the grading, quality and health issues facing domestic agriculture. AMS does not have a research and development program in place to address these needs. However, AMS works with other Federal, State and local agencies, academia and food and fiber industry stakeholders in developing and testing innovative technologies that improve upon current marketing tools and services in a cost effective way. Both AMS commodity and support programs and our stakeholders have benefited from this association.

1.3. Current Technology Transfer Goals, Objectives, and Measures of Success (Metrics)

Although AMS does not have a formal technology transfer program in place, the agency does oversee the Plant Variety Protection Act (of 1970, and amended in 1994), which provides legal protection in the form of intellectual property rights to developers of new varieties of plants. The intent of the Act was to “encourage the development of novel varieties of sexually reproduced plants and tuber propagated plants and to make them available to the public, providing protection to those who discover, develop and/or breed new varieties, and thereby promoting progress in agriculture in the public interest.” In order to gain protection over their intellectual property, plant breeders must demonstrate that their new varieties are distinct from previously existing variety, uniform within each generation of reproduction, and stable across generations of reproduction. Once these standards have been met, plant breeders gain control over the marketing of their new variety (i.e., advertising, exportation, importation, and sales). The term of protection is 20 years for most crops and 25 years for trees, shrubs, and vines. This creates an incentive for investment in the development for new plant varieties. Thus, the PVP Act facilitates technology transfer by protecting the intellectual property rights of those individuals who discover, develop and/or breed new plant varieties.

The AMS’ Plant Variety Protection (PVP) Office has the responsibility for administering the program and is user-fee funded. Since 1970, PVP Office has issued more than 10,200 certificates of protection. The Office maintains crop databases for over 180 species including 70,000 commercial seed-reproduced varieties.

1.4. Strengthening Current Activities

The PVP Office interacts with several Federal agencies and international organizations. These relationships help to coordinate the application of Federal regulations related to the marketing of plant varieties. For example, applicants for PVP certificates are required to submit seed samples or tissue cultures to support and enable their applications. These samples are stored at the National Center for Germplasm Resources Preservation (NCGRP) in Ft. Collins, Colorado. The PVP Office regularly discusses issues of common concern with NCGRP staff. A Memorandum of Understanding, between the two programs, is updated on a regular basis. The samples deposited in support of applications are released to others after the term of protection ends. The deposit form and SOPs are currently being updated to ensure that the eventual distribution of the samples is unencumbered by other intellectual property rights or regulations related to genetically modified crops.

Seeds from outside the United States must be accompanied by a phytosanitary certificate. When they are shipped into the U.S., they must be shipped to USDA's Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ) office. Once the seeds or tissues pass quarantine, PPQ sends them directly to NCGRP. Plant varieties also need to have a variety name that is unique for marketing purposes. The Federal Seed Act, administered by the AMS' Livestock, Poultry and Seed (LPS) Program, Seed Regulatory and Testing Division oversees truth-in-labeling laws to protect consumers. Such laws cover variety naming and trueness-to-variety testing. The PVP Office uses the services of the LPS Program to determine if the variety names provided in PVP applications are acceptable.

The U.S. is a member of The International Union for the Protection of New Varieties of Plants, known by its French acronym UPOV. The UPOV treaty sets forth the principles of how intellectual property rights are granted to plants. These principles are then used to enact legislation in each member country, such as the PVP Act and the Plant Patent Act. Regular meetings with UPOV working groups and the governing council help to update treaty language and processes. As a member of this treaty organization, the PVP Office provides information about what plant varieties are seeking PVP protection. Recently, UPOV released an online version of this information so it is more quickly available to member countries. (Previously, this information was released on CD-ROMs bi-monthly.) UPOV is also leading the discussion about harmonization of forms, processes, and the sharing of varietal descriptive information. The PVP Office is actively involved in these discussions.

The office prepares annual reports for the World Intellectual Property Organization to track the effectiveness of this form of intellectual property protection. These reports detail the number and sources of new applications filed, and the numbers and sources of grants of protection. The most recent report was filed in March 2014.

1.5. Activities in FY2014

The PVP Office received a total of 523 applications, ranging from agronomic crops to flowers and vegetables, requesting PVP. The Office conducted searches on 818 applications to determine whether the plant constituted a new variety. On the basis of those searches, the program issued 1,060 certificates of protection. At the end of the fiscal year, 6,657 certificates were in force while protection expired for 44 different varieties. During the same period, the Seed Regulatory and Testing Division cleared 1,339 different variety names and tested 257 trueness-to-variety samples for 3 different kinds of seeds.

Also, the PVP Office continued its work in developing a virtual PVP application filing (ePVP) system by launching a beta version of the web-based software for testing. The project used the Agile software development technique, which is based on iterative and incremental development where requirements and solutions evolve through collaboration between the PVPO and vendor development teams.

When fully operational, the ePVP system will allow stakeholders the ability to file new plant variety applications electronically and provide PVPO examination staff the real-time tools that are necessary to conduct a complete review of the application (including varietal search in the Office database).

2. Animal and Plant Health Inspection Service

2.0. Combined Metric Tables

TABLE 1. Collaborative Relationships for Research and Development (R&D)

NR- not reported, data not available

APHIS-Wildlife Services (WS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• CRADAs, total active	5	4	4	8	9	9	9
- New, executed	1	2	1	5	3	3	1
▪ Amendments¹, total active	3	2	1	2	2	7	9
- New, executed	0	1	0	2	0	5	3
▪ Traditional CRADAs, total active	5	4	4	8	9	9	9
- New, executed	1	2	1	5	3	3	1
▪ Small Business Cooperators, total active	1	1	1	4	5	7	6
- New, executed	0	1	0	3	1	2	1
▪ Foreign Cooperators, total active	2	1	2	4	6	7	5
- New, executed	0	1	1	3	2	1	0
• Other Collaborative R&D Relationships	94	100	117	156	217	170	333
▪ Confidentiality Agreements³	4	6	11	33	38	48	59
- New, executed	1	2	17	16	10	9	9
▪ Material Transfer Agreements³	9	5	7	14	30	41	71
- New, executed	3	3	1	7	9	11	18
▪ Other Agreements², total active	81	89	99	109	149	81	203
- New, executed	43	47	54	69	76	72	107
• Publications	140	80	144	134	104	130	147
-Peer-Reviewed Scientific Publications	94	77	113	123	87	98	142
-Non-Indexed Publications	46	3	31	11	17	32	5
APHIS-Veterinary Services (VS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• CRADAs, total active	NR	NR	NR	NR	0	0	0
• Other Collaborative R&D Relationships	NR	NR	NR	NR	37	179	68
▪ Confidentiality Agreements	NR	NR	NR	NR	0	134	1
- New, executed	NR	NR	NR	NR	0	134	1
▪ Material Transfer Agreements	NR	NR	NR	NR	11	21	9
- New, executed	NR	NR	NR	NR	11	21	9
▪ Other Agreements², total active	NR	NR	NR	NR	26	24	58
- New, executed	NR	NR	NR	NR	7	3	23
• Publications	NR	NR	NR	NR	63	26	35

Annual Reporting on Technology Transfer in USDA, FY 2014

-Peer-Reviewed Scientific Publications	NR	NR	NR	NR	61	24	35
-Trade Journal Publications	NR	NR	NR	NR	2	2	0
APHIS-Plant Protection and Quarantine (PPQ)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• CRADAs, total active	NR	NR	NR	NR	NR	0	0
• Other Collaborative R&D Relationships	NR	NR	NR	NR	NR	198	381
▪ Confidentiality Agreements	NR	NR	NR	NR	NR	0	0
- New, executed	NR	NR	NR	NR	NR	0	0
▪ Material Transfer Agreements	NR	NR	NR	NR	NR	0	1
- New, executed	NR	NR	NR	NR	NR	0	1
▪ Other Agreements⁴, total active	NR	NR	NR	NR	NR	198	380
- New, executed	NR	NR	NR	NR	NR	99	147
• Publications	NR	NR	NR	NR	NR	31	68
-Peer-Reviewed Scientific Publications	NR	NR	NR	NR	NR	22	39
-Trade Journal Publications	NR	NR	NR	NR	NR	9	29

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

² Includes Trust Fund Agreements, Cooperative Service (Reimbursable) Agreements, Non-Funded Cooperative Agreements, and MOUs.

³ The number of Wildlife Services Confidentiality and Material Transfer Agreements increased significantly this year due to an adjustment in the way agreements with no specified end date were tracked.

⁴ This includes 241 cooperative agreements; 144 of total funded with Farm Bill funds and 11 of total funded with USDA HLB Multi-agency Coordination Initiative funds. This also includes 50 interagency agreements; 32 of total funded with Farm Bill funds.

TABLE 2. Invention Disclosures and Patenting

APHIS-Wildlife Services (WS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• New invention disclosures in FY	0	1	0	1	0	2	2
• Patent applications filed in FY, total	0	0	0	1	1	0	0
▪ Non-Provisional	0	0	1	0	1	0	0
▪ Provisional	0	0	0	0	0	0	0
• Patents issued in FY	0	0	1	0	1	1	1
▪ Life Sciences	0	0	1	0	0	0	1
▪ Chemical	0	0	0	0	0	0	0
▪ Mechanical & Measurement	0	0	0	0	1	1	0
APHIS-Veterinary Services (VS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• New invention disclosures in FY	0	0	0	0	0	0	1
• Patent applications filed in FY, total	0	0	0	0	0	0	0
▪ Non-Provisional	0	0	0	0	0	0	0
▪ Provisional	0	0	0	0	0	0	0
• Patents issued in FY	0	0	0	0	0	0	0
▪ Life Sciences	0	0	0	0	0	0	0
▪ Chemical	0	0	0	0	0	0	0
▪ Mechanical & Measurement	0	0	0	0	0	0	0

TABLE 3. Licensing: Profile of Active Licenses¹

APHIS-Wildlife Services (WS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• All licenses, total active in the FY ²	NR	1	1	1	1	1	1
▪ Patent licenses, total active in FY	NR	1	1	1	1	1	1

¹Totals include only those licenses that actually received royalty income.

²WS/NWRC has only one license

TABLE 4. Income Bearing Licenses¹

APHIS-Wildlife Services (WS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• All royalty bearing licenses ^{1,2}	1	1	1	1	1	1	1
▪ Patent licenses	1	1	1	1	1	1	1

¹Totals include only those licenses that actually received royalty income.

²WS/NWRC has only one license

TABLE 5. License Income

APHIS-Wildlife Services (WS)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
▪ Patent licenses							
• Total Earned Royalty Income (ERI) ¹	NR	\$500	\$1,339	\$432	\$0	\$0	\$0
▪ Patent licenses, total ERI	NR	\$500	\$1,339	\$432	\$0	\$0	\$0

¹WS/NWRC has only one license

TABLE 7. Disposition of License Income

APHIS-Wildlife Services (WS) ¹	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
• Income distributed, total	NR	\$500	\$1,339	\$432	\$0	\$0	\$0
- To Inventors	NR	\$500	\$1,339	\$432	\$0	\$0	\$0
▪ Patent licenses, total	NR	\$500	\$1,339	\$432	\$0	\$0	\$0
- To inventors	NR	\$500	\$1,339	\$432	\$0	\$0	\$0

¹WS/NWRC has only one license

2.1. WILDLIFE SERVICES

http://www.aphis.usda.gov/wildlife_damage/nwrc/

2.1.1. Mission Statement

The mission of USDA APHIS Wildlife Services (WS) is to provide Federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist. Wildlife is an important public resource greatly valued by the American people. However, wildlife is a dynamic and mobile resource that can damage agricultural and industrial resources, pose risks to human health and safety, and affect other natural resources. The WS program carries out the Federal responsibility for helping to solve problems that occur when human activity and wildlife are in conflict with one another. The WS program strives to develop and use wildlife damage management strategies that are biologically sound, environmentally safe, and socially acceptable.

2.1.2. Nature and Structure of Research Program

WS conducts program delivery through its Regional and State Offices and National Programs, providing high quality wildlife damage management services for its customers that result in the protection of agriculture, wildlife and other natural resources, property, and human health and safety. The National Wildlife Research Center (NWRC) is the research arm of Wildlife Services. WS NWRC is the only Federal Laboratory devoted to resolving problems caused by the interaction of wild animals and society.

WS NWRC is headquartered on the Foothills Research Campus of Colorado State University in Fort Collins, CO. The WS NWRC employs more than 150 scientists, technicians, and support personnel at its Fort Collins, CO, headquarters and at the 7 field stations located throughout the United States and Monell Chemical Senses Center in Philadelphia, PA. Approximately two-thirds of WS NWRC staff is located in Fort Collins. The remainder of the highly specialized staff is located in the other 8 locations throughout the United States, facilitating a unique ability to address regional wildlife damage management issues. Further, WS NWRC routinely conducts international consultations in this specialized area.

Scientists at WS NWRC apply a diverse array of expertise to the development of practical, biologically, environmentally, and socially sound methods to resolve these problems and to maintain the quality of the environment shared with wildlife. Scientific staff specializes in several disciplines, including animal behavior/psychology, chemistry, biology, ecology, zoology, economics, genetics, immunology, pharmacology/toxicology, physiology, wildlife biology, and wildlife disease. In addition, WS NWRC works with other experts who have additional specialties through cooperative ties with universities, not-for-profit research facilities, and other public and private research entities.

WS NWRC develops effective wildlife damage management methods through contributions in the following areas:

- Damage assessment
- Investigation of the biology and behavior of problem animals
- Evaluation of the impact of management practices on wildlife and the environment
- Development and improvement of existing management technologies
- Investigation of potential applications of new management technologies
- Support for registration of chemicals, drugs, and devices used to manage wildlife
- Transfer of scientific and technical information
- Provision of scientific guidelines on wildlife damage for use by regulatory agencies
- Development of cooperative research and training with other organizations
- Responsiveness to needs of user groups and the public

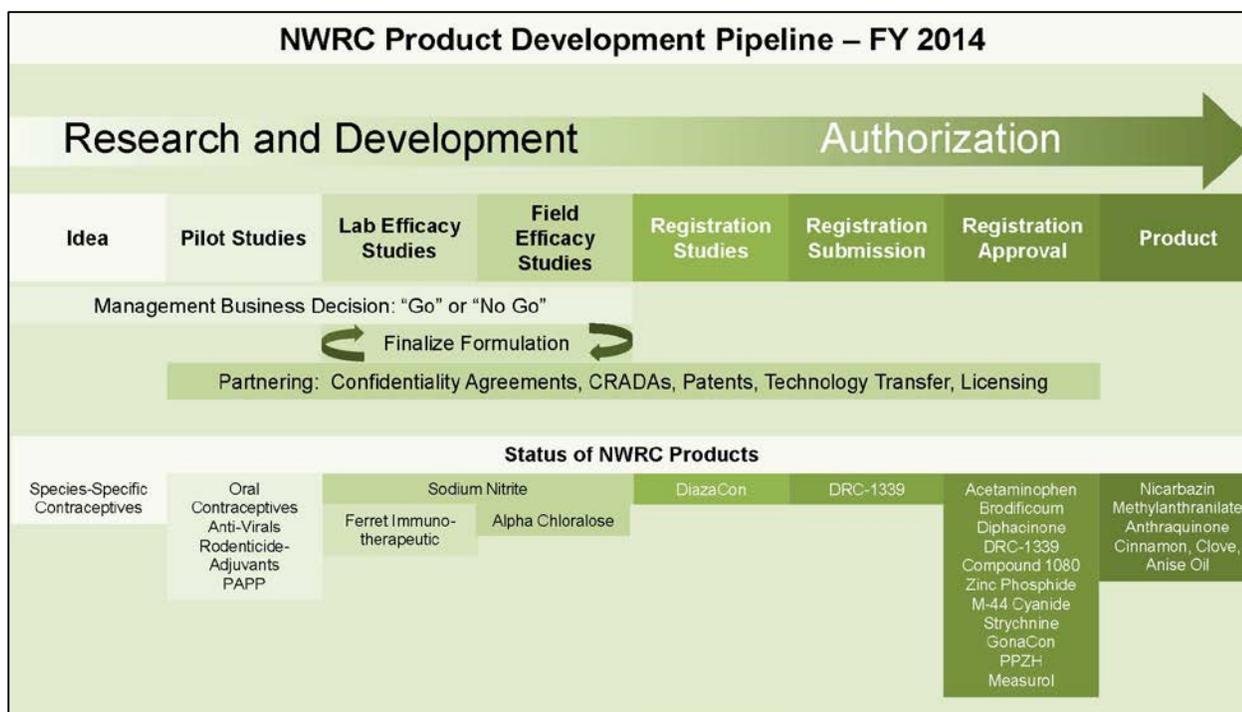
2.1.3. WS Technology Transfer Goals, Objectives, and Measures of Success

Scientists at WS NWRC produce methods, technology, and materials for reducing animal damage. Through the publication of results and the exchange of technical information, WS NWRC provides valuable data and expertise to the public and the scientific community, as well as to APHIS' WS program.

WS follows the general USDA definition of technology transfer as the adoption of research outcomes (i.e., solutions) for public benefit. Through public and private partnerships, WS NWRC research creates new or improved technologies, processes, products and services that benefit the nation by increasing productivity, increasing efficiency (keeping costs low), and enhancing global competitiveness for the U.S. agricultural sector. Technology transfer is critical to accelerating use of public research and methods development, creating economic activity, jobs, and sustaining economic development. WS uses formal instruments of technology transfer, including Confidentiality Agreements (CA), Material Transfer Agreements (MTA), and Cooperative Research and Development Agreements (CRADAs). In addition, WS transfers technology through patents and invention licenses for commercialization by the private sector. WS has an ongoing formal agreement with ARS Office of Technology Transfer (ARS OTT) to administer WS patents and licensing and to assist with the development CRADAs. WS NWRC's Manager of the Technology Transfer Program serves as the primary liaison for APHIS to the ARS OTT and patent review committee. In addition, the Manager prepares the APHIS contribution to the USDA Annual Report on Technology Transfer by providing ARS OTT with information on APHIS technology transfer activities and metrics, including tabular metrics of inventions, licenses, CAs, MTAs, CRADAs, as well as other notable "downstream outcomes."

In addition to patents and licenses, WS transfers knowledge and technology through many other formal and informal mechanisms. Primary among these methods for WS NWRC scientists is publication in peer-reviewed scientific journals. Other important mechanisms for transferring technology and knowledge include presentations at technical or professional conferences and publications in proceedings, technical assistance to the public or stakeholders, informal and formal exchange of information and products among colleagues, public outreach via factsheets, brochures, web pages and social media and laboratory open houses.

WS Operations and the NWRC have dedicated staff devoted to registration/authorization of products with regulatory agencies, including the Environmental Protection Agency, the Food and Drug Administration, and the USDA Center for Veterinary Medicine. When products are developed, they proceed through the research and development pipeline (see schematic below) and are registered with the appropriate regulatory agencies. Products with limited private market potential, but highly desirable to WS Operations, are produced and distributed by the WS Pocatello Supply Depot. Products with significant private market potential are licensed for sale to a private company. Efforts to increase the number of APHIS products licensed by private companies include patenting innovative technology, development of CRADAs, participating in regional technology transfer fairs, interacting directly with and national, state and local governments, universities, and industries, and enhancing training for WS NWRC scientists in technology transfer.



WS currently measures success of its technology transfer using several metrics. To measure the success with which WS NWRC scientists are partnering with collaborators, WS NWRC looks at the number of agreements established with collaborators. These include CAs, MTAs, and CRADAs established with partners. However, because many of our partnerships do not necessarily involve the transfer of intellectual property, WS NWRC also follows the number of other agreements established, including cooperative agreements, cooperative service agreements, and interagency agreements, all of which measure the degree of collaboration that WS NWRC has with universities, businesses, other federal government agencies, state and local governments, non-governmental organizations, and foreign governments and universities.

Cooperator funding is very important to WS and to WS NWRC in accomplishing their mission. Efforts are being made to increase the amount of cooperator funding generated. For example, cooperator funding at WS NWRC averages about 16% of the annual budget. Cooperator funding has steadily increased during the last 5 years, generating \$1.8 million in 2010, \$2.4 million in 2011, and \$2.4 million in 2012, \$2.7 million in 2013 and \$3.5 million in 2014. Agreements with federal cooperators account for approximately 58% of NWRC's annual incoming cooperator funding, while 42% is obtained through agreements with non-federal collaborators.

WS NWRC tracks its outreach and communication efforts through numbers of technical publications. WS NWRC has a full-time legislative and public affairs staff person, and is increasing its outreach efforts through press releases, stakeholder announcements, fact sheets, website postings, social media, facility tours, and workshops. One area we have begun to emphasize is outreach to the business community and communication to WS Operations and stakeholders regarding the economic value received for their research investment. WS NWRC also tracks the number of registrations (existing and new) that have been obtained with regulatory agencies. This is an indicator of new product development that has been provided for use by the public or by WS operational staff.

2.1.4. WS response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business

In the USDA's implementation plan for the Presidential Memorandum, WS described three initiatives to promote technology transfer response and commercialization.

USDA 20: Increase awareness in WS of technology transfer mechanisms, leading to increased pace of effective technology transfer and commercialization.

WS NWRC has traditionally been active in transferring technology and scientific information through use of outreach to collaborators, including WS operational personnel and through publications. Successful outcomes may include improved wildlife damage management practices, scientific information that enhances U.S. competitiveness by protecting crops and property, or increased awareness about wildlife diseases that threaten health of livestock or humans. Most of these outcomes do not require a patent and license for implementation. This initiative is designed to increase awareness among WS personnel about the importance of both formal and informal technology transfer.

In FY 2014, the Manager of WS NWRC's Technology Transfer Program provided one-on-one technology transfer trainings to six scientists, increasing the general knowledge and raising the awareness of scientists as to the power of partnerships, importance of developing intellectual property, and the array of technology transfer agreements available to facilitate their research. In addition, WS NWRC's Technology Transfer staff continued to reach out to WS Operations on technology transfer and intellectual property issues. WS Operations staff contacted WS NWRC's Technology Transfer Program for regulatory advice on two potential patents, one related to feral swine trapping and the other for regulatory review of a confidentiality agreement related to hunter take of feral swine.

WS continues to emphasize the importance of collaborative agreements with stakeholders to offset diminishing discretionary funding, while increasing relevance of research to stakeholders, such as the private sector. WS, as part of the annual report table, continues to track the number of agreements it maintains each year, including cooperative agreements, cooperative service agreements, MOUs, and interagency agreements. In addition, WS will track numbers of specific technology transfer agreements, including CAs, MTAs, and CRADAs. In FY 2014, WS NWRC maintained 9 active CRADAs. One new CRADA was signed in 2014. This CRADA is with SenesTech, Inc. (Flagstaff, AZ), and provides \$75,000 for laboratory testing of an oral contraceptive for rodents and further development of a liquid delivery system for using the product in the field. In addition, WS NWRC is currently partners in 59 CAs, 9 of which were new in FY 2014, and 71 MTAs, 18 of which were new in FY 2014.

USDA 21: Increase knowledge of WS and NWRC and their impact in preventing wildlife conflicts, leading to increased development of collaborative research and more effective use of public resources.

WS NWRC has committed to increasing the amount of information disseminated to the general public and stakeholders on research, collaborations and products provided by the Program. The WS NWRC works closely with APHIS public affairs staff in the preparation and dissemination of information on WS NWRC research and collaborations, as well as WS's role as the premier organization for managing human-wildlife conflicts.

As part of continued efforts to increase local and regional community awareness of the WS NWRC, in FY 2014, the Center hosted tours to more than 200 students, visiting scientists, business and agency partners, and USDA employees. It also partnered with representatives at Colorado State University and the Centers for Disease Control and Prevention to coordinate and host 4 seminars as part of the Foothills Infectious Diseases Seminar Series. Center representatives hosted booths at university career fairs to inform students of potential job

opportunities with the WS NWRC. Through the USDA's blog site, twitter site, and GovDelivery system, WS NWRC notified various stakeholders of research activities, accomplishments, and upcoming events. WS NWRC responded to approximately 100 media and community requests for information and published 10 brochures, factsheets, press releases and reports for the general public.

USDA 22: Increase the pace of WS technology transfer and commercialization activities.

To accomplish this objective, WS NWRC will increase its efforts to obtain partners for technologies ready to be commercialized by working with ARS and by utilizing the ATIP Program.

WS will continue maintaining existing products and registering new products with the Environmental Protection Agency and the Food and Drug Administration for use by WS personnel and the public. In FY 2014, APHIS WS maintained 15 Section 3 registrations with the Environmental Protection Agency and made 1 new pesticide registration application submission. A total of 26 Section 24c (Special Local Need) pesticide registrations were maintained and three new labels were obtained; 1 Experimental Use Permit was in place. In addition, APHIS WS maintained 2 Investigational New Animal Drug permits with the Food and Drug Administration.

2.1.5. Downstream Outcomes



Preventative Treatment for Adrenal Cortical Disease in Domestic Ferrets

Ferrets are the third most common pet in the United States. There are approximately 350,000 households in the U.S. with ferrets as pets. As with any domestic pet, owners and caretakers desire long and healthy lives for their pets. However, as a result of spaying and neutering, a large percentage of middle to old aged ferrets develops Adrenal Cortical Disease (ACD), eventually leading to cancer and early death. ACD is the leading cause of death among domestic ferrets. During the development efforts for GonaCon Immunocontraceptive Vaccine as a tool for managing fertility in wildlife species, U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Wildlife Services (WS) National Wildlife Research Center (NWRC) scientists began a collaboration with a prominent exotic animal veterinarian (Dr. Robert Wagner, University of Pittsburg), who was interested in investigating if GonaCon could be used as an immunotherapeutic to treat or prevent ACD in ferrets.

Surgical castration of ferrets causes an increase in reproductive hormone, which leads to ACD. GonaCon impacts the reproductive system by reducing the amount of reproductive hormones in treated animals. Through this research collaboration, it was shown that subcutaneous vaccination with GonaCon was not an effective treatment for spayed or neutered ferrets already exhibiting signs of ACD. However, GonaCon did perform well as a preventative treatment if vaccinations were administered prior to ferrets exhibiting signs of the disease. These

results lead to a patent application in 2012 and the US Patent and Trade Office (USPTO) accepting the efficacy claims in January of 2014. The patent is expected to be published in 2015.

While this particular patent and use of an NWRC product is not directly within the WS mission, it does provide significant benefit to WS, because once licensed and manufactured by a private company, WS will no longer need to manufacture GonaCon for wildlife uses. They will be able to purchase it directly from the private licensee. WS NWRC's Technology Transfer staff estimates this ferret product could generate the licensee between \$1 to 4 million in direct sales alone. This does not take into account the impacts on the secondary ferret market or the unquantifiable benefit to ferret owners. WS NWRC Technology Transfer staff has actively sought a licensee for this product and expects a license application in 2015.



Automated Bait Cartridge and Delivery System for Controlling Brown Treesnakes

The invasive brown treesnake (BTS) was introduced to Guam nearly seventy years ago, probably via post World War II cargo shipments. Since its introduction, the snake has colonized the entire island, at densities of up to 33 snakes per acre. These venomous snakes have caused the extinction of most of Guam's native birds, bats, and lizards; feed on young poultry and other small livestock; and threaten human health and safety. They also cause power outages throughout Guam, causing millions of dollars in structural damages and lost revenue.

Federal, state, and territorial governments are committed to preventing the dispersal of BTS from Guam and mitigating their day-to-day impacts on the island. The unintentional movement of snakes as a result of shipping or travel is a very real danger to all islands in the western Pacific basin and sections of the U.S. mainland. The economic costs of the potential BTS colonization to the Hawaiian Islands alone are estimated to be as high as \$2 billion annually.

To prevent the spread of BTS and reduce the snake's impacts on Guam, WS' program is partnered with the Government of Guam's Department of Agriculture, the U.S. Department of Defense Office of Insular Affairs, and the U.S. Fish and Wildlife Service (FWS). A variety of control tools and strategies are being employed, including the use of traps, fumigants, hand capture, snake-detector dogs, public education, and an oral toxicant. This toxicant, acetaminophen, was granted a registration by the U.S. Environmental Protection Agency (EPA) in 2003 based on research conducted by WS NWRC scientists. The toxicant is currently used in bait stations around ports, the airport, and other easily accessible areas of the island.

In 2009, WS NWRC and Applied Design Corporation (ADC) entered into a series of cooperative agreements to design a bait cartridge, an automated manufacturing system, and an aerial bait delivery system for the distribution of acetaminophen to BTS in remote and inaccessible areas on Guam. The NWRC provided information on BTS ecology and behavior, guidance regarding the Environmental Protection Agency's regulation of pesticides and early prototype concepts. Working together, WS NWRC scientists and experts at ADC were able to design a biodegradable bait cartridge and delivery system for aerially dispersing bait cartridges at any desired bait density.

In 2014, ADC and WS NWRC jointly filed for a U.S. patent for the bait cartridge and ADC plans to file two additional patents related to its automated bait delivery system and bait manufacturing process. ADC plans to commercialize this technology for use in wildlife damage management. This new technology provides for large-scale control of BTS populations on Guam, and invasive species management world-wide.

2.2. BIOTECHNOLOGY REGULATORY SERVICES (BRS)

<http://www.aphis.usda.gov/biotechnology/index.shtml>

2.2.1. Mission Statement

The mission of BRS is to protect and enhance U.S. agricultural and natural resources using a dynamic, science-based regulatory framework to ensure the safe importation, interstate movement, and environmental release of genetically engineered (GE) organisms.

2.2.2. Nature and Structure of Program

BRS does not perform research. BRS regulates the introduction (importation, interstate movement, and release into the environment) of GE organisms that may pose a risk to plant health. Researchers and product developers, Federal or private, should understand and work with the appropriate regulatory agencies that may have oversight of an organism at different stages in the development of a product. This can facilitate efficient development of the appropriate information necessary for regulatory review.

Since 2009, BRS has provided compliance assistance to the regulated community for the voluntary adoption of a Biotechnology Quality Management System (BQMS) Program. A BQMS serves as an important tool to help organizations involved in biotechnology research and development analyze the critical control points within their management system to better maintain compliance with USDA APHIS regulations for the import, interstate movement, and environmental release of regulated GE organisms (7 CFR part 340).

The BQMS Program integrates a dynamic, science-based approach of risk assessment and mitigation, allowing for sound decision making and effective management of the research and development of regulated GE organisms. The program integrates principles from other quality management systems, such as the Codex Alimentarius Hazard Analysis Critical Control Point System and ISO 9001:2008. The BQMS program offers to organizations a flexible approach to implementing a quality management system, where the BQMS is tailored to the organization's individual size and research scope. The BRS Office of Compliance Assistance provides participants with the tools and guidance needed to develop a BQMS through training, documented guidelines and one-on-one assistance. BRS provides an initial assessment of an organization's regulatory compliance processes and assists with periodic reviews and audits of the organization's BQMS. Twenty organizations, including public sector research institutions and multi-national corporations, have voluntarily established a BQMS within their organization through the services provided by BRS. These organizations share common goals of responsible research and facilitating regulatory compliance. Information on the APHIS BRS BQMS Program can be found at http://www.aphis.usda.gov/biotechnology/compliance_assistance_main.shtml

2.3. INTERNATIONAL SERVICES

http://www.aphis.usda.gov/international_safeguarding/index.shtml

2.3.1. Mission Statement

The International Services (IS) Mission is to advance the Agency's mission of protecting the health and value of U.S. plant and animal resources through its overseas programs and workforce.

2.3.2. Nature and Structure of Program

IS' presence abroad enables the Agency to monitor and respond to pest and disease threats, develop international strategies and partnerships to prevent their spread to the United States, and support U.S. agricultural trade through the resolution of technical barriers. Through its services, IS contributes directly to global food security by promoting safe global trade and facilitating the development of science-based regulatory systems around the world. IS works closely on an ongoing basis with its sister units, including VS, PPQ, BRS, WS and other headquarters staff to ensure that its day-to-day work overseas reflects the priorities of these domestic programs. This collaboration is key to IS' success and is achieved through joint planning, enhanced communications, clear direction to the field, and implementing coordinated strategies.

Consistent with the APHIS mission, IS' overall strategic goals are the following:

- IS Goal 1: Protect U.S. agricultural and natural resources by working with foreign governments to prevent the spread of high-risk plant pests and animal diseases.
- IS Goal 2: Facilitate the safe international movement of agricultural commodities, including those derived from modern biotechnology, through science-based regulations and internationally accepted standards.
- IS Goal 3: Enhance global health and U.S. biosecurity through the development of science-based regulatory systems and policies around the world.

IS supports APHIS Program Unit work overseas related to technology transfer through creating linkages and supporting partnerships, collaborations and cooperative programs.

While IS did not have any specific goals related to technology transfer, IS supports APHIS Program Unit work overseas related to technology transfer through creating linkages and supporting partnerships, collaborations and cooperative programs. For example, in the island of Hispanola, IS assisted in the continued study of swine field samples, which APHIS collected with the governments of Haiti and the Dominican Republic. This allowed IS to help set a multi-pronged strategy for the ongoing classical swine fever (CSF) eradication efforts and for controlling Teschen's Disease, a new swine disease to the island. In an experimental field trial, a commercial swine vaccine was used to improve the population's immune status, and an experimental autogenous Teschen's vaccine was produced in the US by APHIS for a field trial in Haiti and possibly in the Dominican Republic. IS also continued to assist with the efforts to install modern CSF laboratory diagnostics in both national veterinary laboratories.

2.4.1 PLANT PROTECTION AND QUARANTINE

http://www.aphis.usda.gov/plant_health/index.shtml

2.4.1. Mission Statement

We safeguard U.S. agriculture and natural resources against the entry, establishment, and spread of economically and environmentally significant pests and we facilitate the safe trade of agricultural products.

2.4.2 Nature and Structure of PPQ's Methods and Technology Development Program

PPQ's technology development is facilitated and implemented through cooperation between its 3 divisions; namely Policy Management (PM), Field Operations (FO), and Science and Technology (ST). CPHST is the main component of PPQ's Science and Technology core functional area, which also includes the National Clean Plant Network (NCPN). APHIS is one of three agencies of the USDA (along with ARS and NIFA) who, through a memorandum of understanding, support research, quarantine and outreach activities for the NCPN. The NCPN is "*a voluntary association of specialty crop networks that promote the use of pathogen-tested, healthy plant material for food crops in the United States*" (<http://nationalcleanplantnetwork.org/about/>).

The Center for Plant Health Science and Technology (CPHST) provides scientific and technical support for the regulatory decisions, policies, and operations of APHIS' Plant Protection and Quarantine (PPQ) program in order to safeguard U.S. agriculture and natural resources. CPHST is responsible for ensuring PPQ has the information, tools, and technology to make the most scientifically valid policy and regulatory decisions possible. CPHST is headquartered on the campus of North Carolina State University in Raleigh, North Carolina. The broader CPHST system however consists of approximately 200 scientists, analysts, and support staff at 7 principal laboratories, with satellite locations throughout the United States and in Guatemala. It also includes four programs and multiple work units. CPHST supports regulatory plant protection activities by developing methods and conducting analyses in the following program areas: AQI/Commodity Treatment Support, Trade Issues and Risk Analysis, Identification and Diagnostics, Pest Detection, and Pest Management.

CPHST activities are primarily focused on supporting PPQ needs, but also support stakeholders such as State plant regulatory programs and the agricultural and nursery industries. CPHST conducts its work with internal stakeholders but also engages other federal agencies (i.e. ARS, NIFA, Forest Service, DOE National Labs, DHS and EPA), academia, international institutions and industry to acquire knowledge, best management practices, products and protocols, and to develop methods and protocols needed for plant protection and management of invasive pests.

2.4.3 Current Technology Transfer Goals, Objectives, and Measures of Success

PPQ is committed to use of the best science, tools, and technologies to strengthen the efficiency and effectiveness of PPQ's work. PPQ transfers new methods and technology through several mechanisms. Technical documents, protocols, risk assessments and pest survey guidelines are distributed directly to stakeholders or are made available through PPQ websites. Another important mechanism to transfer information is through the publication of results in peer-reviewed scientific journals. Other important mechanisms for transferring technology and knowledge include presentations at technical or professional conferences, publications in proceedings, technical assistance to public or stakeholders and industry and public outreach events. The CPHST Identification Technology Program (ITP) provides digital pest identification tools that are available online (<http://idtools.org>) that are used by APHIS scientists as well as scientists in Customs and Border Protection, in state departments of agriculture, in domestic and international academic institutions and also by national and regional plant protection agencies to identify plant pests. CPHST also provides technical training to stakeholders in certain areas (i.e. diagnostic testing, pest risk assessment, treatments) and also provides information and training on quality

management and accreditation. For example, the CPHST Beltsville Lab provides hands-on training on newly developed molecular diagnostics for regulated plant diseases to state and academic diagnosticians and in FY 2014 conducted five training sessions for nearly 40 diagnosticians. The National Plant Protection Laboratory Accreditation Program (NPPLAP) accredits state and academic laboratories and certifies their staff to perform specific diagnostics through development and distribution of proficiency tests. The Pest Epidemiology and Risk Assessment Lab (PERAL) staff provides basic pest risk assessment training workshops for interested parties in the domestic and international plant health regulatory community.

Formal agreements, including cooperative and interagency agreements and memoranda of understanding are used to formalize collaborations with other government scientists, universities, private companies and other stakeholders. In FY2014, CPHST ended the year with 380 active agreements including 147 new agreements. The total includes 241 cooperative agreements, 144 of which are funded with Farm Bill funds and 11 of which are funded with USDA HLB Multi-agency Coordination Initiative funds. The total also includes 50 interagency agreements, 32 of which are funded with Farm Bill funds.

In FY 2014, PPQ entered into an interagency agreement with the ARS Office of Technology Transfer (ARS-OTT) along with VS and WS to execute formal technology transfer activities on our behalf of PPQ. ARS-OTT worked with the PPQ National Scientific Technologies Coordinator to provide three sessions of technology transfer agreements training to the CPHST management, CPHST principle investigators, staffs in the APHIS Financial Services Branch, PPQ Resources Management Planning Service and Wildlife Service. PPQ worked closely with the ARS-OTT to identify technology transfer opportunities and will continue to in FY2015 as CPHST reviews projects for additional technology transfer needs.

2.4.4 APHIS-PPQ response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

In the USDA's implementation plan for the Presidential Memorandum, APHIS-PPQ described four initiatives to promote technology transfer and commercialization. The initiatives and their implementation in FY 2014 are described below.

USDA 23: Enhance Collaboration Efforts in Pest Detection and Management

PPQ's scientific support focuses on improving and developing pest detection and management tools to discover new invasive species early and respond quickly, better identify and target offshore pest threats, develop diagnostic tools and techniques, and transfer technology to cooperators and impacted industries.

Goal 1. CPHST provided new diagnostic and pest detection methods to Ports of Entry.

- Piloted the CANARY detection assay and training plant inspection station staff to conduct the assay for *Ralstonia solanacearum* on Pelargonium interceptions at the Linden, New Jersey and Atlanta, Georgia Plant Inspection Stations. S&T worked with field staff to successfully conduct union negotiations for phase 2 studies in FY 2015, which will finalize data needed for an implementation plan.
- Assisting with pilot studies to identify insect thrips using DNA sequence data and DNA analysis methods to identify intercepted fungi in the genus *Colletotrichum* at plant inspection stations.
- Cooperating with Customs and Border Protection (CBP) to identify intercepted wood boring beetle larvae in solid wood packing material through rearing to adulthood and molecular tools.
- Provided critical support to Field Operations to implement a new risk-based sampling method for plant inspection stations that provides statistically supported guidance to port staff on sampling protocols.
- Revised guidelines for commodity import risk analyses that reduces the time required for analyses for improved efficiency, and provides more accurate assessment of pest risks.
- Delivered pest risk analysis training for PPQ, state, and international plant protection staff.

- Continued to work with the citrus industry and Master Gardeners in Texas to implement a biological control program for ACP in urban areas in south Texas with public support.
- Engaged and trained phytosanitary irradiation industry stakeholders to support the wider use of this method in agricultural trade and provide an alternative to methyl bromide fumigation. Working with U.S. phytosanitary irradiation facilities to validate their procedures, resulting in a letter of appreciation from Senator Cochran for work to allow port of entry irradiation at the Gateway America facility in MS.
- Worked with the International Atomic Energy Association to collaborate on research to remove artificial trade barriers to irradiated commodities.
- S&T scientists have provided ongoing scientific support since 2010 related to negotiations to export U.S. potatoes to Mexico. This has involved extensive discussion with the North American Plant Protection Organization and Mexico counterparts on phytosanitary issues. As a result of this work, in March 2014, Mexico published a new global potato regulation that allows U.S. tablestock potato exports to Mexico and APHIS published a final rule to allow the harmonized importation of tablestock potatoes from Mexico. Undersecretary Avalos visited Raleigh to personally express his appreciation to the scientific staff that contributed to this project.
- Examined solid wood packing materials to identify pests. Pest larvae cannot be identified with current tools in the ports of entry. To date, S&T analysis has identified 185 specimens, many of which are known to be damaging exotic pests, demonstrating that regulatory noncompliance is an issue in this pathway.
- Executed an interagency agreement with the Agricultural Research Service Office of Technology Transfer (OTT) to assist in PPQ technology transfer needs.

Goal 2. Strengthened PPQ's partnership with the Dept. of Homeland Security (DHS) by developing advanced technologies for pest detection and identification, commodity treatments, and decontamination and disposal.

- Completed phase 1 of a DHS/PPQ project funded by DHS to develop the requirements from PPQ and CBP for notional detection technology to detect plant pests. Delivered a report to DHS/PPQ on the joint initiative to assess promising pest detection technologies for potential deployment in port inspections. Other initiatives included risk analysis and potential ag-bioterror agents.
- Completed data analysis from a DHS/PPQ field trial of volatile organic compound detection devices to detect methyl bromide in fumigated wood. The most sensitive devices could detect and confirm methyl bromide treatment 5 months after fumigation.
- Initiated a DHS funded project to identify volatile compounds for wood boring beetles and khapra beetle that could assist CBP and PPQ in detection of beetles in cargo and passenger baggage. DHS committed \$200,000 for further detection tool development.
- Collaborated with DHS Depopulation, Decontamination, and Disposal team to evaluate technologies and demonstrating efficacy of alkaline digester and disinfectant treatments.
- Delivered online multi-media pest identification tools for scales and Lepidoptera (moth) larvae, and completing the beta version of *image ID*, a website containing over 31,000 pest images to aid in pest identification.
- Delivered an on-line, multi-media, identification tool (keys, images, fact sheets, glossary, illustrations, etc.) to pest scales (<http://idtools.org/id/scales/>).

Goal 3. Provided leadership on the Port Environs initiative to understand which ports of entry pose the highest risks.

- Established the Port Environs Working Group and established conceptual definitions of port environs.
- Analyzed top ports of entry by water, air, and other pathways, to assist in ranking the state by importance as a major port of entry.
- Conducted preliminary analysis of the port environs for Texas, with emphasis on the southern U.S. border.
- Analyzed U.S. state, county, and 10 kilometer grid cell ranking of likelihood of plant pest entry.

- Delivered final geospatial delineation of port environs for the U.S. These data will serve as the foundation for pest, pathway, commodity, and economic analyses to support resource allocation decisions.

Goal 4. Better identify and target offshore pest threats.

- Completed 21 pest risk assessments for potential commodity imports, including six for plants for planting (Q-37), a pest risk analysis for cotton treatments, and a revision and update of the pest risk assessment for lemons from Argentina based on publication of relevant research.
- Completed two high importance weed risk assessments for genetically modified corn and soybeans.
- Completed a very large and very complex pest risk assessment for citrus from China in a greatly shortened time frame of less than three months. This supported posting of a draft rule for approved access in FY 2014.
- Drafted guidelines for a new risk element, Likelihood of Survival and Reproduction at the Arrival Site which should strengthen risk assessments.
- Completed 38 export risk assessments including an assessment to expand market access of U.S. potatoes beyond a 26-kilometer border zone inside Mexico.
- Analyzed 40 new pests and pests of imminent threat under the New Pest Advisory Group (NPAG), and completed 23 full NPAG reports.
- Completed 20 reports on pests recommended for deregulation at ports of entry.
- CPHST supported the creation and implementation of PestLens, an innovative phytosanitary early-warning system that applies technology to enhance PPQ decision-making, provides a basis for organizational and process improvements, and increases efficiency of communications. *PestLens is a PPQ product that is the result of the merger of two previously existing PPQ systems—Exotic Pest Information Collection and Analysis (EPICA) and the Offshore Pest Information System (OPIS). PestLens embodies the principle of accountability: detailed performance metrics are available to all of PPQ through the PestLens web-system. The development of PestLens has been highly cost-effective (<https://pestlens.info/>). Several CPHST scientists technically support the development of PestLens products.*

USDA 24: Provide Timely Scientific and Technical Support for Emergency Response and Management

PPQ must develop and maintain a high level of expertise to support preparedness in the areas of science, technical support, and technology transfer for rapid response efforts.

- Developed two economic commodity models for orange and pear sectors to improve the estimation of pest impacts to support PPQ decision-making.
- The National Plant Protection Laboratory Accreditation Program continued to support a national network of labs that can conduct regulatory diagnostics. Provided quality management best practices guidance and diagnostic training to laboratory partners in the NIFA National Plant Diagnostics Network and to federal and state regulatory partners.

Goal 1. CPHST contributed to the long-term goal of eradicating European grapevine moth (EGVM) from California.

- Provided the technical information to complete an EGVM operational plan for eradication.
- Leading a technical working group to provide the scientific basis for trapping and mating disruption and pesticide control requirements for eradication and eventual deregulation. This work has contributed to the eradication of EGVM in Solano County, and portions of Napa and Sonoma Counties.
- Overseeing studies in Italy and Portugal to evaluate novel mating disruption formulations and characterize lure performance. This has led to improved ability to detect EGVM in areas under mating disruption control treatments.

- Collaborating with the Agricultural Research Service (ARS) to develop an effective phosphine fumigation treatment that will be an environmentally improved alternative to methyl bromide fumigation for imported grapes.
- Completing initial development of irradiation schedules for sterilizing EGVM and rearing methods for sterile insect technique control.
- Initiating work to evaluate controlled atmospheres and radiation as alternative regulatory treatments for EGVM.
- In addition to meeting the performance requirements, initiated a spatial analysis project to evaluate the effectiveness of the area-wide management program. Application of treatments, surveillance data, and regulatory actions along with pathway analysis, cropping patterns and climatic variables will be evaluated to determine the effectiveness of the area-wide program and to identify areas that may harbor residual populations or are at risk of reinvasion.

Goal 2. CPHST contributed to the long-term goal of preventing citrus greening disease (*huanglongbing*, HLB) from California.

- Transferring risk-based survey models developed with ARS collaboration to California. As a result, the CA Department of Food and Agriculture can focus limited resources for survey in areas of highest risk for HLB. Current Asian citrus psyllid trapping data is incorporated into the model to build increasingly accurate tools. In addition, ARS models for managing ACP populations are being deployed by APHIS in California to support area-wide management in the San Joaquin Valley.
- Reared and released over 756,000 biological control wasps (*Tamarixia radiata*) along the Texas/Mexico border to control the Asian citrus psyllid (ACP) which transmits the disease. Immature psyllids in south Texas have been reduced by 51.9%, with average parasitism rates of 54.9%. Immature psyllids in Mexico have been reduced by 36.1%, with average parasitism rates of 70.3%. Production goals were exceeded by 25%. The Texas Asian Citrus Psyllid-Huanglongbing Management Team, led by PPQ S&T, received an APHIS Administrator's Award for their contributions to control HLB in December 2013.
- Transferred bio-control in-field rearing methods to mass rearing personnel in Texas, Arizona, and California to allow cooperators and a private insectary to establish a robust greenhouse and field cage based rearing program. California produced over 1 million parasitoids in 2014 and a private insectary has established a new operation to support the bio-control program. The combined production by these mass-rearing operations will result in production of > 2 million parasitoids in 2015 to widely establish *T. radiata* across Southern California. Cooperators in Texas have released over 240,000, and in Arizona have released over 40,000 psyllids in FY 14 as a result of this work.
- Identifying spinosad compounds as an effective pesticide option for organic citrus growers. This treatment is compatible with bio-control agents if they are released at least a week after treatment.
- Developed a novel Hot-Spot Cluster Analysis that predicts areas which may contain an HLB infected plant based on the proximity of positive psyllid samples. This is helping to focus resources for HLB detection in the field.
- Developed two new diagnostic assays to improved molecular diagnostic tests for citrus greening that resolves and reduces the number of inconclusive results.
- Providing the scientific management and administrative processing for the Huanglongbing Multi-Agency Coordination Group that was established by the USDA Secretary in December 2013. The HLB-MAC is chaired by APHIS PPQ Policy Management with PPQ, ARS and other representatives to coordinate \$20 million for research projects to combat this disease by offering growers solutions in 1-2 years. S&T established a web-based project submission and review system to efficiently manage this work.

Goal 3. Provide scientific methods to the fruit fly program.

- Validating STATIC ® Spinosad Methyl Eugenol (ME), a safer and more effective eradication tool, for fruit fly eradication program use. This technology replaces a restricted use pesticide that requires stringent worker safety

protection.

- Delivered a systems approach for interstate movement of tomatoes from areas regulated for Medfly, and drafting the protocols for movement of cherries regulated for Oriental fruit fly and citrus regulated for Mexican fruit fly. These protocols reduce the regulatory burden on industry, but still allow for safe movement of commodities without spreading invasive fruit flies.
- Supporting fruit and vegetable imports/exports by conducting studies to develop generic cold and fumigation schedules for multiple fruit fly species. As a result, a proposed cold treatment for multiple fruit fly species in China citrus has been developed.
- Delivered a modified diet formulation that saves \$90-200,000 each year in Mexican fruit fly rearing costs and recommended remodeling changes to rearing facilities to improve rearing practices.
- Demonstrated that fruit fly bait stations provide effective protection from Mediterranean fruit fly infestation for up to 60 days and are equivalent to weekly treatments using bait sprays. Bait stations are organically approved and are now being tested for preventing Mexican fruit fly infestations in Texas. This method has the potential to be a cost effective and environmentally safe way to manage exotic fruit flies.
- Participate on the Food and Agriculture Organization Technical Panel for Phytosanitary Treatments which recommended adoption of three cold treatments for Tephritid fruit flies; one irradiation treatment for mealybugs; two fumigation treatments for insects and nematodes; one treatment using dielectric heating for wood products; and one vapor heat treatment for fruit flies.
- Delivered fruit fly host list references for Mediterranean fruit fly and guava fruit fly that are the basis for regulatory decisions in trade affected by exotic fruit flies.

USDA 25: Improve Communications between CPHST and its Customers to assure Market Relevance

CPHST aims to establish and maintain an effective dialogue with its customers to ensure development activities are useful and applicable to customer needs.

- S&T participated in 11 industry and public outreach events, 5 educational outreach events, led activities for students in APHIS' AgDiscovery program, and hosted an intern through the USDA Agricultural Ambassadors Program funded by the USDA Hispanic-Serving Institutions National Program.
- Provided scientific and technical expertise to support a Seed Health Summit with industry stakeholders, which will assist PPQ in developing future seed health program plans.
- Supported a major PPQ initiative to review the diverse portfolio of Agricultural Quarantine and Inspection (AQI) activities, which resulted in formation of an AQI board to manage these activities.
- Championed a cross-functional Treatment Programs Analysis Group that completed a report providing recommendations on treatment staffing, program changes, and management changes.
- PPQ participated in the four annual Regional Plant Board meetings and in the annual National Plant Board annual meeting. In FY2014 PPQ and the National Plant Board formed a strategic alignment to "*utilize our respective state and federal authorities, assets, and expertise to safeguard plant health and enable safe trade*". (<http://nationalplantboard.org/collaborative-documents/>)
- In FY2014 CPHST commissioned and completed a CPHST Laboratory Review that involved 136 in-depth interviews with CPHST staff and CPHST customers and stakeholders to obtain input on CPHST's functions and capacity to support PPQ needs, and determine areas where improvements may be needed.
- Established a monthly CPHST seminar series held by webinar to improve scientific connections between labs and is open to PPQ staffs to provide communication on projects.
- S&T subject matter experts represented PPQ and provided extensive technical expertise to International Plant Protection Convention and North American Plant Protection Organization technical panels. This work ensured that the U.S. put forward the best available scientific and technical expertise and information to guide the

development of international standards and help PPQ achieve its strategic objectives related to facilitating the safe expansion of trade.

- Participated in APHIS Commodity Sector Meetings to obtain industry stakeholder input on APHIS programs.

USDA 26: Improve the CPHST Work Plan Development and Project Prioritization Process to Assure High Quality Outcomes for Customers / Stakeholders

CPHST will continue to develop a process with PPQ operations to produce mutually acceptable work plans that ensure appropriate product quality.

- Delivered employee training and guidance to all project leaders managing cooperative agreements to ensure high quality work plans and knowledge of administrative requirements.
- Provided quality management training and guidance to PPQ staff and state cooperators.
- Commissioned and completed a CPHST Laboratory Review, conducted by APHIS' Policy and Program Development, Program Assessment and Accountability division, to review the CPHST network of laboratories and assess how well the organization is positioned to support PPQ's scientific and technical needs. This independent review concluded that CPHST is meeting current PPQ needs, is adequately positioned to meet future needs, and provided recommendations for enhancements that will be the basis for CPHST strategic planning.
- Provided oversight on nearly 250 cooperative agreements with domestic and international researchers and organizations with a total value of nearly \$19 million (> 25% increase in agreement funds managed from FY13). This includes successfully obtaining and administering \$11.9 million in additional Farm Bill funding to expand CPHST's ability to support PPQ programs.
- Completed the purchase and acquisition of a Laboratory Information Management System to improve sample diagnostic processing and documentation.
- Approved a transition to a new project management and tracking system utilizing an existing web-based platform (Salesforce) that will be completed in FY15. Project Information and Work Request tracking is also planned for implementation in early 2015 which will provide stakeholders the ability to request needed work and monitor the progress of key projects.

2.4.5 Downstream Outcomes



A new method for killing pests in solid wood packaging materials.

Solid wood packaging materials (SWPM) encompass a pathway by which serious wood pests can be moved from their native range to previously uninfested areas, where the lack of evolutionary history can leave trees highly susceptible. Examples of pests that have recently moved into the U.S. in SWPM include Asian longhorned beetle and emerald ash borer. In 2005 the U.S. adopted an international standard, ISPM-15, in an effort to block transport of pests in SWPM. The standard requires that wood is de-barked and disinfested, using either fumigation or heat, before being used in packaging materials in international trade. Initially, ISPM-15 specified only conventional heat treatments, but treatment using dielectric heating by microwaves was the first alternative accepted to ISPM-15 in 2013. Recently research conducted by the PPQ CPHST Otis Lab on Cape Cod and the Pennsylvania State University have added data to expand the dielectric spectrum with specific data on treatment within the wood profiles. Using radio-frequency (RF) waves has some logistical advantages over microwaves and why it has been added to ISPM-15 recently for use by the international community. The CPHST and Penn

State team are now engaging in research to scale up RF methods such as heating uniformity in bulk wood and dielectric schedules based on wood species. This is providing the information needed for commercialization of this technology and facilitate its adoption by the industry in FY2015.



An alternative and improved trap for emerald ash borer.

Emerald ash borer (EAB) is a metallic wood-boring beetle from Asia that was discovered in the Detroit, MI area in 2002. Since then, it has spread through much of the Midwest and East, killing nearly 100% of ash trees in areas where the pest has established. APHIS-PPQ and state cooperators have been tracking the distribution of EAB to allow them to regulate movement of wood materials that may contain the pest and also to identify optimal sites for releasing biological control organisms (parasitic wasps) that attack EAB. The past few years, purple sticky traps developed by the PPQ CPHST Otis Lab on Cape Cod, along with their collaborators, have been used for this purpose. A new trap (the green multi-funnel trap) was also developed by the Otis Lab using electrophysiological tests to determine the sensitivity of EAB eyes to different colors, along with field tests of color saturation, trap coatings (to make traps slick), trap size (number of funnels) and trap deployment strategies such as height and sun exposure. Compared to the old purple trap, the green trap catches more EAB, lasts longer (can re-used multiple years), and is easier to handle due to the lack of sticky surface. This trap is being made available to state cooperators as a second trap option for use in the 2015 EAB trapping season.



Biological control of Asian citrus psyllid, the vector of citrus greening disease.

The Asian citrus psyllid (ACP) has invaded citrus-growing areas in the US over the past decade and is a vector of a bacterium that causes citrus greening disease or Huanglongbing (HLB). A key component to a management program is aggressive control of ACP vector. *Tamarixia radiata* is a species specific ectoparasitoid of the ACP that was imported from Pakistan after satisfying APHIS PPQ permitting requirements for field release in Texas. In FY14, the PPQ CPHST Mission Lab developed the technology and mass produced over 468,000 *T. radiata* for the biological control of ACP, bringing cumulative total releases to over 1.2 million. Releases are made where plant tissue tests positive for HLB. Since these biological control releases began, we have seen ACP populations gradually decline by 50% in the urban environment. The insects produced also serve as inoculum to “seed” field insectary cages. This novel single field insectary cage concept has been found to produce an average of 12,000 parasitoids per tree. In FY14, over 20 field insectary cages were installed that have produced an additional 240,000 beneficial insects for south Texas bringing the cumulative released total to over 555,000 using the field insectary cage approach. The field insectary cage technique has been transferred to researchers at the University of Florida, Immokalee, FL and to the Puerto Rico Department of Agriculture for implementation. Most recently the field insectary cage technique is being deployed in collaborative efforts with the University of California, Riverside, the California Department of Food and Agriculture, the Citrus Research Board, Cal Poly Pomona, and the California citrus industry as a novel approach to enhance biological control efforts.



Pathway analysis tool improves the source estimation for medfly.

The Mediterranean fruit fly, *Ceratitidis capitata* (Weidemann), is a tephritid fruit fly that is considered one of the most serious pests of agriculture. Native to Sub-Saharan Africa, it has successfully invaded areas worldwide. Occasional infestations in California and Florida by this fly at times have required intensive trapping and implementing costly integrated pest management efforts. Knowing the source of these infestations is important and helps PPQ and state agencies minimize future occurrences. The existing diagnostic methods using DNA to determine fruit fly origin while informative, generally resolve origin only to the regional-level. The Medfly Molecular Tool (MMT), developed at the USDA PPQ Lab in Mission, TX provides improved resolution to below regional-level. This tool relies on nuclear and mitochondrial DNAs for revealing the source of introductions and was shown to be more informative as compared to existing DNA methods used for pathway analysis. Recently, the mitochondrial DNA methods from the MMT, including a sequencing database containing 210 reference sequences from collections gathered worldwide, were shared with California Department of Food and Agriculture in order to improve upon their diagnostic capacity and assist in the source estimation of this fly for California captures.



NORS-DUC: A unique research site dedicated to the study of pests and diseases affecting the health of ornamental plants. Recent steam sanitation protocols transferred to the field.

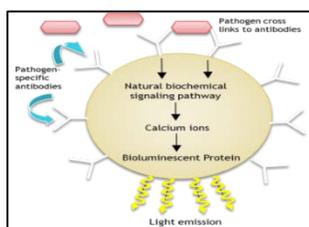
NORS-DUC, the National Ornamentals Research Site at Dominican University of California, is a secure, sophisticated and unique field nursery designed to contain quarantined pathogens for the purpose of conducting research in a safe “real world” environment that models an authentic nursery setting. Using 2008 and 2014 Farm Bill funds PPQ establish the facility in 2009 and Farm Bill funds continue to support its expenses through cooperative agreements administered by PPQ. The Executive Committee of NORS-DUC consists of a representative from PPQ and the National Plant Board to implement the activities and provide management decisions through interaction with the NORS-DUC Steering Committee with representatives from the nursery industry, forestry, regulatory and research community. The first research conducted at the site by national and international research scientists is focusing on understanding and controlling the long-range spread of *Phytophthora ramorum* through infested nursery stock shipments. NORS-DUC staff are responsible for: (1) conducting research on behalf of the participating U.S. research scientists on a daily basis; (2) optimizing diagnostic techniques for pathogen detection; (3) conducting on-site monitoring, surveying, and local, state and national educational outreach; (4) supporting facility research activities related to NORS-DUC Governance and Audit-Based Nursery Certification Programs; and (5) providing technology transfer successes to the nursery industry, regulatory agencies and interested parties. Recently, NORS-DUC scientists developed a steam sanitization treatment that was transferred to the field by providing outreach and training opportunities to nurserymen and State Departments of Agriculture in several western states. The treatment protocol was designed to use steam to sanitize substrates such as potting mix, mulch and soil to destroy plant pests such as *P. ramorum* and the Coconut Rhinoceros Beetle (CRB). They have demonstrated the success of this treatment by steaming nursery beds in infested Nurseries in California, Oregon and Washington State. Most recently, NORS-DUC

personnel went to Hawaii to assist in the CRB outbreak and mitigate future outbreaks by adapting the steam treatment to mulch piles infested with CRB and to transfer the technology to the Hawaii Department of Agriculture to implement the treatment.



The USDA *Huanglongbing* Multiagency Coordination Initiative focuses on near-term tools for the citrus industry.

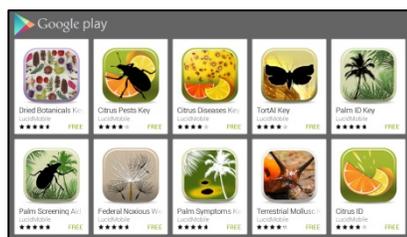
Huanglongbing (HLB, also called citrus greening) is one of the most serious citrus diseases in the world and poses a real and growing threat to citrus production in the United States, with citrus revenue in Florida down \$4.4 billion due to HLB. In December 2013, USDA Secretary Vilsack established the HLB Multiagency Coordination (HLB MAC) framework in response to the citrus industry's request for more urgency and greater coordination in the response to HLB. An important focus of the HLB MAC Group, composed of federal, state and industry representatives, is coordinating Federal research with industry efforts in order to fill gaps, reduce duplication, and speed progress to more quickly provide practical tools and solutions for the citrus industry to use in combatting HLB. Toward that end, the Group quickly provided more than \$5 M from the \$21 M budget for shovel-ready projects identified in conjunction with stakeholders including scaled up biological control production and release, field tests of several promising antimicrobials, and establishment of a demonstration grove in Florida illustrating the importance of inoculum reduction combined with best management practices. The Group also established the Stakeholder Suggestion process to cast a wide net for suggestions from industry, academia, and State and Federal researchers. The more than 50 submissions were scored by reviewers for timeliness of positive impact; utility to industry; technical merit/likelihood of success; scalability; budget suitability; and adaptability of the methodology/technology. Nearly 20 of the more than 50 Suggestions that met those criteria will be supported through cooperative agreements and include promising early detection technologies, encouraging field ready methods to treat and sustainably produce citrus in the face of HLB, and new ways to manage the insect that transmits the disease. Through this interagency coordination and collaboration, the HLB MAC initiative is providing practical, near term tools and solutions to the citrus industry across the U.S.



CANARY: A technology platform with field applications moving to commercialization for detection of plant pathogens.

Development and use of field deployable systems that are underpinned with sophisticated science but are simple to use, ruggedized for dirty environments, and are sensitive and rapid are what is needed for detection of plant pests at points of inspection. In the late 90s, the Massachusetts Institute of Technology (MIT), Lincoln Laboratory developed a unique biosensor that combined speed and sensitivity through the use of B lymphocytes or B cells. The B cell lines were engineered to express aequorin, a calcium sensitive bioluminescent protein from jellyfish, and express membrane-bound antibodies specific for pathogens of interest. When two antibodies are bound by the appropriate pathogen calcium concentrations within the B cell increases in seconds causing the aequorin to emit light that can be measured. One type of B cell biosensor is called CANARY (acronym selected by MIT representing Cellular Analysis and Notification of Antigen Risks and Yields). PPQ CPHST has collaborated with the MIT Lincoln Lab to develop CANARY cell lines for plant pathogens since 2004 and has produced and evaluated CANARY cell lines for *Ralstonia solanacearum*, fungi in the Genus *Phytophthora*,

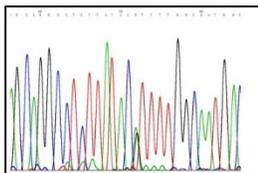
viruses in the Potyvirus family, Citrus Leprosis virus and *Xylella fastidiosa* citrus strain. The cell line for *Ralstonia solanacearum* (*Rs*) is the best characterized by MIT and the CPHST Beltsville Lab with sensitivity at the level of PCR. The *Rs* cell line (*Rs* CANARY) was just used in a pilot study by PPQ at the Atlanta and Linden Plant Inspection Stations (PIS) in FY 2014 to test for *Rs* in geranium cuttings from countries not in the APHIS pre-clearance program. *Rs* CANARY technology platform was met with enthusiasm and acceptance by the PPQ PIS employees due to its ease of use and rapid time-to-results. A pilot project in FY2015 will include the use of the *Phytophthora* CANARY line as an option to ELISA when screening for *P. ramorum*. MIT recently signed an exclusive license with PathSensors, Inc for agriculture targets. PathSensors also holds the license for CANARY for bio warfare agents and is working with PPQ and MIT to transfer the technology from the labs for commercialization in FY2015. PPQ is currently developing a material transfer research agreement with PathSensors (with assistance from ARS-OTT) to facilitate transfer of the *Rs* CANARY and additional plant pathogen CANARY biosensors and protocols to PathSensors.



App and web-based identification tools for plant protection.

Rapid and accurate identification of plant pests is an essential component of our nation's agriculture safeguarding effort. The APHIS PPQ Identification Technology Program (ITP) team in Fort Collins, Colorado develops digital technology products to detect and identify invasive insects, mites, snails and slugs, diseases, and weeds ("pests") to support PPQ's prevention efforts. ITP advanced its mission on several fronts during FY2014 by releasing its first apps ([ITP iOS Apps](#), [ITP Android Apps](#)), which are mobile versions of the Lucid keys from ten of its existing tools. Lucid Mobile apps exploit the use of mobile devices and represent a major step in supporting PPQ and PPQ's off-shore, port, and state partners longstanding need for field-based products for pest screening and identification. In another "first," ITP delivered a tool specifically designed for use by PPQ port Identifiers based on a group of pests frequently seen. The tool, [LepIntercept](#), provides customized identification support for Lepidoptera larvae, the life stage most often encountered at ports-of-entry for moths and butterflies. *LepIntercept* is similar in design and format to ITP's other 34 web-based tools (<http://idtools.org>); the website offers species fact sheets, an image gallery, a glossary, and a Lucid key. ITP uses Lucid software for developing identification keys within their tools for two reasons: 1) the software excels at capturing expert knowledge into digital format and 2) the deployed interactive, matrix-based key is becoming the format of choice by students to experts when identifying unknown biological specimens. ITP released three tool updates during FY2014: [Hispinines of the World](#) now has fact sheets for all genera and a detailed, illustrated description of the entire hispine beetle group; the second phase of [Longicorn ID](#) adding to its coverage of the longhorn beetle family with a Lucid key to its 82 tribes and photographs of 568 exemplar species; and the four tools in ITP's classic scale resource (first released in 2007) were enhanced and combined into a single, easily navigable, streamlined, and attractive package as [Scale Insects, Edition 2](#). ITP's products continue to diversify and broaden in number and scope and the FY2014 usage analytics showed a significant increase in the use of these products, both globally and domestically. The metrics showed that the ITP's [Image Database](#) node had over 1 million image views in FY2014 representing a 22% increase from the previous year. This increase came from expanded usage by universities, extension services, and state departments of agriculture. Finally, in FY2014, the ITP team continued its collaboration with the PPQ Beltsville, MD Lab on the development of the resource "Online Identification Tools of *Phytophthora*". Planned for release in 2015, this digital resource, which will include a Lucid key, tabular key, and sequencing analysis, will offer plant regulatory groups scientifically-robust identification and diagnostics tools for this taxonomically complex and economically important genus. (note: *Mobile versions of ITP's keys can be used by PPQ and its partners for screening and identification in the field or any non-office setting. These ten Lucid Mobile Android*

apps are freely available at the Google Play Store (search on "USDA APHIS ITP"). The iOS versions are available for download from the iTunes App Store.)



Revision of the taxonomy of *Phytophthora* and the development of on-line identification tools.

The plant pathogenic fungal genus *Phytophthora* contains 142 species, many of which cause significant damage to crops, ornamental plants, and forests. Many species are considered of regulatory concern globally, including 29 species exotic to the USA that were hierarchically ranked by USDA APHIS in 2009. Approximately 200-600 additional species could be described in the future. Although considerable progress has been made in understanding evolutionary relationships, identification, and diagnostics in the last 10 years, this work is still challenging due to omissions of the most important specimens (type specimens) in taxonomic publications, numerous misidentifications submitted to online genetic resources, and a lack of knowledge of the rules for taxonomy. Therefore, there is an urgent need for the revision of the taxonomy of this genus. The PPQ CPHST Laboratory in Beltsville, MD is pioneering the “Revision of the Taxonomy of *Phytophthora*” and the implementation of the “Online Identification Tools of *Phytophthora*: Lucid Key, Tabular Key and Sequencing Analysis” based on the type specimens to provide information for the correct identification of species and solid tools for the development, evaluation, and validation of robust diagnostic systems for *Phytophthora* species of concern. The laboratory is implementing the online resource and a database of complete, high-quality reference DNA (signature) sequences of the most informative genes and a system for identification that will be linked to the [Phytophthora Database \(PD\)](#). These tools have been developed through collaboration with international experts at the PD (Pennsylvania State Univ.); the [World Phytophthora Collection](#) (University of CA, Riverside); the [Centre of Phytophthora](#) (University of Murdoch in Australia); [Q-Bank Phytophthora](#) (CBS-The Netherlands), and other institutions. The revision of the Taxonomy of *Phytophthora* and the Online Identification Tools to *Phytophthora*, expected to be published during 2015, will improve the systems of identification and diagnostics in the Genus, and will facilitate international trade.



Building molecular diagnostic capacity for regulated plant pathogens.

Accurate and rapid detection and identification of regulated plant pathogens is of paramount importance to APHIS PPQ for making timely and effective regulatory decisions. This requires the existence of a laboratory network with capacity and capabilities to produce accurate diagnostic results for the regulatory programs or in the case of a pest outbreak on national scale. The PPQ CPHST Lab in Beltsville, MD contributes to enhanced preparedness and improved molecular testing capabilities by administrating the Proficiency Testing (PT) Program for the PPQ National Plant Pathogen Accreditation Program (NPPLAP) and providing hands-on training to the USDA NIFA National Plant Diagnostic Network (NPDN) and State Department of Agriculture plant pathology laboratories. Validated PT panels for three high consequence plant pathogens are produced and distributed to participating laboratories annually. In FY 2014 forty-three diagnosticians in 15 laboratories nationwide have been certified for screening or confirmatory diagnosis of citrus greening, thirty-three diagnosticians in 14 labs for *P. ramorum* and seventeen diagnosticians in 9 labs for plum pox virus. These laboratories provide screening molecular testing for the PPQ run programs that result in faster sample turnaround time. In 2014, the Beltsville Laboratory scientists provided hands-on laboratory training for molecular diagnostics of regulated plant pathogens to thirty five diagnosticians from NPDN and State laboratories who attended five training sessions.

Seven diagnosticians were trained for citrus greening screening molecular testing, ten for *P. ramorum* (and *P. kernoviae*) four for potato wart and three for other citrus pathogens. Eleven participants received training on using bioinformatics tools for sequence analysis for diagnostic purposes.



The System for True, Accurate and Reliable Diagnostics (STAR-D) brings quality management to U.S. diagnostic labs.

PPQ has been a driver in promoting improved quality assurance of plant pathogen diagnostic screening and rigorous quality control of regulatory sample test results that significantly impact agricultural commerce and trade. Development of laboratory Quality Management systems for use in plant diagnostic testing by PPQ is a major technology transfer initiative. CPHST has successfully established quality management components from available expertise within CPHST and APHIS Veterinary Services, as well as the American Association of Veterinary Laboratory Diagnostics and the International Organization of Standards ISO/IEC 17025:2005. The CPHST Quality Manager and the National Plant Protection Laboratory Accreditation Program (NPPLAP, the program that provides quality assurance of plant molecular diagnostic tests for PPQ), have been integral contributors. These activities have resulted in an accreditation program developed through collaboration with the National Plant Diagnostic Network (NPDN). This new accreditation standard is called the System for True, Accurate and Reliable Diagnostics (STAR-D) and is designed specifically for plant pathogen molecular diagnostics laboratories and ensures technologies transferred by PPQ maintain a high level of confidence in regulatory testing through specific quality control and quality assurance processes. Plant pest detection capacity, laboratory expertise, and technology capabilities have been enhanced by application of the STAR-D standard that focus on continual improvement, customer relationship building, test monitoring, and controlled improvement to developed technologies. Milestones for implementation of STAR-D were met through coordination with PPQ CPHST experts by facilitating ISO/IEC 17025:2005 training, providing expertise on developing NPDN laboratory audits and collaborating with the APHIS VS NAHLN to provide AAFLD standard training to STAR-D participating laboratories. Utilizing the STAR-D standard provides increased confidence from stakeholders in NPDN capacity for urgent regulatory test sample surges of high consequence organisms and has increased support for PPQ led initiatives that are driving accreditation implementation. Stakeholders have formed a review committee for STAR-D accreditation activities, and consistently reach out for further training in quality management best practices which are indicators of broad based support for these initiatives. As a result of all the activities outlined here, a large network of diagnosticians and diagnostic facilities in the U.S. are accredited to conduct critical testing for significant regulatory pathogens of PPQ interest using a standard that harmonizes use of diagnostic methods between the participating network labs.

2.5. VETERINARY SERVICES (VS)

http://www.aphis.usda.gov/animal_health/index.shtml

2.5.1. Mission Statement

As the recognized animal health leader and trusted partner, Veterinary Services safeguards the health of animals, people, and the environment. VS's authorities derive from the Animal Health Protection Act and the Virus Serum Toxin Act. VS integrates One Health principles with USDA business objectives by contributing leadership, expertise, infrastructure, networks, and systems to collaborate effectively with local, State, Tribal, national, and international partners. Its comprehensive and integrated on-farm surveillance activities provide VS the capability to achieve national goals for animal disease prevention, detection, and early response.

2.5.2. Nature and Structure of Program

In FY 2013, VS was organized into policy and permitting staffs, a field force, and three science centers, described below:

The National Veterinary Services Laboratories (NVSL)

The mission of NVSL is to safeguard U.S. animal health and contribute to public health by ensuring that timely and accurate diagnostic laboratory support is provided directly or by its coordination of the nationwide animal-health diagnostic system. NVSL accomplishes its mission through:

- Performing diagnostic laboratory testing for Veterinary Services' program diseases and for suspected outbreaks of foreign animal diseases;
- Serving as the U.S. national and international reference laboratory for animal disease diagnosis by providing unique veterinary diagnostic capabilities, providing other diagnostic laboratories with animal disease information, technical guidance, reagents and reference materials;
- Providing national leadership in coordination of the National Animal Health Laboratory Network (NAHLN) and emergency laboratory response by training State, University and foreign laboratory personnel, providing proficiency testing, and developing improved diagnostic technologies;
- Preparing for responding to animal health emergencies and emerging threats to animal agriculture including threats to the poultry and aquaculture industries by being able to conduct and/or support diagnostic testing in an outbreak environment.

Among other potential TT activities, NVSL develops and validates assays, and manufactures and distributes over 500 biological reagents to support veterinary diagnostics, many of which are not available from any other source.

Before a test is utilized by Veterinary Services for disease control or surveillance, it must be validated for that purpose. Samples for test validation for program diseases such as brucellosis and tuberculosis are in serum and tissue banks generated and maintained at the NVSL. These samples are made available to commercial kit manufacturers for their initial validation, and additional test validation is conducted at the NVSL before the results are submitted to the USAHA Scientific Advisory Committees. This is in addition to any testing for licensure required by the Center for Veterinary Biologics.

The NVSL is also involved in the development and validation of assays used to detect diseases that are foreign to the United States. Some of these assays are utilized in the reference laboratory as confirmatory tests, while others are deployed to the NAHLN laboratories and utilized in surveillance programs.

Identification, feasibility testing, development, optimization and validation of new assays and/or technologies are all accomplished within the NVSL. The NVSL staff collaborates with, and provides scientific advice to other Federal and State Government agencies that are also developing new assays and technologies, and NVSL scientists partner with other reference laboratories around the world to obtain diagnostic specimens from naturally infected animals. These collaborative efforts result in enhanced expertise at the NVSL and in reference collections that are available for assay development and validation.

Centers for Epidemiology and Animal Health (CEAH)

The mission of CEAH, with a view to the future, is to explore and analyze animal health and related agricultural issues to facilitate informed decision-making in government and industry. CEAH also partners with the World Organization of Animal Health (OIE) and its member countries to improve international disease surveillance capabilities and analytic methods supporting trade decisions. CEAH has a multidisciplinary staff that includes agricultural economists, spatial analysts, GIS and computer specialists, veterinary epidemiologists, technical writers/editors, and data managers.

CEAH collaborates with university partners on analysis methods and tools. In some cases the products produced are commercialized by the academic partners.

Center for Veterinary Biologics (CVB)

The mission of the CVB is to implement the provisions of the Virus-Serum-Toxin Act (VST) to assure that pure, safe, potent and effective veterinary biologics are available for the diagnosis, prevention, and treatment of animal diseases. This mission mandates the use of sound scientific technology to:

- Ensure that biologics are free of disease producing agents, especially foreign animal diseases
- Develop appropriate standards and procedures for product release
- Issue licenses and permits
- Monitor and inspect products and facilities
- Control field tests and release of veterinary biologics

CVB-developed methods and biological standards are applied equally to all products, but by the same token can be adopted whole by the regulated commercial manufacturers, becoming part of their manufacturing and release process.

2.5.3. Current Technology Transfer Goals, Objectives and Measures of Success

APHIS-VS transfers technology primarily to State animal health agencies, animal owners, and their associations. Recent examples have included:

1. Information technology - Development of and training on Mobile Information Management systems for recording animal health information in the field for incorporation not only with VS supported data bases but other industry databases as well – utilized by industry, state/federal animal health.
2. Animal disease surveillance - Development of and training in methodologies/software for outbreak surveillance (outbreak surveillance toolbox) – utilized by state/federal animal health
3. Geospatial analysis – Development of and training in a process to integrate spatial/geophysical features of the environment and county level land use policies to determine suitable sites for carcass disposal– utilized by industry, state/federal animal/public health.
4. Diagnostic assays – Training (courses and one-on-one) in diagnosis of high consequence diseases from foot and mouth disease to spring viremia of carp.

5. Diagnostic protocols and reagents – Protocols and reagents for assays and assay validation of Avian Influenza and Porcine Epidemic Diarrhea Viruses were provided to APHIS-equivalent laboratories in Mexico and the Dominican Republic.

3.0 Agricultural Research Service (ARS)

<http://www.ars.usda.gov>

3.1. Mission Statement

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provides 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 U.S. natural resources and the environment; and
- provide economic opportunities for rural citizens, communities, and society as a whole.

3.2. Nature and Structure of Research Program

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, (f) keeping costs down for consumers, and (g) supporting the growth and development of Rural America.

ARS employs approximately 2,100 scientists and post docs and approximately 6,000 support staff to conduct research in projects funded by Congressional appropriations at 90+ locations. Research projects are managed as 17 National Programs (Table 1). The Office of National Programs in Beltsville, MD plans the scope and objectives of Agency's research projects, while eight Area Directors implement research projects at the locations in their geographic areas.

Table 1. Research program management of ARS, showing 17 National Programs.

Animal Production & Protection	Natural Resources & Sustainable Ag Systems	Crop Production & Protection	Nutrition, Food Safety & Quality
Food Animal Production	Water Availability & Watershed Management	Plant Genetic Resources, Genomics & Genetic Improvement	Human Nutrition
Animal Health	Climate Change, Soils, and Emissions	Crop Production	Food Safety
Veterinary, Medical, & Urban Entomology	Pasture, Forage & Range Land Systems	Plant Diseases	Quality and Utilization of Agricultural Products
Aquaculture	Biorefining	Crop Protection & Quarantine	
	Agricultural & Industrial Byproduct		
	Agricultural System Competitiveness & Sustainability		

ARS conducts a series of reviews designed to ensure the relevance and quality of its research work and maintain the highest possible standards for its scientists. Customer input helps keep the research focused on the needs of the American food and agricultural system. Plans for each of the approximately 750 active research projects undergo a thorough independent external prospective peer review managed by the Office of Scientific Quality Review (OSQR). All ARS employees, including the scientific workforce, are subject to annual performance reviews, and all scientists and engineers have technology transfer as a performance element in their annual performance appraisal. Research scientists undergo a rigorous peer review (Research Position Evaluation System-RPES) on a 3 to 5-year cycle. These processes ensure the continuing high quality output of the ARS research addressing the needs of U.S. agriculture.

3.3. ARS Approach and Plans for Conducting Technology Transfer

Because of the delegations of authority by the Secretary, ARS's Office of Technology Transfer (OTT) is assigned the responsibility for obtaining patent protection for intellectual property (IP), developing strategic partnerships with outside organizations, licensing ARS technologies to the private sector and academia, and performing other activities that effectively transfer ARS research outcomes and technologies to the marketplace. USDA's Office of the General Counsel provides legal guidance to OTT in regard to intellectual property as needed.

The ARS technology transfer program has centralized policy and approval procedures that are managed by OTT. Research agreement negotiation and implementation is decentralized and managed by the ARS Area Offices. The Area Office Technology Transfer Staff serve as liaisons with scientists, ARS managers, OTT, university partners, and the private sector.

To facilitate technology transfer, OTT is organized into three sections. The *Administrative and Partnership Section* conducts day-to-day operations, coordinates technology transfer policy development, interacts with the Office of National Programs on agreement policy and review, and oversees the activities in the partnership, patenting, and licensing sections. This Section maintains strong stakeholder relationships at the local, regional, and national levels, ensuring the adoption of research results. This Section is also responsible for coordinating and managing both agreements and the Agricultural Research Partnerships (ARP) Network. The *Patenting Section* provides strategic guidance to scientists regarding patent protection for their research results. The Section is also responsible for receiving invention reports, convening three National Patent Committees (Mechanical and Measurement, Life Sciences, and Chemistry), preparing and prosecuting patent applications, and reviewing patent legal work performed by cooperator and ARS contract law firm. The *Licensing Section* manages invention licensing from all the intramural scientists in every USDA agency, including the review of license applications and the negotiation and monitoring of license agreements to assure compliance with agreement terms. This Section also collects and disburses license revenues, manages international patent filings, and provides expert advice on all matters related to USDA invention licensing.

Technology transfer is accomplished through many mechanisms, such as:

- developing written information for customers and stakeholders, including scientific publications, publications in trade journals, and reports to stakeholders;
- releasing plant germplasm to the public;
- transferring research materials to scientists outside of ARS;
- entering into formal partnership agreements, such as CRADAs, and other cooperative agreements;
- licensing IP (patents, Plant Variety Protections Certificates, and biological materials);
- participation in meetings with industry organizations and universities, workshops and field days; and distributing information to the public via the ARS Information Staff, the National Agricultural Library, and other sources.

Because the ARS mission is to transfer technologies for broad public use by the most effective mechanism, ARS pursues patents and licensing principally when they facilitate technology transfer to the marketplace. This is usually the case when complementary investment by the private sector is necessary to commercialize a product, and patent protection is required to protect this investment. By ARS policy, patents are not filed on inventions that are considered only research tools. The purpose of this policy is to encourage scientific research. In licensing practices, ARS continues to reserve the right to allow use of any IP protected technology for research purposes (non-commercial).

Meaningful performance metrics in technology transfer are often difficult for research agencies to formulate. ARS is continuing to work on defining better metrics for technology transfer within USDA. For example, for ARS, successful outcomes may include improved agricultural practices, scientific information that enhances U.S. competitiveness, increased awareness about pathogens to help prevent human and animal diseases, or findings that help corporations and universities make informed decisions in allocating their research resources. Many of these outcomes do not require patenting or subsequent licensing for implementation. Additionally, ARS uses its ARP Network to match technical expertise of ARS researchers with firms who can capitalize on the ARS research capacities, facilities and research outcomes.

Licensing policies also promote small business success with nominal licensing fees in the early years, but with annual maintenance fees and royalties that escalate in subsequent/future years, sometimes after the first commercial sales of the product. Terms of sublicensing by the exclusive licensee also incentivize small-businesses, in that the licensee retains a substantial percentage of all fees and royalties arising from the sublicenses. This policy further enhances commercialization by encouraging broadest utilization of a federal invention. ARS also incentivizes scientists on the reporting of inventions, patenting, and licensing by providing 25% of the license revenues to inventors (this is a higher percentage than that required by statute, $\geq 15\%$). Thus, there are policies in place that incentivize commercialization, minimize transaction costs, and yet provide fair and equitable compensation for those who create federal innovations. Development and expansion of the ARP Network further enhances opportunities for the outcomes of scientists to be adopted.

These are all parts of a robust and effective technology transfer program that consists of a variety of mechanisms and programs to complement the research conducted by the agencies.

3.4. Agricultural Research Partnerships (ARP) Network Programs

The ARP Network concept evolved from an earlier outreach model, Agricultural Technology Innovation Partnership (ATIP) Network, where the Office of Technology Transfer partnered with nine economic development entities to further enhance likelihood that ARS research outcomes would be adopted by the private sector for commercialization. Although replete with scientific expertise, the ARS research program does not have the resources or the authority to provide ARS commercial partners with business mentoring, marketing, manufacturing, and fiscal resources needed for the success of their businesses. Consequently, the Network was established to provide these complementary assets.

The Network was redesigned in FY2014 with a broader mission. The Network was renamed the Agricultural Research Partnerships (ARP) Network to distinguish it from both the ATIP Network and ATIP Foundation. The mission of the new ARP Network is to extend the impact of ARS research by supporting a sustainable and competitive agricultural economy. ARS research outcomes can provide economic and other opportunities for citizens, communities, and society as a whole. To further this mission, the ARP Network assists ARS in creating new partnerships and in supporting existing partnerships to advance ARS research and development and subsequent utilization, including commercialization. This expanded mission required a broader membership base. In FY 2014 the membership base was increased to include any organization interested in agriculture-based economic development. The ARP Network includes all players in an innovation ecosystem and has members

spanning the U.S. with a shared vision to grow and sustain a competitive agricultural economy. Members include ARS and stakeholders interested in agriculture-based economic development including, but not limited to rural agribusiness; urban, community and/or economic development groups; organizations that support farmers, growers and/or food processors; and capital programs for business attraction and acceleration. Membership in the ARP Network is formalized through Non-Funded Cooperative Agreements.

FY 2014 accomplishments:

- Recruited over thirty new ARP members who have close connections with companies, universities, agriculture associations and business resources within their regions and states. A list of ARP member can be found on the OTT website (<http://www.ars.usda.gov/business/Docs.htm?docid=24715>).
- Engaged in match making activities to connect businesses that have technology needs with ARS researchers and/or patented ARS technologies. These connections have resulted in both informal and formal partnerships (CRADAs) to further develop and commercialize technologies.
- Worked with ARP members (Innovate Mississippi, Montgomery County Department of Economic Development, and Center for Innovation), USDA Rural Development, and University Extension to organize listening sessions and forums in Mississippi on renewable energy and bioproducts, Oklahoma on the control of aflatoxin contamination in crops, and Maryland on crop production in plastic high-tunnels. The Maryland event was video-taped, edited into several modules, and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).
- Developed a series of webinars on ARS bioproducts, soybean and wheat research. These webinars were held in collaboration with an ARP member, namely the Center for Innovative Food Technology. The webinars were edited and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).

3.5. Agricultural Technology Innovation Partnership (ATIP) Foundation

The nine founding members of the old ATIP Network established the ATIP Foundation in 2011 to provide a unifying entity independent of ARS with the flexibility to engage other organizations that have a vested interest in seeing USDA research outcomes adopted by the private sector (<http://atipfoundation.com>). Foundation objectives are: (1) Expedite the transition of USDA technologies from USDA labs into the commercial sector; (2) Increase the use of agriculture technology discoveries that meet the needs of emerging markets (3) Seek funding to support the technology needs of the Agricultural industry and efforts to adopt and commercialize new technologies; (4) Develop industry access to utilize USDA research and research facilities; (5) Create sustainable communities by promoting regional innovation clusters, supported by USDA research outcomes; (6) Co-host regional events with USDA, showcasing technologies and facilitating adoption of research outcomes; and (7) provide for the development of skilled workers needed to sustain the growth of the industry.

The Foundation's interface with the USDA is through the USDA Liaison Committee (LC). The LC is an internal USDA committee and not a part of the Foundation. The LC serves three primary purposes: (1) to ensure the independence of USDA-ARS research activities; (2) maintain mission relevance; and (3) align the purpose of research and mission with the work of the ATIP Foundation. The USDA Liaison Committee will receive and the USDA Liaison Committee will review and approve internal USDA and external Foundation requests to fund USDA research to determine whether those requests fit the USDA mission and research priorities.

The ATIP Foundation established two Public-Private Partnerships with ARS: *Resilient Economic Agricultural Practices* and *Branded Food Products Database for Public Health Public-Private Partnership*.

Resilient Economic Agricultural Practices Public-Private Partnership

This project was initially funded through a federal grant and expired in FY2013. At the request of ARS, a new funding mechanism was established by the ATIP Foundation to ensure uninterrupted continuation of this project in data collection and development of guidelines and tools needed to assess long-term effects of food, animal feed, fiber, and biofuels production on soil health. The new public-private partnership capitalizes on federal scientific research on soil health through cost sharing with private sector firms and organizations that have an interest in continuation of this research. The following is a list of FY2014 accomplishments:

- At the Tri-Society (**American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America**) Annual Meeting in Tampa, FL, REAP scientists reported results of multi-location studies that included a 239 site-year yield dataset. In addition, a broad range of environmental issues (e.g., soil organic carbon, microbial communities, cover crops, etc.) related to corn stover management was discussed.
- The REAPnet database was developed which was closely aligned with the ARS Greenhouse Gas Reduction through Agricultural Carbon Enhancement Network (GRACEnet) database. The database application is a data discovery tool that provides site-specific projects information that, once peer-reviewed, will become publically available.
- Field data were used to develop and validate a Landscape Environmental Assessment Framework (LEAF) tool. This tool has been available to private sector investors in the bioenergy industry through a cell phone application, thus enabling producers to make in-field determinations regarding the general suitability of that location for corn stover harvest. A version of LEAF is also being used to guide on-the-go, site-specific single-pass corn grain and corn stover harvest as well as subsequent tillage operations.

Branded Food Products Database for Public Health Public-Private Partnership Accomplishments

In FY 2013, ARS, the ATIP Foundation, and the International Life Science Institute North America (ILSI North America) established a public-private partnership to enhance the public's health through increased knowledge of the nutritional content of the nation's food supply. This will be accomplished by obtaining comprehensive food composition data from the food industry and making it available to government, industry, the scientific community and the general public through an enhanced USDA National Nutrient Database, developed and maintained by the ARS Nutrient Data Laboratory in Beltsville, MD. FY2014 accomplishments:

- The public-private partnership convened three listening sessions in Cleveland, OH, Washington, DC, and Portland, WA to engage a broader group of stakeholders. One of the purposes of the listening sessions was to gather input regarding current and potential usage of the National Nutrient Database. Some of the current uses of the Database included early stages of product development; consumer education; developing enhanced 3rd party proprietary nutrition guidance software; evaluating competition; calculating nutrition values for recipes; and for clinician use to counsel patients. Comments also included a need for a one-source database with a robust search engine and downloadable data; data that reflects what people are truly eating; more current oils, trans fatty acid information; phytonutrients; date stamp to facilitate changes in products and diet over time; nutrients of public health concern; and descriptive information of ingredients declared on the label (Nutrient Facts Panel, Ingredient list and when provided Expanded Facts Panel Data). Further results of the listening sessions can be found on the ATIP Foundation website at <http://static.squarespace.com/static/5102f4bce4b091e9d61659f2/t/53ea32a0e4b04b3e2c7f3418/1407857312486/ATIP+Website+Report+on+Combined+Listening+Session+Discussion+Notes.pdf>

- A pilot project was instituted to test the proof-of-concept that food composition data could be delivered electronically from manufacturers via the GS1 data stream to the National Nutrient Database. Five manufacturers are participating in this pilot program and records on up to 500 foods are being delivered.

3.6. Technology Transfer Highlights

- Forty-three new CRADAs were executed and the scope of research was expanded through amending 72 active CRADAs. The current 214 active CRADAs are valued at more than \$117 million over the course of their life (up to 5 years) with more than \$23M in funds going directly to ARS researcher projects. Approximately 23% percent of the newly executed CRADAs were with small businesses. A new type of research agreement (Material Transfer Research Agreement, MTRA) was developed in FY2013 to fit the needs of specific research projects (refer to President Initiative USDA 13). The number of MTRAs has significantly increased in the last year from 86 to 105. While there has been a steady decrease in the number of CRADAs from 2012-2014, there has been a general increase in the number other types of collaborative research agreements (Trust Fund Cooperative Agreements, Reimbursable Agreements, Specific Cooperative Agreements and Non-Funded Cooperative Agreements) over the same period. In addition, the new MTRA is being used as a collaborative research agreement that in past would have been CRADA. Refer to Table 1 in Section 3.8 and figures 1, 2 and 3 in Section 3.12.
- One hundred and one invention disclosures were received, 83 of which were reviewed by the patent committees. One hundred and 10 patent applications were filed and 78 patents were issued by the U.S. Patent and Trademark Office (USPTO). Most of the issued patents in FY 2014 were in life sciences discipline. In FY 2015, funds will be available for on-site scientist training. Refer to Table 2 in Section 3.8 and Figures 4 and 6 in Section 3.12.
- The nature of the National Patent Review Committees discussion was changed to improve technology transfer. The discussion for the past year has focused on 7 questions: (1) How would a patent increase transferring the technology beyond what could be achieved through publication; (2) Is the invention of sufficient scope to justify patenting; (3) Would a patent on this invention be enforceable; (4) Would stakeholders support the patenting and licensing of this technology? Is there current commercial interest in the invention or a high probability of commercialization in the future; (5) Is the magnitude of the market relative to the costs of commercialization large enough to warrant a patent; (6) Is there any patents, pending patent applications, invention disclosures, or research that could impact the technology described in this invention disclosure; and (7) Is the invention ready to write as a patent application right now if approved by the committee? There are two possible outcomes of the discussion: (1) **Approval** (recommend patent application preparation and filing) or (2) **Suspension** (not enough or insufficient data available to make a recommendation; additional research data is required to draft a strong patent application; a partner is needed to reduce the invention to practice; or the technology can be transferred by means other than a patent).
- Judicious use of intellectual property rights (IPR) is an important cornerstone of the patent committees. IPR is used as an incentive for commercialization and full realization of the research impact of USDA technologies. The new structure the patent committee review should help in “judicious” patenting to increase the percentage of patents that are issued. While the year in which a patent issues is not the year in which the patent is filed, over time the ratio of the number of patent application filed over the number of patents issued does represent a trend of the percentage of patents that are issued. Refer to figure 5 in Section 3.12.
- Twenty-eight new licenses were executed. Of the new licenses agreements that were executed, 53% were with small businesses, 4% with start-up businesses, and 36% with universities. The number of income bearing licenses, as well as the earned royalty income, has steadily increased over the last five years. The percent of those licenses that were granted exclusively has basically remained constant at approximately 70%. Most of

the \$4,927,938 in earned royalty income (ERI) came from a few licenses, for the median ERI was \$3,232. In addition to the new licenses, 10 license amendments were executed. Refer to Tables 3, 4 and 5 in Section 3.8 Figure 7, 8 and 9 in Section 3.12.

- A Technology Transfer Process Working Group, with representatives from all the groups involved in the technology transfer process at ARS, was established to explore options for ensuring an effective technology transfer program. The Group started by dividing technology transfer into three strategies based upon how research outcomes would most likely be adopted: 1) require an exclusive license; 2) require a non-exclusive license; and 3) not require a license (public domain). Potential tactical plans for implementing each of these strategies were developed. The group proposed that at the early stages of implementing research projects the scientists, Office of National Programs (ONP) and OTT should select a potential technology transfer strategy. By determining the most effective technology transfer strategy, ARS can be proactive in developing an appropriate tactical plan for the adoption of the research results. In FY2015, a pilot program for implementing this new technology transfer paradigm will begin. In this pilot, OTT will coordinate the review of scientists' annual research progress reports (ARS form AD-421) in an effort to develop an appropriate technology transfer strategy and tactical plan. This new paradigm will align technology transfer with research objectives of the scientists early in the project cycle, strengthening the impact of our research outcomes.
- An SBIR-Technology Transfer Program, a new collaboration between the USDA's National Institute of Food and Agriculture (NIFA) Small Business Innovation Research Program (SBIR) and ARS, was established that encourages SBIR applicants to license ARS technologies and be considered for a SBIR grant. The relevant language in Section 5.1 of the SBIR Request for Application states: "Additional factors that will be considered in the review process include whether an application involves a CRADA with a USDA laboratory, or a license to a USDA technology, or is a resubmission. In the event that two or more applications are of approximately equal merit, the existence of a CRADA with a USDA laboratory or a license to a USDA technology will be an important consideration. If one application is a resubmission, this will also be an important consideration. A list of available technologies for licensing and CRADAs that may be considered as projects under the SBIR program can be found at the **USDA Office of Technology Transfer (OTT) website**. Each of these technologies would be appropriate for one of the topic areas in section 8.0 of this program solicitation. If an applicant is interested in proposing a research project that addresses one of these technologies, the applicant should contact the OTT office at 301-504-6905 or on the **OTT Website** to discuss the possibility of signing a license agreement and possibly also a CRADA agreement prior to submitting the proposal to the SBIR program."
- The OTT website was redesigned by dividing the site into pages on news, training, licensing, patenting, partnerships/agreements, available technologies, and reports. Each page was improved with more content and information. For example, the available technologies list was broken down into disciplines (animal health, bioenergy, crop production, crop protection, environment, food processing, plant genes, and new materials). Website: <http://www.ars.usda.gov/Business>
- ARS introduced its intranet site (Axon). OTT started developing a technology transfer page on Axon that will be more fully developed in FY2015. Website: <https://axon.ars.usda.gov/OTT/Pages/Home.aspx>
- As a means to encourage submission of invention disclosures and acknowledge the accomplishments of ARS inventors, on World Intellectual Property Day, a list of patent recipients and first time inventors was published. This list was also placed on Axon website.
- The international technology transfer communities in Uzbekistan, Brazil, Pakistan, Korea, China and Iraq through Department of Commerce programs such as CLDP and the USPTO reached out to OTT as experts to

help them develop technology transfer policies and strategies. In addition to workshops presented in the US, OTT professional staff visited Korea and Uzbekistan for more extensive training.

- OTT professional staff played a very active role in the Federal Laboratory Consortium both at the national and regional levels (e.g. coordinator of the Mid-Atlantic region, member of the national executive board, trainers, tech transfer award reviewers, and meeting speakers).
- OTT professional staff served as reviewers for USDA-SBIR grant proposals, several economic development entities grant proposals, and the USPTO Patents for Humanity nominations.
- OTT represented the Department for the White House Office of Science and Technology Policy's Lab-to-Market and Maker Faire Initiatives.

3.7. Response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business

In the USDA's implementation plan for the Presidential Memorandum, ARS described 13 initiatives to promote technology transfer and commercialization. These initiatives and their implementation are described below. The following initiatives were completed in FY 2013: USDA 1, USDA 8, USDA 9, and USDA 13.

USDA 1: New metrics proposed for standard annual reporting in addition to those required by Circular A-11 instructions on annual reporting of technology transfer

This initiative was completed in FY2013 and the new metrics are now a standard component of the metric tables.

USDA 2: Update Policy and Procedure (P&P) 141.2 "Technology Transfer in ARS"

An update is necessary to reflect statutory changes since 2000, and to reflect changes in structure and operation of the National Patent Committees, and to include licensing of biological materials and use of the ARP network. A Technology Transfer Process Working Group with representatives from the core functions involved in the technology transfer process was established. As a result of this group, changes were made in the invention disclosure review process, as well as the development of an outline for determining a strategic and tactic technology transfer plans for research projects. Based upon these changes, a new P&P is expected to be written in FY 2015.

USDA 3: Expand Agricultural Technology Innovation Partnership (ATIP) efforts to enhance access to complementary assets by USDA partners

***New Title:* Expand Agricultural Research Partnership (ARP) Network efforts to extend the impact of ARS research**

The ATIP Network was redesigned and renamed the Agricultural Research Partnerships (ARP) Network. The mission of the new ARP Network is to extend the impact of ARS research by supporting a sustainable and competitive agricultural economy. To further this mission, the ARP Network will assist ARS in creating new partnerships and in supporting existing partnerships to advance ARS research and development (R&D) and subsequent utilization, including commercialization. This expanded mission required a broader membership base. The membership base was increased to include any organization interested in agriculture-based economic development. The ARP Network includes all players in an innovation ecosystem and has members spanning the

U.S. with a shared vision to grow and sustain a competitive agricultural economy. Members include ARS and stakeholders interested in agriculture-based economic development such as, but not limited rural agribusiness; urban, community and/or economic development groups; organizations that support farmers, agritourism and/or food processors; and capital programs for business attraction and acceleration. Membership in the ARP Network is formalized through non-funded Trust agreements executed by the Office of Technology Transfer. There are currently 33 ARP Network members. We will continue to add members as appropriate.

USDA 4: Expand outreach efforts in technology transfer to scientists in ARS

OTT worked with Office of National Programs to connect ARS scientists' research capabilities and technologies with a number of different companies. This was done through the ARP Network, responding to public solicitations, responding to industry scouting, and through webinars conducted by Federal Laboratory Consortium. This outreach has resulted in several agreements as well as ongoing discussions between ARS and commercial partners in a number of areas.

ARS introduced its intranet site (Axon). OTT started developing a technology transfer page on Axon that will be more fully developed in FY2015. Scientist training materials, brochures, documents, and templates that are currently on the OTT website are being migrated to Axon.

OTT has begun the development of standard technology transfer training modules for ARS employees. To date two PowerPoint modules have been prepared ("Tech Transfer: Introduction" and "Tech Transfer: Agreements") and two are currently in preparation ("Tech Transfer: Patenting" and "Tech Transfer: Licensing"). In FY2015, voice will be added to the four modules. When completed the training modules will be upload to the ARS intranet site Axon and be made available on the USDA e-training program, AgLearn.

USDA 5: Encourage other S&T agencies to adopt OTT's approach to technology transfer

In the past, OTT has provided technology transfer services (policy advice, agreement review, patenting / licensing services, etc.) to the USDA-Animal and Plant Health Inspection Service (APHIS) Wildlife Services, USDA Forest Service (FS), Department of Interior's Bureau of Reclamation (BoR). In FY 2014, these services were expanded to include APHIS's Wildlife Services, Plant Protection and Quarantine, and Veterinary Services), as well as the FS's Forest Products Laboratory. In addition, the BoR agreement was modified to include the Department of Interior's (DoI) U.S. Fish and Wildlife Service.

USDA has a role in helping to develop Federal government technology transfer policy through OTT's active participation on the Interagency Working Group on Technology Transfer and the White House to Lab-to-Market Working Group. In FY2014, the Lab-to-Market Working group established cross agency goals (Developing Human Capital, Empowering Effective Collaborations, Opening R&D Assets, Fueling Small Business Innovation, and Evaluating Impact). OTT took the lead in developing the white paper Co-Funding and Philanthropic Partnerships under Empowering Effective Collaborations.

USDA 6: Explore expanded use of Enhanced Use Lease (EUL) authority as technology transfer tool to promote longer term relationships with key customer groups

Under the 2008 Farm Bill, the Secretary was given the authority to establish a pilot project at the Beltsville Agricultural Research Center (BARC) to lease non-excess property to any private or public entities. The EUL Project was used as a technology transfer tool designed to provide longer term public-private partnerships than can be done through existing technology transfer partnership instruments. The pilot authority was used to develop a process to identify underutilized laboratory resources that could be used by the private sector to commercialize ARS research outcomes. Prospective lessees needed to establish either a licensing partnership or research

collaboration with ARS. In exchange, EUL terms provide the lessee 20 years of use of the facility to develop its business. EUL authority proved to be a very successful strategy to leverage resources for entrepreneurial activities. USDA's first lessee (Plant Sensory Systems) was a small business that in FY 2013 was awarded a \$1.8 million ARPA-E grant (Better Biofuel Feedstock from Beets) based on the success of the research project conducted using BARC laboratory facilities. Access to these facilities was essential, because this small business did not have sufficient capital to build the facilities needed for this research project.

This pilot authority for BARC was reauthorized in 2014 Farm Bill. BARC is in the process of identifying new EUL opportunities.

USDA 7: Beginning in FY 2012 / 2013, roll out a nationwide series of regional forums to identify issues and deliver solutions

The goal of the regional forums is to provide technology-based solutions to regional agricultural problems for farmers and businesses. The fora use a multistep approach: (1) a series of regional listening sessions comprised of businessmen, farmers, economic development organizations, regulatory and extension personnel are held to identify a broad list of regional issues; (2) from the list of issues, those with an existing research-based solution, or a researchable issues that could be addressed by ARS, local universities, cooperative extension, state agencies or agricultural businesses are selected as potential topics for a forum; and (3) finally, a forum is convened as a roundtable discussion on the potential solution(s) and their implementation. Participants in the forum may include farmers, growers, agri-business professionals, university and ARS researchers, extension service personnel, rural development personnel, NIST Regional Manufacturing Extension Partnership (MEP) staff, funding and regulatory agency personnel, as well as ARS technology transfers professionals.

Collaborated with ARP members, USDA Rural Development, and University Extension to organize listening sessions and forums in:

- Mississippi on renewable energy and bioproducts;
- Oklahoma on the control of aflatoxin contamination in crops;
- Maryland on crop production in plastic high –tunnels. The Maryland event was video-taped, edited into several modules, and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).
- Ohio on bioproducts, soybean and wheat research. The sessions in Ohio were by webinar. The webinars were edited and placed on the OTT website (<http://www.ars.usda.gov/AboutUs/Docs.htm?docid=24945>).

In addition a technology showcase was held in Fresno, CA. The purpose of the Showcase was to advertise partnering opportunities for local businesses interested in commercializing broad-band water management technologies developed by ARS and Lawrence Livermore National Laboratory scientists. This Showcase was also part of the USDA Rural Development's (RD) *Strong Cities, Strong Communities* Fresno pilot project which is focused on increasing capacity for use of broad-band technologies to support and develop the rural economy. One of the outcomes of the Fresno Showcase was identifying the need for better water management technologies to address drought conditions within the California Central Valley. As a result, ARS and RD held a series of meetings and workshops with companies, economic development entities, venture capitols and others on water issues. One of the results of these meetings is the collaboration of the Santa Ana Watershed Project Authority, the USDA-Forest Service, RD and ARS to shift management of the forest-water shed towards the specific objective of increased water generation. The goal of the collaboration is to add the "third dimension" to forestry management (fire risk reduction, water generation, & bio-energy). Removal of trimmed woody biomass is a remaining challenge. An ARS patented technology on a new mobile fast pyrolysis system for converting brush into bio-oil will be used to address this remaining challenge.

USDA 8: Provide opportunities for applicants to the USDA Small Business Innovation Research (SBIR) program to partner with ARS scientists to further develop science necessary for business success

In FY2014, a new collaboration between the USDA's National Institute of Food and Agriculture (NIFA) Small Business Innovation Research Program (SBIR) and the USDA's Agricultural Research Service (ARS) was established that encouraged SBIR applicants to license ARS technologies and be considered for a SBIR grant. The relevant language in Section 5.1 of the "Request for Application" states: "Additional factors that will be considered in the review process include whether an application involves a CRADA with a USDA laboratory, or a license to a USDA technology, or is a resubmission. In the event that two or more applications are of approximately equal merit, the existence of a CRADA with a USDA laboratory or a license to a USDA technology will be an important consideration. If one application is a resubmission, this will also be an important consideration. A list of available technologies for licensing and CRADAs that may be considered as projects under the SBIR program can be found at the **USDA Office of Technology Transfer (OTT) website**. Each of these technologies would be appropriate for one of the topic areas in section 8.0 of this program solicitation. If an applicant is interested in proposing a research project that addresses one of these technologies, the applicant should contact the OTT office at 301-504-6905 or on the **OTT Website** to discuss the possibility of signing a licensing agreement and possibly also a CRADA agreement prior to submitting the proposal to the SBIR program."

USDA 9: Provide Cooperative Research and Development Agreement (CRADA) partners opportunity to link to local Manufacturing Extension Partnership (MEP) resources to assist in commercialization efforts

When appropriate, ARS CRADA partners are provided a contact in their regional National Institute of Standards and Technology's Hollings Manufacturing Extension Partnership (MEP) office to provide manufacturing assistance. OTT works with MEP headquarters to identify those contacts.

When a particular ARS Regional Forums (see USDA 7 initiative) has a manufacturing component, the regional MEP field staff is invited to provide an overview of the resources they have available to assist in manufacturing.

**USDA 10: Partner with the University of Mississippi's "Insight Park" for extraction, chemical analysis, and scale up of natural products for production agriculture and pest / pathogen / disease vector management
New Title: Work with regional incubators to identify opportunities for ARS scientists and ARS commercial partners**

This initiative directly addresses Section 4 of the Presidential Memorandum in establishing joint partnerships with university research parks, incubators, and other state / community economic development organizations. Since we have not yet been able to identify a project for the specific use of the University of Mississippi incubator's facilities, we expanded this initiative to include other incubators besides the one at University of Mississippi.

OTT is working with the Federal Laboratory Consortium (FLC) to provide outreach to incubators on opportunities for partnering with federal laboratories. The FLC has an ongoing project to identify incubators throughout the country. In FY2014, the FLC identified the incubators in the midwest and will be identifying those in the farwest in FY2015.

USDA 11: Partner with the National Cancer Institute (NCI) on "Enhancing translation of nutrition science from bench to food supply"

***New Title: Establishment of the “Branded Food Products Database for Public Health”
Public-Private Partnership***

This initiative has evolved from the initial discussions with NCI. Since NCI as an agency is no longer a partner in this project, the title has been changed to more accurately reflect the initiative. Individuals within NCI still participate in the discussions. In FY 2013, ARS, the ATIP Foundation, and the International Life Science Institute North America (ILSI North America) established a public-private partnership to enhance the public’s health through increased knowledge of the nutritional content of the nation’s food supply. This will be accomplished by obtaining comprehensive food composition data from the food industry and making it available to government, industry, the scientific community and the general public through an enhanced National Nutrient Database, developed and maintained by the ARS Nutrient Data Laboratory in Beltsville, MD.

The Partnership convened two listening sessions in Cleveland, OH and Washington, DC to engage a broader group of stakeholders. The purpose of the listening sessions was to communicate about the Partnership, gather input regarding current and potential usage, and opinions on proposed criteria to the USDA National Nutrient Database, specifically from existing user groups and food manufacturers. During the listening sessions, a number of comments identified the various current uses for the USDA National Nutrient Database, such as for early stages of product development; to educate consumers; for developing enhanced 3rd party proprietary nutrition guidance software; evaluating competition; calculating nutrition values for recipes; and for clinician use to counsel patients. Comments also included a need for a one-source database with a robust search engine and downloadable data; data that reflects what people are truly eating (updated at least annually, reflects variability and includes products from retail stores, restaurants, food service); more current oils, trans fatty acid information; phytonutrients; date stamp to facilitate changes in products and diet over time; nutrients of public health concern; and descriptive information of ingredients declared on the label (Nutrient Facts Panel, Ingredient list and when provided Expanded Facts Panel Data). Again, the appeal for a single-source for comprehensive, high quality, current database was expressed. Further results of the listening sessions can be found on the ATIP Foundation website at <http://static.squarespace.com/static/5102f4bce4b091e9d61659f2/t/53ea32a0e4b04b3e2c7f3418/1407857312486/ATIP+Website+Report+on+Combined+Listening+Session+Discussion+Notes.pdf>

USDA 12: Evaluate various options for reducing license negotiation transaction costs

Several proposals for establishing standard pre-commercialization license terms for all CRADA Subject Inventions were reviewed. Possible benefits included: creating business certainty for CRADA partners; providing an additional incentive to enter into a CRADA; and reducing transaction costs for both the CRADA partner and USDA.

This initiative is now completed with the pre-negotiated license language as an option in the CRADA template to be used in situations where a CRADA partner has indicated that they would like to lock in the royalty rate before proceeding with the CRADA.

USDA 13: Develop Material Transfer Research Agreement (MTRA) as a new instrument to promote development and commercialization of materials from USDA

USDA scientists create new materials that may have value in further research and development with the private sector. Current Material Transfer Agreements (MTA), widely used by USDA, only allow for the transfer of materials, but not engagement in joint research between the provider and the recipient of the materials. In order to enable some collaborative research with the material, in FY 2012 by combining the Material Transfer Agreement and the Trust Fund Cooperative Agreements authorities the MTRA was created. MTRAs are now reported as a metric in the Collaborative Relationships for Research and Development Table.

3.8. Metric Tables

TABLE 1. Collaborative Relationships for Research and Development.

*ND- no data available.

Agricultural Research Service (ARS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total number active CRADAs	262	275	243	230	214
Active traditional CRADAs	208	190	180	182	160
Active non-traditional CRADAs	54	85	63	48	54
Active CRADAs with small businesses	ND	ND	ND	116	96
Number newly executed CRADAs, total	83	78	53	62	43
Newly executed amendments ¹	91	91	82	86	72
Newly executed traditional CRADAs	59	57	39	41	29
Newly executed non-traditional CRADAs	22	21	14	21	14
Newly executed CRADAs with small businesses	ND	ND	20	21	10
Total number active MTRAs²	ND	ND	12	100	188
Newly executed MTRAs	ND	ND	12	86	105
Total number of active other agreements³	10,214	13,007	13,835	12,717	12,953
Newly executed other agreements	1,273	1,525	1,119	1,776	1,808
Number newly executed MTAs	885	1038	970	991	906
Newly executed outgoing MTAs	633	672	661	647	506
Total number of publications	11,459	11,260	8,695	8,295	8,385
Peer-Reviewed Scientific Publications	5,083	5,279	5,027	4,922	5,209
Trade Journal Publications	79	83	86	93	85
Abstracts	4,076	3,773	3,582	3,280	3091

1. Amendments extend existing CRADAs for additional years to a maximum of 5 years, and/or change Statements of Work, and/or change funding levels.
2. Material Transfer Research Agreements. Involves collaborative research on a specific material.
3. Includes mostly Trust Fund Cooperative Agreements, Reimbursable Agreements, Specific Cooperative Agreements and Non-Funded Cooperative Agreements.

TABLE 2. Invention Disclosure and Patenting

*ND- no data available.

Agricultural Research Service (ARS)	FY 2010	FY 2011	FY 2012	FY 2013 ⁴	FY 2014
Total number new invention disclosures¹	131	126	137	165	101
University co-owned	42	22	66	46	37
Based upon scientific discipline					
Life science	68	61	59	74	39
Chemical	36	36	53	49	32
Mechanical & measurement	24	28	14	19	9
Plant patents ³	5	7	17	12	4
Plant variety protection ³	ND	ND	ND	11	17
Total number patent applications filed²	106	110	108	144	110
University co-owned	ND	ND	ND	36	34
Based upon scientific discipline					
Life science	ND	ND	ND	62	47
Chemical	ND	ND	ND	44	25
Mechanical & measurement	ND	ND	ND	13	17
Plant patents	ND	ND	ND	14	6
Plant variety protection	ND	ND	ND	11	6
Total number patents issued	42	46	60	60	78
University co-owned	ND	ND	ND	17	23
Based upon scientific discipline					
Life science	ND	ND	ND	17	36
Chemical	ND	ND	ND	25	21
Mechanical & measurement	ND	ND	ND	11	11
Plant patents	ND	ND	ND	7	10

1. Inventions arising at the federal lab. For FY 2013 and 2014 also includes the plant protected through Plant Variety Protection.
2. Includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, continuation-in-part applications, provisional applications, and Plant Variety Protection.
3. Plants may be protected in one of two ways based upon their mode of reproduction- patent (vegetatively reproduced) or variety protection (seed reproduced).
4. FY 2013 numbers were revised (higher) in FY 2014.

TABLE 3. Profile of Active Licenses

*ND- no data available.

Agricultural Research Service (ARS)	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
Total number active licenses	323	337	363	380	392
Executed to small businesses ¹	ND	ND	118	137	150
Executed to startup businesses ²	ND	ND	ND	11	12
Executed to universities	ND	ND	142	169	168
Amended in FY	ND	ND	ND	ND	10
Invention licenses ³	292	301	321	331	341
Executed to small businesses	ND	ND	ND	113	125
Executed to startup businesses	ND	ND	ND	11	12
Executed to universities	ND	ND	ND	162	160
Other IP Licenses ⁴	31	36	42	49	51
Executed to small business	ND	ND	ND	24	25
Executed to startup businesses	ND	ND	ND	0	0
Executed to universities	ND	ND	ND	7	8
Total number newly executed licenses	22	33	31	23	28
Executed to small businesses	ND	ND	15	9	15
Executed to startup businesses	ND	ND	ND	0	1
Executed to universities	ND	ND	12	10	10
Invention licenses				17	26
Executed to small businesses	ND	ND	ND	5	14
Executed to startup businesses	ND	ND	ND	0	1
Executed to universities	ND	ND	ND	10	10
Other IP Licenses				6	2
Executed to small businesses	ND	ND	ND	4	1
Executed to startup businesses	ND	ND	ND	0	0
Executed to universities	ND	ND	ND	0	0

1. A small business, together with its affiliates, must not have more than 500 employees.
2. For the purpose of this report, a startup company is a privately-held, U.S., for-profit company operating for less than 5 years and actively seeking financing to commercialize a federal scientific work product.
3. Invention licenses refer to patents and plant variety protection certifications.
4. Other IP licenses refer to biological materials licenses.

TABLE 4. Characteristics of Income Bearing Licenses

Agricultural Research Service (ARS)	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
Total number of income bearing licenses	321	335	360	378	390
Exclusive	230	239	259	273	278
Partially exclusive	16	16	14	13	15
Non-exclusive	75	80	87	92	97
Invention licenses¹	290	299	318	329	339
Exclusive	226	234	252	265	269
Partially exclusive	16	16	14	13	15
Non-exclusive	48	49	52	51	55
Other IP Licenses²	31	36	42	49	51
Exclusive	4	5	7	8	9
Partially exclusive	0	0	0	0	0
Non-exclusive	27	31	35	41	42
Total number royalty bearing licenses	125	130	128	134	131
Invention licenses	113	119	114	115	117
Other IP licenses	12	11	14	19	14

1. Invention licenses refer to patents and plant variety protection certifications.

2. Other IP licenses refer to biological materials licenses.

TABLE 5. Income from Licensing

*ND- no data available.

Agricultural Research Service (ARS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total income all active licenses	\$3,641,476	\$3,989,228	\$3,806,164	\$4,385,952	\$4,927,938
Invention licenses ¹	\$3,566,048	\$3,854,820	\$3,670,692	\$4,053,931	\$4,733,200
Other IP licenses ²	ND	ND	ND	\$332,021	\$194,738
Total earned royalty income (ERI)	\$3,075,199	\$3,136,813	\$3,059,989	\$3,353,876	\$3,610,774
Median ERI	\$4,911	\$4,748	\$5,000	\$3,609	\$3,232
Minimum ERI	\$2	\$6	\$44	\$5	\$32
Maximum ERI	\$331,674	\$630,847	\$757,219	\$856,987	\$575,753
ERI from top 1% of licenses	NP ³				
ERI from top 5% of licenses	\$1,493,456	\$1,932,197	\$1,752,367	\$1,969,155	\$2,048,317
ERI from top 20% of licenses	\$2,540,101	\$2,672,414	\$2,604,008	\$2,892,796	\$3,103,143
ERI distributed					
Inventors	\$1,370,296	\$1,391,111	\$1,206,713	\$1,192,808	\$1,305,695
Funds to be used for salaries	ND	ND	ND	ND	\$2,812,269
Patent filing preparation, fees, & annuity payments paid ⁴	ND	ND	ND	ND	\$809,974

1. Invention licenses refer to patents and plant variety protection certifications.

2. Other IP licenses refer to biological materials licenses.

3. Not presented, represents one license.

4. Approximately 40% is reimbursed when licensed.

TABLE 6. Licensing Management: Elapsed Execution Time and Termination

Agricultural Research Service (ARS)	FY 2010 ¹	FY 2011 ²	FY 2012 ³	FY 2013 ⁴	FY2014 ⁵
All licenses					
- average (months)	6.6	5.9	5.8	3.5	5.9
- median (months)	6.4	3.3	4.2	2.3	5.8
- minimum (months)	0.7	0.6	0.3	0.4	0.9
- maximum (months)	18.5	18.2	19.7	12.5	21.5
Licenses terminated for cause	0	0	0	0	0

- ¹ During FY 2010, USDA received 24 new invention license applications, for which 4 new licenses were granted, 16 license agreements are currently in negotiation, 3 applications were withdrawn by the applicants, and 1 application is on hold by request of the applicant. The FY 2010 data is based upon 14 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.
- ² During FY 2011, USDA received 29 new invention license applications, for which 4 new licenses were granted, 21 license agreements are currently in negotiation, 0 applications were withdrawn by the applicants, and 4 applications are on hold by request of the applicant. The FY 2011 data is based upon 13 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.
- ³ During FY 2012, USDA received 16 new invention license applications, for which 7 new licenses were granted, 9 license agreements are currently in negotiation, 0 applications were withdrawn by the applicants, and 0 applications are on hold by request of the applicant. The FY 2012 data is based upon 18 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.
- ⁴ During FY 2013, USDA received 28 new invention license applications, for which 8 new licenses were granted, 15 license agreements are currently in negotiation, 3 applications were withdrawn by the applicants, and 2 applications are on hold by request of the applicant. The FY 2012 data is based upon 18 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.
- ⁵ During FY 2014, USDA received 15 new invention license applications, for which 8 new licenses were granted, 5 license agreements are currently in negotiation, 2 applications were withdrawn by the applicants, and 0 applications are on hold by request of the applicant. The FY 2014 data is based upon 17 licenses granted to commercial licensees and does not include licenses executed with universities for co-owned inventions. In accordance with 35 USC 202(e), such licenses are granted for the purpose of consolidating rights in the invention, and therefore license applications are not required.

3.9. Downstream Outcomes



NUTRITION, FOOD SAFETY, QUALITY

National Program:

- **Human Nutrition, NP 107**
- **Food Safety, NP 108**
- **Quality and Utilization of Agricultural Products, NP 306**

Microgreens

Microgreens are a new food rich in human nutrients. ARS scientists in Beltsville, Maryland, were the first to study the nutrient content of microgreens - leafy vegetables older than sprouts, but much younger than baby greens. The scientists tested 25 commercially available microgreen varieties and discovered they possess two to four times higher nutrient content in Vitamin C, carotenoids, and Vitamins K and V than the same plants' mature leaves. This nutritional data will serve as a reference for health agency recommendations and consumers of fresh microgreens. In addition, the scientists optimized growing and harvesting conditions, and improved storage life to 14 days from the previous 3 to 5 days. This significant shelf life extension will enable microgreen growers to ship their product by ground rather than air providing considerable cost reduction. (NP 306, Project #1245-43440-004-00D).

Cranberry sugars prevent bacteria from adhering to urinary cells

Urinary tract infections result in millions of doctor visits annually and some people suffer from recurrent bacterial infections. Cranberry juice phenolic compounds associated with its red color were previously thought to be solely responsible for preventing *E. coli*. ARS scientists in Wyndmoor, Pennsylvania, described the composition of sugars derived from and unique to cranberry pulp that prevented the adherence of *E. coli* to urinary tract cells. A joint patent application was filed under a collaborative research and development agreement with a major cranberry producer. These newly recognized cranberry sugars may have the potential to provide the consumer with another bioactive food ingredient which improves health. (Project #1935-41000-089-00D).

Shelled eggs pasteurized using an innovative process

Pasteurization of all shelled eggs in the United States would reduce Salmonella illnesses by approximately 110,000 annually, yet only about 1 percent of eggs are currently pasteurized because the process is costly and

damages the egg white appearance. ARS researchers in Wyndmoor, Pennsylvania, developed a radio frequency (RF) energy process that eliminates 99.999 percent of Salmonella that may be present in eggs. The RF process is significantly (more than 50 percent) faster than the current pasteurization process, and the egg whites look perfect. ARS filed for patent protection and several companies have expressed interest in licensing the technology. RF pasteurization substantially reduces the threat of illness from uncooked and undercooked shelled eggs. (Project #1935-41420-01-00D).

Screening method for fluoroquinolone residues

Fluoroquinolone antibiotics are used to treat humans and often serve as the last defense against antibiotic resistant microorganisms. However, they are also used in veterinary medicine. Worldwide, this has been a particular concern in monitoring programs for individual countries' regulatory control. Current screening tests using microbial inhibition for antibiotics do not respond well to fluoroquinolones. A new screening method is needed for these drugs. ARS researchers in Wyndmoor, Pennsylvania, developed a novel approach which met U.S. tolerance detection levels. Adoption of this new screening process for these important drugs will ensure proper veterinary practices, and reduce the chances of transferring antibiotic microbial resistance. (Project #1935-42000-056-00D).

Antibiotic treatment of cattle in feedlots does not increase prevalence of antibiotic resistant *E. coli*

Some classes of antibiotics are critically important to human medicine and are prescribed for the treatment of serious *E. coli* and *Salmonella* infections. Concerns have been raised that therapeutic treatment of feedlot cattle with antibiotics in the same classes as those used for humans increases the prevalence of resistant *E. coli*. ARS scientists in Clay Center, Nebraska, assessed fecal samples before, during, and after antibiotic treatment for disease in a feedlot herd over a ten month period. A baseline, a low level of antibiotic resistant *E. coli* was detected in cattle upon arrival at the feedlot, antibiotic resistance temporarily increased after antibiotic treatment, and resistance levels returned to baseline levels after several weeks. Genetic analysis of 312 resistant *E. coli* isolates obtained from this study demonstrated that the baseline level of resistant *E. coli* in the herd was more likely due to the persistence of a few feedlot adapted resistant *E. coli* strains rather than the transfer of the genes conferring resistance between *E. coli* strains. These results indicate that antibiotic treatment of disease in cattle feedlots does not increase the prevalence of antibiotic resistant *E. coli* in those cattle when they are harvested. (Project #5438-42000-015-00D).

Extending the life of frying oils with antioxidants

During frying, oils that are high in healthy polyunsaturated fatty acids, such as soybean oil, quickly react with oxygen and polymerize which causes darkening, foaming, and a reduction in nutritional value. Synthetic antioxidants are used to protect oils during frying, but many synthetic antioxidants have come under scrutiny because of potential negative health effects. Food companies are very interested in replacing synthetic antioxidants with natural antioxidants. ARS scientists in Peoria, Illinois, discovered that phytosteryl ferulates, natural antioxidants found in corn, rice, wheat, and rye, formulated with Vitamin E, another important antioxidant found in oils, protect each other and work together to protect the oil during frying. With this combination, soybean and other healthy oils can be used for a longer time for frying, a cost savings for food processors and restaurants owners. As part of this research the scientists discovered that a low resolution nuclear magnetic resonance instrument, commonly used by oil companies and in quality assurance environments, may be substituted for traditional methods of measuring oil degradation. During deep fat frying, it is necessary to monitor oil quality so food processors and restaurants know when to replace the oil. Although several instruments are available for quick measurements they are not very accurate. The advantages of the new hand-held method are that, once calibrated, it correlates with standard methods, it requires no solvents and minimal sample preparation, and it is easy and fast to use so that anyone could be trained to measure frying oil degradation. (Project #3620-44000-050-00D).

Irrigation management strongly affects arsenic and cadmium accumulation in rice grain

Changing concepts of dietary arsenic risk to humans threatens the safety of U.S. rice, the only grain that accumulates substantial levels of arsenic. Flooding rice soils causes arsenite to be generated from soil arsenate; soil arsenite can be accumulated by rice, as can dimethylarsinic acid, a less toxic organic form of arsenic generated by soil microbes. Scientists in Beltsville, Maryland, in collaboration with those the University of Arizona, measured levels of arsenic and cadmium in grains with six different irrigation schemes. Rice grown with traditional flooding, which lowers soil aeration, contained the highest arsenic and the lowest cadmium levels. Any soil oxidation promoted cadmium accumulation, whereas making the soil nearly fully aerobic was required to reach minimal arsenic concentrations in grain. Three tested cultivars varied in arsenic accumulation but showed similar changes with irrigation management. The research concluded that growing rice aerobically rather than via traditional flood culture can substantially lower grain arsenic and yield, and increase grain cadmium. The results provide growers and the FDA with information that may be needed to meet market arsenic limits in areas with naturally high soil levels of the element. (Project #1245-42000-015-00D).

Portable method for identifying harmful bacteria from food

Rapid detection of harmful bacteria in food is necessary to prevent foodborne illness and safeguard public health. The BARDOT sensor technology developed by ARS funded researchers at Purdue University's Center for Food Safety Engineering (CFSE) in West Lafayette, Indiana, is easy to use and allows rapid identification of bacteria. A new portable BARDOT instrument was developed by CFSE scientists and was evaluated by ARS scientists in Wyndmoor, Pennsylvania. The system is able to identify known pathogenic bacteria, including pathogenic *E. coli*, *Salmonella*, and *Listeria monocytogenes*. The pathogen identification capabilities coupled with the portability of this new BARDOT instrument have tremendous potential for improving the response to foodborne illness outbreaks because the method can travel to the source, thereby reducing the time to detection. The utility of the BARDOT system was demonstrated by its ability to detect *Salmonella* in peanut butter within 24 hours with an accuracy of 98 percent. This is comparable to the current USDA, Food Safety and Inspection Service method, which requires about 72 hours. The patented BARDOT system is licensed and available for use worldwide. (Project #1935-42000-072-00D).

Point scan Raman imaging-based detection of food contaminants

Incidents in recent years of profit driven adulteration of milk and wheat ingredients used to make dairy products and pet foods have highlighted the need for nondestructive methods to screen food ingredients for contaminants that can pose significant food safety hazards. A Raman chemical imaging system and method were developed by ARS scientists in Beltsville, Maryland, for detecting multiple adulterants in dry skim milk powder. Spectral image processing methods were developed to remove interference from background fluorescence, and to create Raman chemical images visualizing the distribution of the different adulterants in the milk powder using unique Raman peaks of the adulterants. A correlation was found between adulterant concentration and the number of adulterant pixels identified in the images, demonstrating the utility of this method for regulatory and industry use in the quantitative analysis of adulterants in milk powder. A U.S. patent ("System and Methods for Detecting Contaminants in a Sample") was issued in May 2013. (Project #1245-42000-018-00D).

USDA Integrated Pathogen Modeling Program

Predictive microbiology entails applying mathematical models to predict the growth and survival of foodborne pathogens undergoing complex environmental changes. Predictive models are the building blocks for microbial food safety risk assessments. ARS researchers in Wyndmoor, Pennsylvania, developed an easy-to-use integrated data analysis and model development tool that can be used by students and scientists. The program can also be used in colleges and universities to train students to carry out predictive microbiology research. This software package is offered as a free tool to scientists and risk modelers around the world and can be downloaded from www.ars.usda.gov/Main/docs.htm?docid=23355. (Project #1935-42000-075-00D).

Early development of heart rate regulation and bone growth differ between breast-fed and formula-fed infants

It is not known whether differences in an infant's diet are associated with differences in the development of heart rate control. A longitudinal investigation at the Arkansas Children's Nutrition Center in Little Rock, Arkansas, is studying the development of breast-fed, soy formula-fed, and cow's milk formula-fed infants. Findings in 465 infants on the basis of measures of resting heart rate across the first two years of life revealed that vagal tone, a parameter of the autonomic nervous system that regulates cardiac function by slowing heart rate, was within the normal range across groups but after six months was lower in breast-fed than formula-fed infants. Variations in vagal tone have been related to mental development and emotional behavior in infants, children, and adults. These findings provide new information regarding the influence of early infant diet on neurodevelopment and suggest that variations in early diet may contribute to the development of individual differences in autonomic heart rate control which is important in the regulation of attention, emotion, mental abilities, and behavior. In a study of more than 200 of these infants over their first nine months of age, the breast-fed children were significantly fatter than soy or milk formula-fed infants. Those fed soy formula were leaner than the other groups and accumulated bone and body length faster. These results should help reduce concerns regarding the use of soy formula. Although the long term consequences of these observations are unknown, these children will be followed to ascertain the health effects of the early growth differences. (Project #6251-51000-006-00D and 6251-51000-007-00D).

Fatty acid ratios in food affects human immune response

Although hundreds of studies have been conducted, there is no scientific consensus on how different dietary fatty acids influence the human immune system. Diets containing five different soybean oils that varied in their content of polyunsaturated fatty acid (PUFA) were fed to volunteers for 35 days by scientists at the Human Nutrition Research Center on Aging at Tufts University in Boston, Massachusetts. Standard tests of the immune system were performed at the end of each test period. Two PUFAs, designated omega-6 and omega-3, had the strongest effect on proliferation of immune cells. Soybean growers are changing most strains grown to reduce specific fatty acids. It is critical to know how these changes might affect the health of consumers. (Project #1950-51000-067-00D).

Scientists played a pivotal role in analysis of the pig genome and proteome

ARS human nutrition scientists in Beltsville, Maryland, contributed to a multinational consortium that mapped the entire pig genome, and led a related analysis of porcine genes that control the immune system. Full knowledge of the pig genome will contribute to more efficient production of healthier animals and better meat for human consumption, and will serve as a better experimental model for human diseases. Many of the pig's systems and its genes are closer to that of humans than those of standard laboratory animals such as mice or rats. In addition, a large scale analysis of the proteins in biological fluids from multiple sites in a strain of pigs susceptible to metabolic syndrome was performed and reflected metabolic responses in various organs that will enable scientists to study development of diabetes in real time as it influences different systems in the body. (Project #235-51000-055-00D and 1235-51530-053-00D).

Vitamin K may protect against coronary calcification

Vitamin K is a well known factor in blood clotting, but emerging evidence suggests that it has other functions. Coronary calcium progression, which is a characteristic of severe heart disease, has not been well studied in humans with respect to Vitamin K. To address this gap in knowledge, ARS funded researchers at Tufts University in Boston, Massachusetts, in collaboration with scientists from Wake Forest Medical Center, they measured the Vitamin K concentrations in blood samples from men and women participating in a multi-ethnic study of atherosclerosis, and determined their association with coronary calcium progression. The overall findings suggest those with low Vitamin K concentrations were more likely to have coronary calcium progression. Among participants who were taking blood pressure medication, those with low Vitamin K were even more likely to have coronary calcium progression. These data support the need to review Vitamin K dietary

requirements in the context of health outcomes beyond that of Vitamin K's established role in blood clotting. (Project #1950-51000-069-00D).

Moderately high folic acid negatively affects fetal development

Pregnant women are encouraged to consume prenatal vitamins with extra folic acid. Whereas adequate folate helps prevent many neural tube defects, there is concern about high doses having an adverse effect. Because a study cannot ethically be conducted in humans, scientists supported by ARS in Boston, Massachusetts, fed mice folate at 10 times the recommended amount, which is similar to the level recommended for pregnant women. The mice exhibited increased fetal loss, embryonic delays, and a higher incidence of heart defects in offspring. This indicates that moderately high supplementation of folic acid adversely affects fetal mouse development. It will be critical to follow up this research to determine whether there is concern in pregnant women. (Project #1950-51000-076-00D).



CROP PRODUCTION AND PROTECTION

National Programs:

- **Plant Diseases, NP 303**
- **Crop Production, NP 305**
- **Plant Genetic Resources, Genomics and Genetic Improvement, NP 301**
- **Crop Protection and Quarantine, NP 304**

Sunpreme raisins dry themselves

Eliminating the processing step of tray drying in the field would help maintain the quality of raisins and reduce the need for costly additional post-harvest processing. ARS researchers in Parlier, California, have developed Sunpreme, a new raisin grape that dries naturally on the vine without the grapes requiring cutting and drying in trays. Sunpreme, is particularly well suited for mechanical harvesting, thereby significantly reducing production costs. Unlike Thompson Seedless, the major grape variety used for tray dried raisin production, Sunpreme, can be spur-pruned, further reducing grower costs. (Project #5302-21220-005-00D).

New citrus cryopreservation method developed

The current and future productivity and profitability of the multi-billion dollar U.S. citrus industry is threatened by virulent pests and diseases, such as citrus greening and citrus canker. These pests and diseases also threaten ARS' citrus breeding stock and genebank collections maintained in field and screen house plantings. Until now, preserving vegetatively propagated citrus germplasm under ultra-cold (cryopreservation) genebank conditions has not been feasible. ARS researchers in Ft. Collins, Colorado, and Riverside, California, developed a novel micrografting technique that results in high survival rates of citrus germplasm maintained by cryopreservation. Furthermore, the new cryopreservation technique eliminates several graft transmissible viruses and viroids. This new cryopreservation technique not only provides an effective means for safeguarding invaluable citrus germplasm, but it can also serve as a new pathogen elimination method for producing disease free citrus propagating material. (Project #5402-21000-012-00D and 5310-21000-010-00D).

Discovery of genes for drought tolerance in the common bean

Drought strongly reduces the yields of dry beans in the Northern Plains (North Dakota and Minnesota), Great Lakes (Michigan), and other regions which rely primarily on rainfall for crop growth. Consequently, dry beans with tolerance to drought are critical for those regions, and for adapting this globally important crop to climate change. ARS researchers in Prosser, Washington, and their university colleagues identified two major genes (also known as quantitative trait loci or QTL) that strongly govern drought tolerance in dry beans. The two genes showed positive effects when the dry beans were cultivated in multiple drought stress environments. This research will enhance our capacity for marker assisted breeding to accelerate development of drought tolerant beans by seed companies and public sector breeders in the United States and worldwide. (Project #5354-21220-016-00D).

Rich native U. S. sources of plant genetic diversity identified for crop improvement and research The wild relatives of domesticated crops contain rich sources of genetic diversity which new genomics assisted breeding techniques can now exploit more effectively for crop improvement. It has long been assumed that U.S. flora contains relatively few crop wild relatives. ARS scientists in Prosser, Washington, and Beltsville, Maryland, with international research collaborators, completed an inventory of U.S. flora that contains a rich trove (more than 4,600 different types) of crop wild relatives and wild species that could be exploited directly for food, forage, medicinal, ornamental, and industrial applications. This research has furnished a blueprint for urgent action to conserve the most endangered U.S. crop wild relatives. (Project #5348-21000-022-00D and 1245-21000-228-00D).

Novel multi-seeded mutants identified that might substantially increase sorghum grain yield

ARS researchers in Lubbock, Texas, have identified novel sorghum mutants that might significantly increase sorghum grain yield. The multi-seeded mutants have more and larger primary and secondary flower branches bearing more types of floral organs that develop into seeds. Compared to current sorghum cultivars, these mutants have triple the number of seeds and double the seed weight. The mutants are being evaluated in the field for their ability to substantially increase sorghum grain yield. (Project #6208-21000-017-00D).

Reducing environmental impacts of wine grape production

Better identification of the environmental impacts of wine grape production could help growers facilitate targeted improvement in production system sustainability. ARS scientists in Davis, California, have developed a tool that helps growers and policymakers understand the full environmental impacts of an agricultural production system and identify ways to improve overall efficiency. The Life Cycle Assessment (LCA) tool has been used to assess environmental impacts of wine grape production across a range of vineyard management regimes in two important growing regions of California. The tool evaluates resource extraction; manufacturing of raw materials into products used in wine grape production (e.g., herbicide and fertilizer) and their subsequent transport to the vineyard; activities and energy required to grow the wine grapes (e.g., irrigation and harvest); and final transport of wine grapes to the winery. The tool helped scientists discover a number of alternative management practices,

including but not limited to compost, reduced irrigation, and various cover cropping systems that will assist growers seeking to improve the energy use and air emissions of their vineyards. (Project #5306-21220-005-00D).

Attractants for brown marmorated stink bug

The brown marmorated stink bug is an invasive insect pest that causes severe damage to fruits, vegetables, and field crops that has spread to 40 States, as well as to Canada, Switzerland, Germany, and France. A means of monitoring the numbers of stink bugs is necessary for determining when to apply treatments. ARS scientists in Beltsville, Maryland, have confirmed that the bug is attracted to methyl decatrienoate (MDT), a pheromone of a different Asian stink bug species. The researchers have developed and commercialized a new method of synthesizing this compound for use in monitoring traps. In addition, ARS scientists in Kearneysville, West Virginia, and Beltsville, discovered the true male produced aggregation pheromone of the stink bug and confirmed in field trials that it is attractive to male and female adults and immature bugs. The pheromone was developed into a commercial version that has been transferred to the private sector. ARS scientists in Beltsville also discovered that the performance of the bug's pheromone could be enhanced (synergized) by MDT, providing a superior lure for season long monitoring. A patent application has been filed on discovery of the brown marmorated stink bug attractants. It is expected that the commercialization of this pheromone technology will lead to effective management of the pest and new trap-and-kill techniques to reduce pesticide usage. (Project #1245-22000-272-00D and 1245-22000-273-00D).

Varroa mite migration represents a new control challenge

Varroa mites are a major cause of colony losses in honey bees because they parasitize bees and spread viruses in the colony. ARS researchers in Tucson, Arizona, devised a treatment schedule to control Varroa based on colony and Varroa population dynamics. The researchers found that Varroa populations could be kept at low levels throughout most of the summer with this treatment schedule. However, by fall, mite populations were much larger than predicted or than could be accounted for by mite reproduction alone. The researchers determined that mites appear to be migratory and move between colonies with far greater frequency than previously thought. This finding led to changes in recommendations on Varroa control that include a late fall treatment so mite populations remain low over the winter to prevent the loss of colonies in the spring. (Project #5342-21000-015-00D).

Use of biochar as a component in greenhouse substrates

Fertilizers are becoming increasingly expensive due to the energy required to manufacture them or the cost of mining the raw materials. Phosphorus and potassium are two of the primary nutrients used in fertilizers. ARS scientists in Wooster, Ohio, determined that gasified rice hull biochar, a commercially abundant byproduct from the processing of rice, contains a high concentration of phosphorus and potassium, and has potential as an alternative source for use in commercial potting substrates for greenhouse and nursery crops. The scientists determined that the optimal rate for amendment with gasified rice hull biochar into a typical greenhouse potting substrate is 10 percent by volume. At this rate, sufficient phosphorus and potassium are provided for a variety of crop species without additional nutrients being provided. This data provides the industry with baseline information on rates of application that can be used when this product becomes available to the horticultural industry. (Project #3607-21000-015-00D).

Molecular diagnostic assay for wheat stem rust Ug99 strains

Strains of the wheat stem rust pathogen in the group Ug99 are threats to wheat production worldwide, and while these strains are not yet in the United States, U.S. wheat varieties are vulnerable to Ug99. Until now, the only way to distinguish Ug99 strains from other forms of wheat stem rust was to put the fungus spores on wheat plants and wait for disease to develop. ARS scientists in St. Paul, Minnesota, have developed a two stage assay based on fungal DNA to distinguish among rust strains. The first stage determines if the sample belongs to the Ug99 strain group, while the second stage predicts the specific strain. This assay is currently being used to track the movement of the Ug99 in Africa where the disease is endemic. Deployment of this assay in the United States would greatly enhance growers' ability to detect and identify any Ug99 introductions and to provide information for responding to potential outbreaks. (Project #3640-21220-021-00D).

Natural plant molecules disrupt nematode development

Safe strategies for managing plant parasitic nematodes should effectively control these target pests while having minimal impact upon the environment and non-target species. Using the most economically important plant nematodes in the United States, the soybean cyst nematode and the root knot nematode, ARS scientists in Beltsville, Maryland, found that plant chemicals called catechins inhibit nematode hatching and also significantly inhibit nematode enzymes called proteases. The catechins affect three specific proteases that are part of a complex structure central to nematode survival. Without proper protease function, nematodes fail to develop and will die. This discovery is important because it demonstrates a molecular basis for how this plant chemical can suppress plant parasitic nematode development and reproduction at low doses. In addition, it also demonstrates that catechins can be used as nematode control agents. This information will help scientists develop precision treatment strategies for controlling plant parasitic nematodes and help growers seeking to decrease synthetic chemical use in crop protection. (Project #1245-22000-283-00D).

Flat mite identification tool on the Web

Flat mites, such as false spider mites, red palm mites, citrus mites, and peacock mites, are devastating pests on citrus, tea plants, bananas, coconuts, date palms, olive crops, eucalyptus trees, and ornamental palms. In addition to directly causing damage, these mites also vector plant diseases, including citrus leprosis virus. Accurate identification of these mites is the first step in controlling them. ARS researchers in Beltsville, Maryland, in collaboration with APHIS developed an interactive online identification key with descriptors and numerous images using light microscopy and low temperature scanning electron microscopy. Since its launch one year ago, more than 123,800 visitors from 180 countries have accessed the Website. This tool has enabled correct identification by farmers, extension agents, State and university researchers, government agencies, and APHIS quarantine specialists in controlling mites and plant diseases vectored by mites. (Project #1245-22000-278-00D).

Discovery, field release, and establishment of new natural enemies of Giant Reed in Texas

Giant Reed (*Arundo donax*) is a highly invasive weedy grass from the Mediterranean region that displaces native riparian vegetation in the United States and clogs waterways along the Southern border. Its dense thickets also hinder effective border patrol activities and provide habitat for the tick that carries cattle fever. Giant Reed has become a problem in the United States because it lacks effective natural enemies. Scientists at ARS' European Biological Control Laboratory in Montpellier, France, have now identified four candidate natural enemies after making more than 250 field collections in Spain, France, Italy, and Greece. The candidates were shipped to U.S. quarantine facilities in Mission, Texas, where ARS scientists evaluated them for safety and efficacy against the weed. Two of the agents, a gall forming wasp (*Tetramesa romana*) and a scale insect (*Rhizaspidiotus donacis*), have received APHIS permits and have been released into the field. A third agent, a leaf mining fly (*Lasioptera donacis*), is currently being evaluated in quarantine. During the past year, ARS scientists in Kerrville, Texas, and in Montpellier, France, have also made significant advances in understanding the biological association of the defoliating leafminer fly and associated endophytic pathogens. The fly has previously undiscovered specialized organs on its ovipositor in which it stores the spores of a single species of fungus. The fungus appears to be necessary for complete development of the fly and is probably responsible for much of the damage to the *Arundo* plant. As these natural controls spread they will help to suppress the grass and restore original riparian habitats. (Project #0212-22000-025-00D).

Insect control for export of table grapes and sweet cherries

Spotted wing drosophila (*Drosophila suzukii*) is a newly found invasive pest in the western United States that threatens the ability of growers to export California grown table grapes and sweet cherries which have an annual export value estimated at \$200 million to Australia and New Zealand. ARS scientists in Parlier, California, developed a combination of sulfur dioxide fumigation and cold treatment as a postharvest alternative to methyl bromide fumigation for controlling this pest in California grown table grapes. The scientists further enhanced producer's ability to export grapes by developing a method to remove fungicide residues using ozone fumigation. Following requests of the western U.S. cherry industry, the scientists also completed the validation of a quarantine

treatment utilizing methyl bromide fumigation. This research has enabled the retention and expansion of market access to Australia, estimated at \$55 million annually. (Project #5301-43000-033-00D).



ANIMAL PRODUCTION AND PROTECTION

National Programs:

- **Animal Health, NP 103**
- **Food Animal Production, NP 101**
- **Aquaculture, NP 106**
- **Veterinary, Medical, and Urban Entomology, NP 104**

Development of international genomic evaluations for young dairy cattle bulls

Genomic evaluations have rapidly replaced traditional evaluation systems used for dairy cattle selection and have had a significant impact in increasing genetic progress. However, accurate, unbiased comparison of genomic evaluations from different countries has not been possible because of differences in national methodologies and the data included in evaluations. ARS scientists in Beltsville, Maryland, collaborated with the Canadian Dairy Network (Guelph, Ontario), and the Interbull Centre (Uppsala, Sweden), to develop a genomic multi-trait, cross country evaluation (GMACE) system by modifying techniques used in traditional international evaluations. Initial implementation of GMACE for young Holstein bulls was completed in August 2013 by the Interbull Centre. The availability of accurate international genomic evaluations for young bulls will enable breeders to select globally from the best animals, thereby providing access to a much larger genetic pool and increasing the rate of genetic progress for dairy production worldwide. (Project #1245-31000-101-00D).

Engineered antimicrobial proteins that eradicate *Staphylococcal Mastitis* pathogens

The U.S. dairy industry's loss due to mastitis (infections of mammary glands) exceeds \$2 billion annually. Mastitis is also responsible for the greatest use of antibiotics on the dairy farm despite an international effort to reduce antibiotic use in agriculture. The bacterial pathogen *Staphylococcus aureus* can evade most conventional antibiotics by invading and residing inside the cells (intracellularly) of the cow mammary gland, leading to chronic infection and increased culling of infected animals. Conventional antibiotics do not kill intracellular pathogens; thus, novel antimicrobials effective at killing intracellular bacteria would benefit the dairy industry for the treatment of mastitis and help to replace antibiotics that are facing high levels of resistant strain development. ARS scientists in Beltsville, Maryland, demonstrated that an engineered antimicrobial protein facilitates transport

across the mammary cell walls into intracellular spaces. The scientists then fused the protein to a previously engineered antimicrobial protein with three distinct enzymatic activities. The top candidate engineered antimicrobial protein for the eradication of intracellular *S. aureus* in cultured cell assays showed the ability to reduce the *S. aureus* infection 1,000-fold in a mouse mastitis model. This technology presents a novel alternative mastitis treatment to effectively treat and potentially eliminate bovine mastitis and significantly reduce the need for conventional antibiotic use on the dairy farm. (Project #1245-31000-103-00D).

New semen extender supplement improved fertility of turkey semen

The turkey industry relies exclusively on artificial insemination, a time- and labor-intensive process, to reproduce birds in commercial operations. When producers use freshly collected semen for artificial insemination, fertility rates are typically 94 to 98 percent; however, if semen is held longer than six hours prior to insemination, fertility rates drop to 40 percent. ARS scientists in Beltsville, Maryland, evaluated the biological basis for this drop in fertility and have shown that the sugar residues on the surface of the sperm membrane change when semen is held longer than 6 hours. To address this issue, the scientists conducted an intensive evaluation of the concentration of different sugars, as well as the effect of time and temperature on these sugars. Results indicate that providing extra sialic acid (sugar) in the semen extender can boost the fertility rates of semen held at a cool temperature (4 C) for 24 hours from 40 to 85 percent. This represents a significant advance in poultry semen storage technology that will save producers time and money when reproducing flocks. (Project #1245-31000-105-00D).

Finding markers to predict reproduction efficiency in beef cattle

Reproductive efficiency is arguably the most economically important trait in commercial beef cattle production, as failure to achieve pregnancy reduces the number of calves marketed per cow exposed to breeding. Identification of variation in the genome with predictive merit for reproductive success would facilitate accurate prediction of daughter pregnancy rate in sires, enabling effective selection of bulls whose daughters have improved fertility. ARS scientists in Clay Center, Nebraska, applied a Genome Wide Association Study (GWAS) approach using a procedure based on genotyping multi-animal pools of DNA to increase the number of animals that could be genotyped with available resources. The study identified regions of the genome associated with reproductive efficiency which are being targeted for further analysis to develop robust marker systems. The scientists also demonstrated that DNA pooling can be used to substantially reduce the cost of GWAS studies in cattle. A specific deletion of DNA along chromosome 5 in *Bos indicus* crossbred cattle was identified that is strongly correlated with reproductive failure, providing a potentially useful marker for breeders in sub-tropical areas that make use of these types of cattle. The results demonstrate the ability to leverage the bovine genome sequence to improve reproductive efficiency in beef cattle while significantly reducing technology costs for research communities. (Project #5438-31320-012-00D).

Introduction of free genetic tests for inherited defects of dairy cattle

A method to identify exact locations of loss-of-function mutations and DNA sequences associated with lethal or undesirable conditions of dairy cattle was developed by ARS scientists at Beltsville, Maryland, and automated over the past two years. However, results from that method could not be made available to the dairy industry because the respective DNA sequences were associated with patented genes. Genetic tests were available for some of the lethal mutations, but most females were not tested because individual gene tests were expensive and not included on genotyping chips until very recently. For Holsteins, the method also can be applied to identify DNA markers associated with complex vertebral malformation and brachyspina as well as for desired traits such as red coat color and polledness (no horns). In addition, four new deleterious DNA sequences have been identified for dairy cattle fertility, and those sequences have been incorporated into new genotyping chips. The first release of genomic status information for the inherited defects occurred in August 2013 and is expected to provide the tools for dairy producers to reduce or eliminate costs for genetic testing, decrease the frequency of undesired traits, and increase the rate of genetic progress for desired traits through significant improvements in reproductive efficiency, health, and animal well-being. (Project #1245-31000-101-00D).

Increasing production of healthy omega-3 fatty acids in rainbow trout

The increase in the price of fish oil is making it very expensive to include it at desired levels in aquaculture feeds to improve the nutritional value of farmed fish. ARS scientists in Aberdeen, Idaho, have determined that genetic variation exists between families of rainbow trout in their ability to produce and deposit fish oils in their flesh. During the past year, scientists have measured the variation among families and validated methods for measuring fatty acid levels in live fish. This methodology will improve fish oil content in filets through breeding and ultimately produce fish with greater health benefits to humans. (Project #5366-21310-004-00D).

Kaolinitic clay protects fish from Columnaris disease

Columnaris disease, caused by the bacterium *Flavobacterium columnare*, is a costly disease of many commercially grown fish species including channel catfish. Few preventative methods or therapies exist for this disease. ARS scientists in Stuttgart, Arkansas, evaluated a type of clay, called kaolin, for the prevention of Columnaris disease. Kaolin works by binding to the bacteria, thereby preventing it from attaching to the fish. They demonstrated that addition of kaolin to the water significantly improved the survival of channel catfish that were experimentally challenged with the disease. Kaolin was shown to be a novel, non-antibiotic treatment to increase survival rates in catfish hatcheries. (Project #6225-32000-005-00D).

High survival of Bacterial cold water disease-resistant rainbow trout line in farm trials

Bacterial cold water disease (BCWD) is a frequent cause of farmed trout loss. ARS researchers in Leetown, West Virginia, developed a BCWD resistant rainbow trout line through multiple generations of genetic selection for improved disease resistance. Three consecutive years of performance testing of these fish were carried out under farm conditions. In five completed trials to date in which non-select fish were diagnosed with BCWD, survival of the select line was 95 percent from initial feeding through the early rearing phase. In addition to greater survival, the select line had a smaller percentage of fish that tested positive for the pathogen that causes BCWD. These findings support the release of the germplasm to stakeholders, and the continued evaluation of the select genetic line in large scale production trials. (Project #1930-31000-005-00D).

Development of an improved aerator for the catfish industry

Supplemental aeration is used by all catfish producers. It is critical to maintain dissolved oxygen (DO) at levels that support high densities of catfish grown in production ponds, especially when oxygen levels drop on warm summer nights. Paddlewheel aerators have been used for aeration in aquaculture for over 30 years, and while they transfer oxygen to the water efficiently, they also move a huge volume of water so the oxygen concentration increases slowly. Thus, a great deal of equipment and a large amount of power is required to prevent low DO conditions in commercial ponds. ARS researchers in Stoneville, Mississippi, have developed a new aerator, the Power Tube Airlift (PTA), which can concentrate DO into a small zone of water in a pond using less energy than traditional methods. A patent application for this invention is currently pending. Two commercial scale PTAs were installed in an 8-acre catfish production pond and gave promising results. This new equipment will both lower energy costs and enable higher production densities. (Project #6402-31320-004-00D).

H7N9 outbreak in China: Animal investigations and U.S. animal health preparedness activities

On March 29, 2013, the Chinese Center for Disease Control and Prevention (CDC) completed laboratory confirmation of three human infections with an Avian Influenza A (H7N9) virus not previously reported in humans. By April 26, reports from the China Ministry of Agriculture indicated that the H7N9 virus had been confirmed in chickens, ducks, pigeons (feral and captive), and environmental samples in four of the eight provinces and in Shanghai municipality, confirming that the source of human infections was poultry markets. USDA set up a Situational Awareness Coordination Unit with a core team of subject matter experts and other USDA representatives, including the ARS, APHIS, FSIS, and the Foreign Agricultural Service. USDA and the Chinese CDC worked collaboratively to understand the epidemiology of H7N9 infections among humans and animals in China. To date, there is no evidence of this strain of Avian Influenza A (H7N9) virus has entered the United States. ARS scientists in Athens, Georgia, and Ames, Iowa, rapidly conducted animal studies to characterize the virus pathogenicity and transmission properties of the virus in avian and swine species. Results

from studies performed on poultry and pigs indicated that chickens and quail showed no signs of illness, but they were shedding Avian Influenza A (H7N9) virus. Pigs infected with the H7N9 virus on the other hand, did not amplify or shed the virus. This information was considered critical to prepare first responders in case this new and emerging virus reached the United States. ARS scientists also rapidly developed new diagnostic tests to ensure the virus could be quickly detected, and completed antigenic mapping studies to help identify virus isolates that could be used to develop a vaccine for poultry if needed. (Project #6612-32000-063-00D and 3625-32000-108-00D).

A safe, “leaderless” Foot-and-Mouth Disease (FMD) vaccine platform

ARS scientists at the Plum Island Animal Disease Center identified that if the lead sequence in the FMD virus is removed, it is rendered harmless to animals while still leaving it capable of growing in cell culture. This information has contributed to our understanding of how the FMD virus amplifies, interacts with an animal host, evades the host defense mechanism, and how various parts of the virus genome function. Importantly, ARS scientists used this information to produce a new “leaderless” FMD vaccine virus. The vaccine is safer than current FMD vaccine technologies that use naturally occurring (wild type) virus, because the “leaderless” attenuated FMD vaccine virus does not cause disease in animals. This is a major milestone in vaccine technologies because it will enable the safe production of FMD vaccines, and likely eliminate concerns that FMD vaccine viruses might escape from a manufacturing plant and cause a FMD disease outbreak. This will be especially beneficial for FMD free countries such as the United States, providing the capability to rapidly manufacture millions of FMD vaccine doses without fear of vaccine virus escapes. In addition, the “leaderless” FMD vaccine has been genetically modified to include two negative markers to differentiate it from wild type virus found in animals during a disease outbreak. A patent has been filed for this new technology which is being developed in partnership with a multinational pharmaceutical company. (Project #1940-32000-057-00D).

Elimination of persistent infection and transmission risk following the re-emergence of *Theileria equi* in the United States

Theileria equi is a tick-borne disease of horses that can cause severe acute disease characterized by fever, anemia, hemoglobinuria and, in some cases, death. Infected horses that recover from the acute disease become persistently infected for life. Disease caused by *T. equi*, called piroplasmiasis, has been eradicated from the United States, although in 2009, an outbreak of the disease occurred in Texas. Until recently, horses diagnosed with piroplasmiasis were either euthanized or quarantined for life due to the persistence of infection. ARS scientists in Pullman, Washington, developed a treatment regimen using imidocarb dipropionate to eliminate *T. equi* from naturally infected horses, and removed the risk of transmission of the pathogen to other horses. This allowed the horses to resume their previous lives and has facilitated international movement of horses between infected and non-infected countries. (Project #5438-32000-034-00D)

Development of a *Brucella suis* vaccine for feral swine

USDA continues to work to control brucellosis since an eradication program was initiated in the 1950s. However, the persistence of brucellosis in wildlife reservoirs (bison, elk, and feral swine) poses a risk for reintroduction to domestic livestock. New vaccines and diagnostics that can be applied to wildlife are needed. Brucellosis is not currently a problem in domestic swine. However, it is common in the millions of feral pigs present in the United States. Surveillance has shown that up to 35 percent of some herds of feral pigs may test positive for *Brucella*. In addition, transmission from infected feral pigs, which shed the organism in their urine to cattle, has resulted in dairy herds in the southeastern United States becoming positive for *Brucella*. Recently, ARS scientists in Ames, Iowa developed an experimental vaccine that has been shown to be protective against brucellosis in feral swine when administered orally or parentally. More research needs to occur to determine the optimal dose and efficacy data. However, the vaccine shows promise in reducing the risk of *Brucella* transmission from feral swine to humans and domestic livestock. (Project #3625-32000-111-00D).

Complete genome sequences of new emerging Newcastle disease virus strains isolated from China Five virulent Newcastle Disease Virus (NDV) strains were isolated from geese in China during 2010 and 2011. The

complete sequences of two NDV strains, and the sequences of the envelop glycoprotein genes (F and HN) of three other strains were determined. Phylogenetic analysis classified them into a new genotype, designated as genotype XII, which is genetically distinct from genotype VII, the predominant genotype responsible for most outbreaks of Newcastle disease in China in recent years. This is the first report of complete genome sequences of new emerging genotype XII NDV strains isolated from geese in China. This basic scientific information is critical to ensuring current molecular diagnostic tests can detect emerging viruses that may migrate from China and pose a threat to the United States. (Project #6612-32000-064-00D).

DEET mosquito repellent works by taste and smell

Current mosquito repellents are effective if used correctly, but dosages applied to the skin are very high. Prevention of disease transmission using repellents is a problem because people are reluctant to use unpleasant products until they have already been bitten. ARS scientists in Beltsville, Maryland, have been working to understand the physiological mode of action of repellents. They found that DEET not only affects odor receptors on mosquito antennae, but also taste receptors on the mouthparts. This new understanding that taste and odor are involved in the function of the repellent opens the door to more precisely targeted exploration for repellent active ingredients that work at much lower concentrations. This discovery will change the way that active ingredients in new repellents are evaluated and may ultimately lead to highly effective products that have a greater chance of preventing mosquito bites than current repellents. (Project #1245-32000-007-00D).

Gene silencing technology leads toward safe mosquito control

Only a very limited number of public health pesticides are available for controlling medically important vectors such as mosquitoes and sand flies. This novel approach is based on the technology that allows the specific silencing of genes critical to the survival of the target vector species. This technology uses double stranded RNA (dsRNA) and the process of RNA interference (RNAi) to prevent the synthesis of specific proteins in cells. By choosing the right target, it is possible to debilitate mosquito vectors of disease. ARS researchers in Gainesville, Florida, have demonstrated that a dsRNA construct targeting a gut expressed gene effectively shuts down production of that protein when fed to the adult yellow fever mosquito. The dsRNA was fed to the mosquitoes in a sugar meal and that protein production was stopped in 12 or 24 hours. Oral delivery of dsRNA to mosquitoes could be a practical way to deliver this new technology. The specificity of the dsRNA would prevent any danger to other insects, including pollinators. Also, only tiny quantities of dsRNA would be required which would reduce costs. This research will lead to products that have no nontarget effects and that are safe for humans and the environment. (Project #6615-32000-045-00D).

How house fly maggots live in bacteria rich media

House flies breed in places such as garbage and manure that host numerous species of bacteria. Many of those bacteria are human or animal pathogens. Remarkably, house fly maggots are seldom harmed by the soup of bacteria in which they live. The interaction of the maggot's own immune system and the bacteria in its medium is important in determining whether or not the adult flies emerging from the maggots will carry pathogenic bacteria. In collaboration with Clemson University, ARS scientists in Manhattan, Kansas, sequenced genes that were activated in immune stimulated house flies, and identified several sequences coded for molecules that protect the maggots from bacteria. Production of these substances creates a component of the maggots' immune system, thus allowing the maggot to live in contaminated environments and helps determine which pathogens survive in the adult fly. An understanding of the intricacies of the relationship between larval flies and bacteria will lead to better ways of protecting food and livestock from pathogens. (Project #5430-32000-003-00D).

Development of a new selective insecticide

One of the objections to the use of pesticides is their toxicity to organisms, including humans, that are not intended as their targets. Although residue limits to protect people on the basis of toxicological data exist, compliance with those limits can be a problem. From an environmental perspective, toxic effects on any vertebrate species would be considered undesirable. ARS scientists in Kerrville, Texas, collaborated with researchers at the University of Florida and Virginia Polytechnic Institute and State University (Virginia Tech), to

evaluate a synthetic carbamate insecticide, designated PRC-408, for the control of horn, stable, and sand flies. PRC-408 was as toxic to these insects as carbaryl, an efficacious, commercially available compound. An in vitro assay was used to demonstrate that PRC-408 exhibited approximately 300-fold higher specificity for its arthropod target compared with mammalian (i.e., bovine and human) targets, and may offer improved safety compared with other chemicals in its class. This research will result in new insecticides that are very safe to use but flexible in their application. (Project #6205-32000-033-00D).



ENVIRONMENTAL STEWARDSHIP

National Programs:

- **Agricultural System Competitiveness and Sustainability, NP 216**
- **Water Availability and Watershed Management, NP 211**
- **Climate Change, Soils, and Emissions, NP 212**
- **Pasture, Forage and Rangeland Systems, NP 215**
- **Bio-refining, NP 213**
- **Agricultural and Industrial Products, NP 214**

Controlling bacterial contaminations without antibiotics

Lactic acid bacteria frequently contaminate commercial fuel ethanol fermentations, reducing yields and decreasing bio-refining profitability. The current practice to control these bacterial contaminations involves antibiotics, but there is concern about the fate of these antibiotics in waste water and ethanol co-products used in livestock feed. ARS researchers in Peoria, Illinois, and Beltsville, Maryland, discovered antibacterial enzymes, called phage endolysins, that inhibit lactobacilli. The scientists have expressed the genes for endolysins in ethanol producing yeast. ARS has applied for a patent for this technology which ethanol bio-refineries can use to prevent bacterial contaminations and avoid large scale antibiotic use. (Project #3620-41000-135-00D).

Removing cellulase inhibitors from pretreated biomass

The most expensive step in converting biomass to fuels involves the use of cellulase enzymes to hydrolyze cellulosic biomass to fermentable sugars. One of the reasons for this high cost is that byproducts produced by pretreating cellulosic biomass significantly inhibit cellulase enzymes. ARS scientists in Peoria, Illinois, in collaboration with researchers at Purdue University, developed a low waste fermentation process to remove these enzyme inhibitors, and showed that this biological conditioning or “bio-abatement” process increases conversion of cellulose to fermentable sugars by 20 to 50 percent. (Project #3620-41000-133-00D).

Enzymes for preprocessing biomass

Breaking the chemical crosslinks between lignin and carbohydrate fibers would greatly improve the value of biomass for bio-refining or in livestock feed. Using genomic techniques, ARS scientists in Albany, California, discovered a new feruloyl esterase enzyme that eliminated these crosslinks. The scientists expressed the enzyme in *E. coli*, a bacteria used industrially to produce enzymes, and confirmed the enzyme's effectiveness when applied to rice bran, wheat bran, corn fiber, switchgrass, and corn bran. A patent application was filed; an industrial partner is considering using the technology to produce livestock feed. (Project #5325-41000-049-00D).

Low cost process for producing marketable pyrolysis oil

Pyrolysis converts biomass into bio-oil, a petroleum-like liquid that has the potential to be refined into renewable, drop-in replacements for petroleum-based fuels. However, bio-oil cannot be used by existing petroleum refiners because it contains too much oxygen. Although oxygen can be removed from bio-oil by catalytic hydrotreating (reacting with hydrogen) that process is expensive and reduces product yield. ARS researchers in Wyndmoor, Pennsylvania, developed and are patenting a relatively simple, non-catalytic process utilizing tail gas from the pyrolysis reactor to reduce the oxygen content of the bio-oil from 35 to 12 percent. The new process doubles the yield of distillate product and results in a more narrow range of products (5 to 10 compounds) versus traditional pyrolysis (hundreds of compounds). (Project #1935-41000-082-00D).

Early warning index for flash drought

The flash droughts of 2012 in the Nation's Corn Belt were rapid onset events fueled by below normal precipitation levels and a lingering heat wave that essentially "baked" moisture reserves from the soil profile. ARS scientists in Beltsville, Maryland, developed a satellite-based drought product called the Evaporative Stress Index (ESI) that provided early warning of the deteriorating crop and moisture conditions in 2012, preceding signals of increasing drought severity recorded by the U.S. Drought Monitor and many other standard drought indicators by several weeks. The ESI depicts areas of anomalously low water use and availability, derived from measurements of evapotranspiration (ET) generated with thermal infrared satellite imaging systems. Robust early warning of impending drought provides growers additional time to adjust cropping and marketing strategies during the growing season. ARS scientists are also working with researchers at the National Agricultural Statistics Service to establish the utility of using ESI records of seasonal crop stress to improve estimates of at-harvest yield. With minimal reliance on ground-based observations, the ESI shows good potential for monitoring food and water security at the global scale. (Project #1245-13610-028-00D).

Long-term data from an ARS experimental watershed validates NASA satellite-based rainfall estimates

Water is a critical resource in rapidly developing arid and semiarid regions. Accurate rainfall estimates are essential to effective management of agricultural production and critical water resources, but in many parts of the world, rugged terrain limits the deployment of rain gauges, while simultaneously blocking ground-based radar estimates of rainfall. Working with colleagues from the National Aeronautics and Space Administration (NASA), ARS researchers in Tucson, Arizona, compared rain gauge observations from the densely instrumented ARS Walnut Gulch Experimental Watershed, with rainfall intensity estimates from the Tropical Rainfall Measurement Mission (TRMM) satellite from 1999 to 2010. Results showed a very good agreement between the two sets of rainfall rate estimates, an important finding because rainfall is not well measured over large parts of the globe. The satellite design is also the basis for NASA's new Global Precipitation Mission. In addition to underscoring the importance of ARS' long-term research sites and the data sets they enable, the validation presages success for the new NASA mission. Among other benefits, the significance of quantifying precipitation worldwide has important implications for improving the world's capacity for food production in light of expected population growth and climatic uncertainty. (Project #5342-13610-011-00D).

Assessing feasibility and sustainability of bioenergy crop production

In collaboration with their university partners, ARS scientists in Temple, Texas, assessed the feasibility and sustainability of biofuel production in the eastern and central United States, in the face of growing energy production demands and climate change. Switchgrass productivity, estimated under both current and future

climate change scenarios, showed substantial variation both within regions and over time. In particular, the southern U.S. has the highest current biomass potential, but is predicted to have the largest future decrease in productivity, because the temperature is predicted to increase (and precipitation decrease) in this region. These results help develop a better understanding of the possibility for large scale biofuel production from perennial grasses in the eastern and central United States. (Project #6206-13610-007-00D).

New soil nitrogen test helps to reduce fertilizer applications

Current soil nutrient tests do not account for all sources of plant available nitrogen. Fertilizer recommendations based on these tests frequently overestimate application amounts, leading to a financial loss for the farmer and an increased environmental impact from the excess amounts. Cooperation between ARS scientists in Temple, Texas, and industry has led to the development and commercialization of a method to rapidly and inexpensively determine the total plant available nitrogen in soils. Since its introduction in September 2010, the new testing method, known as the "Haney Soil Health Test," has been adopted by 40 university and commercial soil testing laboratories. The 2012 estimated nitrogen fertilizer savings realized from reduced application recommendations based on analysis of 3,000 soil samples was \$2.5 million. (Project #6206-11220-005-00D).

ARS' greenhouse gas and biofuel sustainability Web-based database now accessible

Data management systems are needed to expand the availability of vast amounts of data generated by field studies. ARS researchers in Fort Collins, Colorado, and other ARS laboratories nationwide created and revised a general data entry template designed to accommodate comprehensive data from various cropping, biofuel, and grazing studies within the ARS Greenhouse Gas Reductions through Agricultural Carbon Enhancement Network (GRACEnet) and Renewable Energy Assessment (REAP) projects. Currently, data from 35 ARS units have been populated in the template, quality controlled, and uploaded to a relational database. A subset of this data is now publically available. Making the greenhouse gas (GHG) flux, soil, vegetation, and other data accessible and easily available is important for enabling a wider variety of researchers to perform meta-analyses, test existing GHG flux and crop growth models, and develop new models. (Project #5402-11000-010-00D).

Revegetation of barren superfund site using compost and gypsum

Wind and water erosion at a 300-acre abandoned asbestos mining Superfund site in Vermont represents a continuing risk to nearby populations. Without vegetation, the site will continue to erode and be a health threat. ARS scientists in Beltsville, Maryland, conducted a three year study to evaluate applications of manure compost plus a gypsum byproduct and fertilizers to obtain an effective vegetative cover of the soil. Results showed the surface applied amendments produced extensive vegetative cover of clover and grasses, while the control plots receiving simple fertilization remain barren. The EPA has estimated that revegetation using two feet of topsoil on the site would cost \$220 million, while revitalizing the soil using these soil amendments and leveling would cost only \$25 million, resulting in a significant savings to the public. (Project #1245-12000-040-00D).

Ammonia recovery from poultry litter with gas permeable membranes

Recovery of gaseous ammonia from poultry litter benefits bird health and productivity while reducing environmental emissions from poultry production. ARS scientists in Florence, South Carolina, investigated the potential use of gas permeable membranes as components of a new process to capture and recover ammonia in poultry houses. Prototype systems consistently reduced headspace ammonia gas concentrations from 70 to 97 percent and allowed recovery of 88 to 100 percent of the ammonium volatilized from poultry litter. The potential industry benefits of this technology include cleaner air inside poultry houses, reduced ventilation costs, a concentrated liquid ammonium salt that can be utilized as fertilizer, and a significant reduction in ammonia volatilization, which will reduce the environmental impact of the poultry industry. A patent application has been submitted for the process. (Project #6657-13630-005-00D).

Effects of grain processing on the carbon footprint of beef cattle

Most cattle in the southern Great Plains are fed diets based on steam flaked corn. Steam flaking corn uses additional natural gas not required when cattle are fed diets based on dry rolled corn. Using data from multiple

trials, ARS researchers in Bushland, Texas, calculated the effects of steam flaking on the carbon footprint of cattle fed high concentrate finishing diets. Despite the additional fossil fuel used in steam flaking compared to dry rolling corn, cattle fed steam flaked, corn-based diets produced less methane, excreted less organic matter (which decreased manure methane production), and improved feed efficiency, thus decreasing the quantity of corn required for finishing. Overall, steam flaking decreased the carbon footprint of cattle feeding by 8 to 18 percent compared to their being fed dry rolled corn. These results can be important in developing accurate life cycle analysis of cattle feeding and in improving sustainability of cattle production. (Project #6209-313630-003-00D).

Improved genetic selection technology for complex grass genomes

Genetic selection programs to improve economically valuable traits for forage grasses with complex genomes (polyploids) have been hindered by a lack of technologies to effectively target specific genetic markers and associated gametes. In response to this critical limitation, ARS researchers in El Reno, Oklahoma, have developed a gamete selection approach for tall fescue and rye grass that now provides forage breeders with breeding technologies similar to those used to effectively increase the yield and adaptability of corn and other commodity crops. This technology has the capacity to revolutionize grass breeding by increasing the rate of genetic progress several fold over conventional breeding strategies by identifying truly elite germplasm for use in subsequent generations through the development of dihaploid selection lines. (Project #6218-21410-003-00D).

Rapid DNA-based paternity testing assay for alfalfa

Alfalfa is the fourth most widely grown crop in the United States, following corn, soybeans, and wheat, with more than 20 million acres harvested in 2012. In alfalfa variety development programs, the pollen donors of plants being evaluated are most often unknown. This lack of paternal identity leads to slower genetic improvement from alfalfa breeding programs. ARS researchers in Madison, Wisconsin, conducted research in collaboration with an industry stakeholder to develop a low cost, rapid, DNA-based paternity testing laboratory assay for alfalfa, including necessary computational software. This new technology doubles the amount of genetic information available to alfalfa breeders, enabling them to target and select specific genetic lines that will significantly increase the yield and adaptability of existing and developing alfalfa varieties. (Project #3655-21000-056-00D).

Improved bioenergy type switchgrass cultivar with high biomass yield tested

Switchgrass cultivars for the northern half of the United States have been limited to upland ecotype cultivars because traditional lowland cultivars have poor winter survival in the region. Lowland switchgrass cultivars, however, have the potential to produce greater biomass yields if they had better winter survival rates. A new lowland type switchgrass cultivar, "Liberty," was released in 2013 by ARS researchers at Lincoln, Nebraska, after crossing northern upland and southern lowland plants followed by three generations of breeding selection for improved winter survival, high biomass yield, and low stem lignin concentration. Over a 3-year period in trials in Illinois, Nebraska, and Wisconsin, Liberty had excellent winter survival. In eastern Nebraska and northern Illinois, it had biomass yields that were two tons per acre greater than the best available upland cultivars. The experimental strain is in the ARS cultivar release process and has been planted in a foundation seed increase field. It will be the first bioenergy type cultivar for the Midwest and the northern Great Plains and will likely be adapted to the northeastern States as well. (Project #5440-21000-030-00D).

Carbon dioxide emissions from grasslands are affected by weather but not cattle stocking rates Grasslands represent the largest land resource in the world, yet little is known about how their management affects the carbon cycle. To help address this knowledge gap, ARS scientists in Mandan, North Dakota, measured carbon dioxide flux from native vegetation and crested wheatgrass pastures over three years. More carbon dioxide was emitted from soil of the crested wheatgrass pasture compared with a native vegetation pasture under heavy grazing; however, there was no difference in carbon dioxide emission between heavy and light grazing for native vegetation. Soil temperature and moisture status were strongly associated with carbon dioxide emissions, though associations were seasonally dependent with temperature most relevant during spring and fall, and moisture status most important in summer. Summer months were characterized by the greatest carbon dioxide emissions which corresponded to periods of warm but generally stable soil temperatures. Accordingly, weather conditions have a

strong influence on grassland carbon dioxide emissions, and as a result long term monitoring is necessary to confidently discern management effects on the carbon cycle. (Project #5445-21310-001-00D).

Biological means of controlling aphids in lettuce

Research is needed to identify efficient strategies for intercropping lettuce with plants, such as alyssum, that provide food for beneficial insects that are the natural enemies of aphids on lettuce. ARS researchers in Salinas, California, assessed the growing of alyssum with organic romaine lettuce and identified a novel intercropping pattern that allowed farmers to grow lettuce and alyssum without displacing any lettuce. This research provides the organic sector of the lettuce industry, which accounts for \$182 million annually in production, with information to fight the most economically detrimental insect pest to lettuce. This information is also applicable to conventional lettuce production valued at more than \$1.3 billion. (Project #5305-21620-012-00D).

Significant reduction of E. coli and Salmonella in high value produce cropping soils

Contamination of spinach and raw vegetables by E. coli and Salmonella has resulted in numerous cases of gastroenteritis, kidney failure, and even fatalities throughout the United States. Preventing contamination of fresh produce is an important strategy for protecting crops from contamination. This research revealed that covering soil with a clear plastic film (solarization) and using biofumigation techniques significantly reduced E. coli survival in a two week period compared with nonfumigated soil covered with black plastic. These results show that soil solarization combined with natural product biofumigants provide a quick and effective strategy to reduce E. coli contamination in high value produce cropping soils. These results will be of interest to organic and conventional leafy greens producers, processors, and marketers. (Project #1245-21660-003-00D).

Reducing nitrate losses in drainage water using cover crops

Nitrate in freshwater streams in the Mississippi River basin contributes to hypoxia in the Gulf of Mexico and requires removal by municipal water treatment plants. Much of the nitrate in the Mississippi River comes from land used to produce corn and soybean, especially if it has been drained with subsurface drainage systems. Oat and rye cover crops grown in the off season after corn and soybeans can significantly reduce nitrate losses in drainage water. During a five year period, ARS scientists in Ames, Iowa, showed that a cereal rye winter cover crop reduced the concentration of nitrate in drainage water by 48 percent. An oat fall cover crop reduced nitrate concentrations by 26 percent. The knowledge that both oat and rye cover crops are viable management options for reducing nitrate losses from corn and soybean production enable growers to contribute to reducing nitrate levels in the Mississippi River basin. (Project #5356-21610-001-00D).

3.10. Outreach Activities: Workshops, Field Days & Forums



Alabama:

National Soil Dynamics Laboratory

- Hosted the Soil Resources and Conservation class from the Crop, Soils, and Environmental Science Department at Auburn University (6/12/2014)

Arizona:

Arid-Land Agricultural Research Center (ALARC) (Maricopa, AZ)

- A technician was invited by Kansas State University to help set up an immunology lab using the protein marking procedure developed by ARS to study insect dispersal patterns in biofuel feedstock cropping systems. (12/15-12/19/13)
- Released v. 4.1.3 of the software package WinSRFR, used for the hydraulic analysis of surface irrigation systems. Version 4.1.3 was developed in response to an NRCS request. (2/19/14)

Pest Management & Biocontrol Control Research Unit (Maricopa, AZ)

- Presented research on pest management and biocontrol to over 3,500 government, university, industry scientists and pest management consultants at the 2013 Annual Entomological Society of America (ESA) conference. (11/10-11/13/13)
- Presented research updates to stakeholders at the Annual Focus Group Meeting held at ALARC, including accomplishments in *Lygus* bug chemical ecology, biochemistry, and transcriptomics, simulations of trap-based detection of invasive insects, and influence of transgenic crops on beneficial insects. (12/3/13)
- Scientists were invited to the Department of Entomology at Ohio State University to consult and help with setting up an immunological laboratory using protein mark-capture dispersal research to study the dispersal of bed bugs. (5/5-5/9/14)
- Unit research plans were discussed with a local representative of the Cotton Board as well as strategies to increase unit interactions with California and Arizona stakeholders. (5/13/14)
- Trained a PhD student from the Commonwealth Scientific and Industrial Research Organization (CSIRO) on molecular gut content analysis to identify key insect and spider predators in cotton. (5/19-5/30/14)

Plant Physiology and Genetics Research Unit (Maricopa, AZ)

- Co-hosted a forum at the Plant & Animal Genome conference and presented “A Forum to Frame Solutions to Bottlenecks in Phenotype Research” to approximately 80 researchers and stakeholders attended. (1/15/14)
- Presented at the Southwest Agricultural Summit on field-based phenomics using proximal sensing to approximately 50 growers, farm advisors and researchers. (2/27/14)

Plant Physiology & Genetics and the Water Management & Conservation Units (Maricopa, AZ)

- Co-hosted a workshop on high-throughput phenotyping for field experiments, with colleagues from the University of Arizona and Kansas State University to approximately 40 researchers and stakeholders. (4/7-4/10/14)

Water Management & Conservation Research Unit (Maricopa, AZ)

- Presented at the American Society of Agronomy, Soil Science Society of America International Annual Meetings on the unit’s research outcomes to approximately 4,000 attendees. (11/3-11/6/13)
- Presented research to stakeholders at the Annual Focus Group Meeting held at ALARC, including an overview of “GeoSim” georeferenced plant-soil-water simulation modeling research thrust and how it can help on-farm management. (12/3/13)
- Provided an update of state-of-the-art Nitrogen management approaches for southwest cotton and durum wheat for surface and sprinkler irrigation to stakeholders, including a private company. (2/27/14, 3/4/14, 3/5/14, 3/13/14)

Southwest Watershed Research Center (Tucson, AZ)

- Presented the history of the Walnut Gulch Experimental Watershed to the Santa Cruz Natural Resources Conservation District and the Hereford Natural Resources Conservation District to encourage attendance at the 60th Anniversary Celebration of the Experimental Watershed. (1/16/14, 2/19/14)
- Presented the history of the Walnut Gulch Experimental Watershed, which totally surrounds the town of Tombstone, at the Tombstone City Council Meeting to approximately 30 citizens. (2/11/14)

Arkansas:

Dale Bumpers National Rice Research Center (Stuttgart, AR)

- On February 11, 2014 Drs. Anna McClung and David Gealy gave presentations at a meeting with some 25 Arkansas rice growers that have interest in organic rice production. The meeting was organized by Stephen Hilsdon, Specialty Rice, Inc., Brinkley, AR which markets organic and aromatic rice in the US.

Dale Bumpers Small Farms Research Unit (Booneville, AR)

- Field day tour of the Dale Bumpers Small Farms Research Center in Booneville, AR, June 7, 2014 for approximately 40 livestock producers from the Arkansas Cattleman’s Association. The tour included a field demonstration of Subsurfer technology and a presentation and tour of watershed research to determine the effectiveness of conservation management for decreasing soil and nutrient losses in runoff from cattle pastures.
- In August 2014, Heifer International facilitated a project with the Arkansas Sustainable Livestock Co-op and Dale Bumpers Small Farms Research Service, in which some of the members raise sheep for meat production and are in need of help to improve their genetics, especially for rotational-grazing based parasite management. Five commercial Katahdin rams with exceptional breeding values (see www.nsip.org or National Sheep Improvement Program) for parasite resistance and maternal traits were transferred to five farms in cooperation with a USDA Organic Research and Education Initiative grant project for on farm research. ARS will assist in data and sample collection to determine performance of the ram and its offspring.

Poultry Production and Product Safety Research Unit (Fayetteville, AR)

- Scientist from the Poultry Production and Product Safety Research Unit worked with local farmers and the Association of Pastured Poultry Producers to host a two day Pasture Poultry Workshop May 2014. Participants included small farm poultry producers and targeted military veterans.

California:

Crop Improvement & Utilization (Albany, CA)

- Presented a progress report on molecular tools for refining future applications of biotechnology in citrus plants to a meeting of the California Citrus Research Board. (8/26/14)

Healthy Processed Foods Research Unit (Albany, CA)

- Held an infrared dry-peeling technology review and demonstration event. Five companies and the California Leagues of Food Processors attend. The technology eliminates water and chemicals and generation of wastewater. (9/4/14)

Produce Safety & Microbiology Research Unit (Albany, CA)

- Presented ways of using the Shiga toxin detection method developed in Albany to Scientific representatives of BASF. (2/4/14)
- Scientists transferred USDA top-down proteomic analysis software and in silico database construction software to Tohoku University Hospital, Miyagi, Japan. (8/29/14)

Immunity and Disease Prevention Research Unit (Davis, CA)

- Shared the results of a study that indicated that cherry consumption decreased circulating concentrations of several biomarkers for several chronic inflammatory diseases with California Cherry Advisory Board, cherry growers and packers. (3/5/14)

Crops Pathology/Genetics Research Unit (Davis, CA)

- Presented seminars on the development of surface renewal as a stand-alone technique to measure whole vineyard water use at economically viable costs to growers, vineyard owners, winemakers, and consultants from Napa and Sonoma Counties. (12/8/13, 12/11/13)

Commodity Protection and Quality Research Unit (Parlier, CA)

- Presented at the Tri-County Walnut Day Meeting in Visalia, CA on research quantifying damage caused by navel orangeworm in walnuts and examining management options. Over 300 growers and pest managers attended. (2/6/14)

Crop Diseases, Pests and Genetics Research Unit (Parlier, CA)

- Presented a third showing of advanced table grape selections during the 2013 harvest season to the Research Committee of the California Table Grape Commission and interested growers. (11/5/13)

Water Management Research Unit (Parlier, CA)

- Presented information on field trials with alternative crops for poor quality soils to 60-75 growers, students, industry, extension, and university personnel at a plant and soil conference. (2/5/14)
- Presented on biofuel production on poor quality soils in the San Joaquin Valley at the San Joaquin Valley biofuels partnership launch meeting. (2/28/14) Discussed specific research activities that may have potential economic and commercial value for agriculture in the San Joaquin Valley with representatives of two agricultural companies. (3/26/14)

Immunity and Disease Prevention Research Unit (Davis, CA) and Water Management Research Unit (Parlier, CA)

- Presented at the Pomology Extension Continuing Conference in Davis, CA on deficit irrigation of table grapes to approximately 30 UC Cooperative Extension Specialists in Pomology. (3/20/14)

Colorado:

Natural Resources Research Center (Fort Collins, CO)

- On February 11, 2014 the Natural Resources Research Center held a climate hub meeting in Fort Collins, CO. The meeting introduced the climate hub concept and was attended by northern Colorado mayors and city managers, Colorado State University, Senate staff, the Forest Service, Platt River Power Authority, Colorado Clean Energy, representatives from the White House, and ARS. The discussions focused on how the participants could work together on climate change issues.

Central Great Plains Research Station (Akron, CO)

- The Great Plains Research Station hosted three field days and two technology transfer meetings. The meetings were attended by hundreds of producers and other stakeholders including extension agents and NRCS professionals. The research staff discussed various dryland crop production issues. Topics included fertilizing triticale hay, soil microbiological activity as influenced by fallow and cover crops, and no-till and dryland cropping systems.

Sugar Beet Research Unit (Fort Collins, CO)

- On January 30, 2014 the Sugarbeet Research Unit held a strategic planning meeting. Attending this strategic planning session were 14 collaborators, stakeholders, and users of the research, 8 staff with the USDA-ARS Sugar Beet Research Unit, and 3 USDA-ARS administrators from the Northern Plains Area Office in Fort Collins. The outcomes of the meeting were a desire for new sources of disease resistance that could quickly be transferred to the industry including DNA markers for the source of resistance that would aid the industry's breeding programs. In the area of pathology, understanding the host/pathogen interaction was extremely important, at seedling, juvenile and adult life stages. Finally, durability of resistance was seen as very important, especially understanding the mode of action of both susceptibility and resistance.

Water Management Research Unit (Fort Collins, CO)

- On 8/8/14, WMRU held a field day at our Limited Irrigation Research Farm. The Day was co-sponsored and organized with Jose Chavez from CSU. Summarized the history of the research farm, which began in 1914 (100 yrs ago) as the USDA Potato Research Station, and has had WMRU research involvement at several periods since. We had 70 attend (not counting WMRU). A couple notable attendees were a large contingent from the state Div. of Water Resources, including the State Engineer (Dick Wolfe); and the governor's Special Policy Advisor on Water (John Stulp).

Agricultural Systems Research Unit (Fort Collins, CO)

- In November 2014, the Agricultural Systems Research Unit hosted a customer meeting of 22 field researchers from around the USA. The Unit demonstrated to attendees the results and value of the applications of models to field research data and provided them hands-on training in the use of the ARS crop system model RZWQM for six days. The Unit has also provided one to one training to interested customers, as well as continuing phone and email support to numerous customers all over the world.

Soil-Plant-Nutrient Research Unit (Fort Collins, CO)

- Several workshops were conducted during FY 2014. The Soil-Plant-Nutrient Research Unit conducted two Nitrogen Index workshops as part of the cooperative project with cooperators from the USDA Foreign

Agricultural Service, ARS-SPNR, several institutions in Mexico, the U.S. Embassy in Mexico, and the Enhancing Capacity for Low Emission Development Strategies (**EC-LEDS**) U.S. government program. This cooperative project in Mexico showed that there is potential to increase nitrogen use efficiencies, reduce reactive losses of nitrogen, and reduce emissions of N₂O. The first workshop the ARS-SPNR scientist conducted in FY 2014 was in Mexico, in cooperation with the Universidad Autonoma de Baja California, which covered the major travel costs of the ARS-SPNR scientist, and also in cooperation with the USDA-FAS EC-LEDS program, which covered the minor travel costs. There were 14 participants at the workshop, and about 150 participants at the conference's keynote seminar about the Nitrogen Index, including technicians, professors, consultants and farmers.

National Center for Genetic Resources Preservation (Fort Collins, CO)

- The National Animal Germplasm Program, which focuses upon the conservation of livestock genetic resources, held stakeholder meetings for small ruminant, swine and beef cattle customers in February and June. Participants included industry (producer) representatives, breed societies, land grant and historical black colleges and university scientists. At these meetings the status of animal gene bank collections were discussed and future collection activities planned. In addition at the beef cattle meeting an update of the genomics database currently under development was given and industry feed-back solicited and incorporated into the database development process. This was a critical step since beef cattle associations are considered to be a major user of the genomics database.

Florida:

Insect Behavior and Biocontrol Research Unit (Gainesville, FL)

- In April 22, 2014, Dr. Jesusa C. Legaspi gave a presentation entitled “Push-pull strategies and integrated pest management (IPM) of insect pests in vegetable crops”. She also participated in the FAMU Center for Viticulture and Small Fruits Research and Center for Biological Control, Tallahassee, FL, Vegetables and Small Fruits IPM and Spring Field Days on May 20, 2014.

Subtropical Horticulture Research Unit (Miami, FL)

- The Miami location hosted Dr. Craig Wilson for a week long program in different colleges and high schools. The objective of his visit was to make connections for future collaborations and to raise possible career profile and paths into USDA-ARS. He also made a presentation to Agricultural Science undergraduate students and professors.

Center for Medical, Agricultural and Veterinary Entomology (Gainesville, FL)

- Neil Sanscrainte, Gary Clark, Bonnie Ebel, Angela Quinata, Susan Wright, Bob Aldridge, Greg Allen, Christopher Polny, Heather Furlong, Betty Weaver, Everett Foreman, Jean Thomas, Nancy Fieleke, and Richard Mankin participated in the Florida State Fair at Tampa, FL from Feb. 6-17, 2014. An “Insect Encounters” booth was set up that served as an educational, interesting and fun event for the public.

Georgia:

Russell Research Center (Athens, GA)

- Poultry Microbiology Safety Research Unit: Hosted a Tunisian Fulbright Scholar – Dr. Raja Chalghoumi from the School of Higher Education in Agriculture-Mateur, Tunisia. She was sponsored by the Fulbright Visiting Scholar Program, Council for International Exchange of Scholars (CIES), Institute of International Education (IIE) with the U.S. Department of State. The impact of these type of research approaches are very important for the future of agriculture and needs all over the world.

Russell Research Center, Poultry Microbiology Safety Research Unit (Athens, GA)

- Dr. Arthur Hinton hosted visiting scientist participating in the Exchange Visitor Program established between Tuskegee University and the Egyptian Higher Education Ministry. Visiting scientists worked on collaborative research projects utilizing equipment that is not available at Tuskegee University. Scientists determined the ability of synthetic compounds and plant extracts to inhibit growth of pathogenic bacteria and spoilage bacteria.

Crop Protection and Management Research (Tifton, GA)

- Dr. Baozhu Guo is collaborating with Florida A&M University on drought stress study with summer student interns. Invited by Florida A&M University to give a presentation on Drought Stress and Food Security and Safety this summer.

Fruit and Nut Research Unit (Byron, GA)

- Dr. Tom Beckman collaborated with faculty from Fort Valley State University in a project to follow the Progress in the adaptation of tissue culture techniques to early season peach selections and new rootstock germplasm. Tours of the USDA laboratory and overview of programs for graduate students in the FVSU Molecular Biology Program were also provided.

Hawaii:

Tropical Crop and Commodity Protection Research Unit (Hilo, HI)

- Presented on the processing of purple-flesh sweet potato french fries at Mealani Taste of the Range, a local food expo and educational event. Approximately 1,000 growers, chefs, and consumers attended. (10/2/13)
- Presented on managing pests and postharvest practices for sweet potatoes at the University of Hawaii's Sustainable Agriculture Workshop: Special Focus on Sweet Potatoes. About 70 growers, shippers and Master Gardeners attended. (11/5/13)

Tropical Plant Genetic Resources and Disease Research (Hilo, HI)

- Gave presentations to Chinese media and officials on improving of papaya through classical breeding and biotech approaches, research resulting in deregulation of Hawaii GMO papaya in Japan, and efforts to deregulate Hawaii GMO papaya in China. (9/21/13)
- Hosted a tour of the Pacific Basin Agricultural Research Center to 10 researchers from the Chinese Academy of Tropical Agricultural Sciences. (11/1/13)
- Hosted a Center tour and overview of research to students and faculty members from two community colleges. (11/15/13), 2/11/14)
- Met with Dr. Lawrence Kent, program leader at Gates Foundation for cassava research and seven people from local agricultural and community organizations (12/7/13)
- Provided an overview of the coffee berry borer research to three growers (1/21/14) and at the Kona Coffee Farmer's Association Coffee Expo to 100 coffee growers and industry reps. (1/31/14)
- Provided a brief update on a new macadamia disease problem found on Hawaii to 15 macadamia nut growers, processors, extension personnel at the Hawaii Macadamia Nut Association meeting. (2/4/14)
- Led a tour and spoke to the Hawaii Business Roundtable group about research, including zero waste and the history of the development of Rainbow papaya and its benefits. (2/20/14)

Idaho:

Small Grains and Potato Germplasm Research Center (Aberdeen, ID)

- Dr. Fredric Barrows hosted numerous site visits from ingredient suppliers, feed manufacturers, and fish producers. He gave 15 interviews throughout the year that resulted in 11 articles in publications, including National Geographic, Mother Jones and the London Financial Times.

- Visited a major brewery's barley breeding program in Ft. Collins, CO and described the properties of low beta-glucan barley mutation. The company is now using the low beta-glucan line in their breeding program. (10/2013)
- Presented on testing for virus resistance at the Potato Variety Selection Advisory Committee meeting to seed and commercial potato growers and processing and fresh-pack industry representatives. Also presented on the promising potato clones from the breeding program. (3/4/14)
- Presented information about breeding schemes for removing unwanted side effects in transgenic barley to an international group of industry and public sector scientists, and regulatory personnel at a meeting in Ottawa, OT, Canada. (1/14-1/15/14)
- Presented information about developing Fusarium head blight resistant barley to producers and industry representatives at the Western Barley Growers Association, 37th Annual Convention, Calgary, AB, Canada. (2/12-2/14/14)
- Provided information to industry at the following venues: McCain Foods Crop and Storage Update, Burley, ID (2/26/14), potato field selection at Parma, ID R&E Center (8/7/14), Northwest Potato Research Consortium meeting in Boise, ID (10/23/13), and Idaho Potato Team Retreat in Sun Valley, ID (10/24-25/13).
- Hosted a tour for the board members of the American Malting Barley Association and discussed malting barley research (6/19/14). During the year the Unit also hosted visitors from Great Western Malting Company and the Craft Brewers Association for on-site discussions of malting barley research.
- Presented information about the Unit's potato breeding program and the University of Idaho Tetonia Experiment Station to the Idaho State Legislature Joint Finance-Appropriation Committee. (9/23/14)

Range Sheep Production Efficiency Research (Dubois, ID)

- Presented methods for natural selenium biofortification of livestock to approximately 100 international scientists, researchers, government food-regulatory representatives at an international forum, China. (11/13/13)
- Presented the strategic use of chlorate salts to minimize presence of pathogenic Enterobacteriaceae in the intestines and feces of ewes and neonatal offspring to approximately 80 US and European livestock producers, APHIS representatives, veterinarians, and livestock-product industry reps. (1/29/14)
- Sage grouse survey results acquired on ARS lands were submitted to Idaho Fish and Game. Results were combined with region-wide monitoring efforts of other agencies to estimate the status of sage grouse populations of the upper Snake River Plain ecoregion. Estimates were used to direct harvest limits and land-management objectives for 2014. (6/1/14)
- Presented model outcomes of predicting post-fire shrub recovery in a Mountain Big Sagebrush ecosystem at an on-site field tour to approximately 20 BLM, USFS, and NRSC field supervisors, range technicians, and wildlife biologists; and 20 ranchers, county commissioners, and rural economic development reps. (9/12-9/15/14)

Illinois:

National Center for Agricultural Utilization Research (Peoria, IL)

- Gave a presentation on biological control of ambrosia beetles carrying fungal diseases on avocado at a workshop on laurel wilt, in Homestead, FL. Workshop attended by approximately 100 growers, Florida Avocado Committee, Miami-Dade County extension and university extension scientists (05/2014).
- Presentation at the "Know Your Food, Know Your Farmer" event in Chicago, IL (hosted by USDA Rural Development Agency), on the use of biological control agents in farming. Participants included approximately 160 farmers, members of the ag industry and Illinois Department of Agriculture personnel (09/2014).

Iowa:

National Laboratory for Agriculture and the Environment (Ames, IA)

- Presentation on installing saturated riparian buffers for nitrate removal in tile drained landscapes at IA-MN-SD Drainage Forum 14 Nov., 2013, Sioux Falls, SD, to 100 drainage contractors and researchers.
- Presentation on Iowa's Water Quality Initiative – technologies for reducing nitrate and phosphorus contamination of surface water from farming activities at the Iowa Water Environment Association Region 4 annual meeting, 4 Apr., Carson, IA, 200 IAEWA – professionals in the water quality and water pollution control industry.
- Presented ArcGIS software tools to assist in development of watershed conservation plans in Ames, IA. Workshop held to demonstrate software and beta version of these software tools provided to 25 users from 6 states, including NRCS, state agencies, county governments, commodity and environmental organizations, and university faculty, staff, and graduate students, who are assisting in trialing its use in variety of Midwestern watersheds. 8/21-22/2014)

Kansas:

Arthropod-Borne Animal Diseases Research Unit (Manhattan, KS)

- Presentations were made at the USAHA Bluetongue Committee meeting to approximately 200 people; and at “One Health – One World Approach to Arboviral Diseases” at the FAO/IAEA consultant's meeting on “Advances in Development of Early Warning Tools for Detection of Vector-borne Diseases of Animals, including Zoonosis - Focus on Vectors,” to approximately 50 people.

Grain Quality and Structure Research Unit (Manhattan, KS)

- Over 100 visitors toured the GQSRU facilities and discussed grain quality related projects with unit scientists. The visitors included public and private sorghum and wheat breeders; Great Plains commodity commission members; US Wheat Associate Trade Teams; domestic and international food processors.

Hard Winter Wheat Genetics Research Unit (Manhattan, KS)

- HWWGRU and GQSRU participated in the Annual Hard Winter Wheat Worker's Field Day on 13 May 2014 in Chillicothe, TX. The event was attended by approximately 40 wheat researchers, students, and industry representatives. During field tours, information on new varieties and test results for quality traits, pest resistance, and agronomics traits were shared. At the business meeting after the field tour, HWWGRU researchers provided updates on research results and discussed the use of next-generation sequencing for genotyping wheat lines. GQSRU researchers reported the milling and baking results from the previous year and distributed handouts and CDs.

Stored Product Insect Research Unit

- Information on using cold temperatures to kill stored product insects was presented to a training session sponsored by the Industrial Fumigant Company Cold. This was part of their annual management training program in Kansas City, MO on 13 February 2014. Approximately 150 pest management professionals were in attendance.
- Information on how to evaluate aerosol insecticide efficacy was presented to 25 pest management professionals and millers at the International Association of Operative Millers on May 21 2014 in Omaha, NE.

Louisiana:

Cotton Structure & Quality Research Unit

- Hosted a visit and tour for a group from the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia and the Agricultural Research Centre for International Development (CIRAD) of France for discussions on current CSIRO, CIRAD, and CSQ research and potential future collaborations. (1/10/2014)

Food Processing and Sensory Quality Research Unit

- Hosted a visit and tour by Japanese International Food Technologist delegates where they were presented with an overview of research activities. (6/25/2014)

Sugarcane Research Unit

- Hosted a visit and tour of the Australian Vocational Training Team included business leaders in the fields of Agriculture, Farming, and Ranching. (3/20/2014)
- Co-host the annual USDA-LSU AgCenter Sugarcane Field Day for approximately 100 guests - including local farmers, and extension/sugar industry personnel. (6/6/2014)
- Hosted a visit and tour of a Philippine delegation of 15 sugarcane industry personnel. (6/2014)

Maine:

Genetic Improvement for Fruits & Vegetables Laboratory

- Conducted the annual Potato Breeding Program's Cooperators' Harvest *in* Presque Isle, ME for over 900 different advanced selections with input provided by university scientists and extension personnel from Florida, North Carolina, Maryland, Pennsylvania, New York, Maine and two private growers (9/14-16 2014)

Maryland:

Office of Technology Transfer

- Co-hosted with ARP member, Montgomery County Department of Economic Development, a listening session and forum on crop production in plastic high-tunnels. The Maryland event was video-taped, edited into several modules, and placed on the OTT website

Beltsville Area Office

- Host Site of the Hispanic Serving Institutions Program Managers Annual Meeting, January 2014: The Beltsville Area (BA) hosted the National Institute of Food and Agriculture (NIFA) Hispanic-Serving Institutions (HSI) New Project Directors Training. The event was organized by the Beltsville Area Diversity Taskforce and NIFA Program Managers with the purpose of encouraging collaborations between faculty from the Hispanic Serving Institutions and Beltsville Area scientists. The visiting faculty members and students were from 23 colleges and universities in Texas, California, Puerto Rico, Florida, and New Mexico participated. The agenda was developed to maximize dialogue among participants and to expose the students to career opportunities available at USDA. January 9-10, 2014
- Coordinated and co-sponsored with the University of Maryland a Symposium on Climate Change food and environmental security. Approximately 125 people attended the event. Dr. Charles Walthall delivered a keynote address outlining the challenges agriculture faces including the need for 70% more protein than is currently produced to meet population demands and how climate change presents challenges for meeting that demand. The symposium included a poster session highlighting research conducted by the University of Maryland and Beltsville Area scientists that centered on the symposium topic.
- BARC Poster Day publicly recognized the newest Research Scientists, Visiting Scientists, and Post-doctoral Research Associates. The event also provided an opportunity to present research results to the scientific

community and others interested in advances in agricultural research. Students from Area High Schools who conducted research projects under the mentorship of Beltsville Area scientists also participated. FAR-B provided financial support so the students could present their work along with BA post-docs and visiting scientists at BARC Poster Day. April 30, 2013.

- The Hispanic Serving Institutions (HSI) Learning Experience at Beltsville, The Beltsville Area Diversity Taskforce-Leadership Advisory Subcommittee and the ODEO Program Manager organized the HSI Learning Experience program which provided approximately 30 Hispanic students with a two month learning experience that will prepare them for future USDA careers. ARS Mentors were identified for 30 undergraduate, graduate, and PhD students from several Hispanic Serving Institutions, which included universities located in Puerto Rico, Florida, and Texas.
- Wallace-Carver Intern Program-The Beltsville Area hosted the Wallace-Carver Intern program of approximately 20 interns in a scheduled program. The specific program details included an overview of the Beltsville Area and its programs delivered by the Area Director, Dr. Joseph Spence; guided laboratory tours of the Beltsville Human Nutrition Research Center's Human Study's Center, the Bee Research Lab, and the U.S. Agricultural Library. June 2014.
- Presidential Leadership Academy, Coahoma Community College, Coahoma, Mississippi: Forty high school juniors and seniors participating in Coahoma Community College's first Presidential Leadership Academy camp received a first-hand look at the agriculture industry as they visited the Beltsville Agricultural Research Center.

Floral and Nursery Plant Research Unit

- Attended the mid-Atlantic Nursery trade Shows (MANTIS) at the Baltimore Convention Center that included over 10,000 registrants including exhibitors (nursery, landscaping, floral, etc.) Exhibitors: 984 companies in 1500 booths FNPRU and other and the National Arboretum staff distributed posters, brochures, and postcards to attendees maintaining relationships with stakeholders. January 9-11.

Electron and Confocal Microscope Unit

- University of Maryland Day -- the lab showcased its capabilities including research in mite structure, habitat, as beneficials and as pests. In conjunction with Hitachi a working portable scanning electron microscope was on display providing a real time photographic exhibit showcasing ability of the lab and equipment. Hundreds of visitors viewed and participated in the exhibit at the College Park campus. April 26, 2014.

Environmental and Food Safety Lab

- EMFSL hosted 40 middle school and high school teachers from around the country who participated in a week long training sponsored by FDA.

Environment Microbiology and Food Safety Laboratory

- Hosted the second BARC Food Safety Conference and NIFA project team member and stakeholder advisor meeting. Many industry stakeholder advisors and collaborators flew across the country to attend the meeting. In addition, approximately 15 industry members of the United Fresh Produce Association and 10 Consumer Safety Officers from the FDA were attended this event. The researchers presented findings and provided a tour of the facilities to the attendees. September 10-11, 2014.

Genetic Improvement for Fruits and Vegetables Lab

- Organized and hosted the annual Mid-Atlantic Plant Molecular Biology Society annual meeting at the Patuxent Wildlife Center <http://bioinformatics.towson.edu/mapmbs/organization.aspx> [august 21 and 22](#).
- Bob Rouse Agriculturalist, LLC, Grower Client Meeting in Owings, Maryland, December 10, 2013. "‘Flavorfest’ availability and low-tunnel update"

Hydrology Research Laboratory

- Ali Sadeghi and Megan Lang from organized a seminar and field tour for a delegation of six South Korean scientists and engineers on May 29, 2014. The objective of the visit was for the Korean delegation to learn about USDA ARS water quality research activities related to Chesapeake Bay and to provide the Korean delegation with new research ideas and approaches that could be applicable to similar ecosystems within Korea. A one-day seminar and a visit to the Choptank watershed was arranged for the delegation and presentations from UMD faculty members, NRCS staff, and several scientists from HRSL were made. Dr. Adel Shirmohammadi (Associate Dean for Research and Associate Director of the Maryland Agricultural Experiment Station, College of Agriculture and Natural Resources, University of Maryland) and the Korean visitors expressed great appreciation for the seminar and tour.
- Ali Sadeghi from HRSL was invited to participate and organize an exchange program on “The Impacts of Climate Change on Animal Productions and Environment” that was funded by the Department of State, under the International Visitor Leadership Program (IVLP).
- A meeting on future research collaborations between ARS Hydrology and Remote Sensing Laboratory SYs Martha Anderson, Bill Kustas and Feng Gao and Embrapa LABEX administrators and researchers Carlos Lazarini, Cornélio Zolin, Eduardo Assad, and Daniel Victoria was held on March 27, 2014. The discussions focused on the continuity of the project "Satellite-based monitoring of drought and water use over Brazil", as well as on new potential collaborations. After ARS and Embrapa research overview presentations on the topic and specific presentations on hydrological models and the use of satellites for ET and drought monitoring, a discussion led to development of a research plan to be conducted by HRSL and Embrapa researchers over the next 2 to 3 years. In August 2014, Martha Anderson accompanied Dr. Lazarini and Drs Walthall and Walbridge from the National Program Office on site visits to several Embrapa facilities to further cement collaborative plans.

Systematic Entomology Laboratory

- SEL mentored over 70 individuals in cooperation with the Smithsonian Museum of Natural History programs and USDA programs. These individuals included participants from all over the US and several foreign countries. Participants learned about entomological research and curation activities that involve USDA, SEL scientists in the National Collection.

National Germplasm Resources Laboratory

- Provided the lead instructor at the Crop Wild Relatives Workshop, hosted by the Keweenaw Bay Indian Community (KBIC), at Baraga, MI on August 5 – 6, 2014. The workshop was sponsored by the Cedar Tree Institute, as a part of their 2014 Zaagkii Wings and Seeds Project, and was in partnership with the U. S. Forest Service (USFS) Eastern Region and the USDA/ARS. The workshop introduced the tribal members to crop wild relatives, native plants that are closely related to food crops, with a major focus on the crop wild relatives that are native to the United States. Conservation and use of these plants is a critical element of future food security. Speakers from the Chicago Botanic Garden and Ferris State University also made presentations on seed collecting and documenting wild plant populations.

Soy Bean Genomics Improvement Lab

- Co-hosted the annual Mid-Atlantic Plant Molecular Biology Society annual meeting at the Patuxent Wildlife Center <http://bioinformatics.towson.edu/mapmbs/organization.aspx> august 21 and 22
- Dr. Savithiry Natarajan presented an invited talk on Application of proteomics in analyzing transgenic soybeans” at the Directorate of Soybean research (ICAR), India to over 100 government, university and private sector scientists.

Sustainable Perennial Crops Lab

- Hosted the World Cocoa Foundation/Beltsville Agricultural Research Center, Roundtable webinar and meeting for stakeholders and cacao researchers. The meeting was attended by approximately 30 stakeholders. (6/3/2014)

National Data Lab

- Nutrient Data Laboratory (NDL) released the 27th version of the **USDA National Nutrient Database for Standard Reference (SR)** in August 2014 on the web at <http://www.ars.usda.gov/Services/docs.htm?docid=8964>. SR is the primary food composition database used in the U.S. and internationally, containing data for over 8,600 food items for up to 150 nutrients and food components. The public can access the database using the online search program. Over 1.3 million unique users accessed the program 2.3 million times in the past year.
- NDL released the first version of **USDA's Expanded Flavonoid Database for the Assessment of Dietary Intakes** in September 2014 on the web at <http://www.ars.usda.gov/Services/services.htm?modecode=12-35-45-00>. It contains data for 29 flavonoid profiles for about 3,000 foods used for processing dietary intakes for What We Eat In America, National Health and Nutrition Examination Survey 2007-08. The database will be used to estimate flavonoids intakes in the U.S. population and to correlate health outcomes with flavonoid intake.
- NDL developed and released an updated **Ground Beef Calculator**, an on-line search program to generate nutrient profiles for retail ground beef based on fat levels between 3 and 30% fat, for raw and four different cooking methods. The data are derived from NDL's analytical study which established the mathematical relationship between the total fat content of raw ground beef and various nutrients. Estimates for protein, fat, minerals, vitamins, and major fatty acid classes (including saturated and trans fatty acids) are provided at <http://www.ars.usda.gov/Services/docs.htm?docid=13933>
- The USDA Nutrient Data Set for Retail Veal Cuts was released by NDL in September 2014, presenting veal nutrient data in an easily usable table format. These data are available as a result of a collaborative research study with Colorado State University, to update and expand data for several veal cuts in the USDA National Nutrient Database for Standard Reference. This publication provides access at <http://www.ars.usda.gov/Services/services.htm?modecode=12-35-45-00> to current and accurate data to comply with USDA's Food Safety and Inspection Service (FSIS) proposed label regulations for fresh meats.
- The USDA Table of Cooking Yields for Meat and Poultry, Release 2 is an updated version of cooking yield data provided by the NDL for over 150 cuts of fresh beef, pork, chicken, turkey, and game. Cooking yields are used in food formulations and recipes to convert nutrient values for uncooked foods into values for cooked foods. USDA yield data provide researchers, nutrition professionals, industry officials, and consumers with important information for reference and for making decisions regarding food preparation. These data were released in September 2014 at <http://www.ars.usda.gov/Main/docs.htm?docid=9448>

Foreign Disease Weed Science Research

- "Biological control of Canada thistle using a rust fungus and releasing APHIS-approved pathogens for control of Russian knapweed and Russian thistle"
- Cooperators: USDA, ARS, Foreign Disease-Weed Science Research Unit, Ft. Detrick, MD and Conservation Services, Biological Pest Control, Palisade Insectary, Palisade, CO, Colorado Department of Agriculture.

Michigan:

Sugarbeet and Bean Research Unit (E. Lansing, MI)

- Presentation to about 100 growers and packinghouse operators about automated apple infield sorting technology at Michigan State University Controlled Atmosphere Clinic and Storage Workshop, Grand Rapids, August 6, 2014.
- Canned Beans Evaluation Training, Jan 10, 2014 (1.5 hr), MSU Agronomy Farm. Training was held for 20 people who work in dry bean breeding, genetics and agronomy. The training covered the description and

importance of canning quality in beans, and also explained the rating scale along with a practice evaluation with the participants.

- Participated in training session for doing isolation and general identification of fungal pathogens organized by CIAT-Africa and Rwandan Agriculture Board (RAB). Approximately 18 agriculture and research personnel from Rwanda took part in the training. In addition, provided some short written protocols and pictures of diagnostic characteristics. (May 12-14, 2014)

Minnesota:

Plant Science Research Unit (St. Paul, MN)

- Presented information on prospective field-specific recommendations for nitrogen fertilizer needs of corn following alfalfa to 50 producers, commercial crop management advisors, and scientists at the Midwest Forage Association Symposium in Wisconsin Dells, WI (01/20/2014), to 65 producers, commercial crop management advisors, and extension personnel at the Tour de Forage at Royalton, MN (01/05/2014), and to 30 certified crop advisors at Paynesville, MN (03/19/2014).
- Presented information on emerging alfalfa diseases and fungicide use in alfalfa at the Midwest Forage Association annual meeting (01/20/2014) for approximately 50 producers, commercial crop management advisors, and extension scientists (Wisconsin Dells, WI) and Forages For U Workshops in Kingston and St. Charles, MN with approximately 25 producers and crop consultants at each workshop.

Soil Management Research Unit (Morris, MN)

- Organized and conducted a field day under the theme “Public-Private Partnerships in Agricultural Research.” Recruited speakers and local organizations who participated and contributed displays of their public services in relation to agriculture and rural development. The public learned new research developments in new health food crops and products, bioenergy, and ecosystem services (8/14/14).
- Invited by several local, regional and international civic groups and centers, and presented/provided information and documents on water in agriculture and the environment, breads of native cultures, long-term agro-ecological research and its future value for watershed management, climate change impact on crop yield and quality, the value of hulled wheats in developing healthy food products and in mitigating biotic and abiotic stresses, rural climate change dialogue, Native American Heritage Seed and its potential nutritional and environmental values, crop genetic resources in Georgia, and evaluation of BARD research proposals/projects (various dates).
- Advised farmers, farmer groups, and entrepreneurs from MN, ND, CA, UT, and OR on selection, management, and characteristics of adapted ancient wheat species as sources of healthy food and new products (various dates).
- Hosted a visit and field tour from a group of 50 farmers from France and the United Kingdom, all with the organization Biodiversity Agriculture Soil and Environment (BASE). Topic was on research on perennial living mulch systems.

Mississippi:

Office of Technology Transfer

- Co-hosted with ARP member, Innovate Mississippi, a listening session and forum on renewable energy and bio-products.

Biological Control of Pests Research Unit

- Hosted a visit and tour for the U.S. Army Corps of Engineers Research and Development Center, Vicksburg, MS to discuss possible collaborative research on biological control of aquatic weeds. (3/13/2014)

Cotton Ginning

- Hosted a meeting for the International Cotton Institute with 36 participants from 14 countries to review current research activities and demonstrate the mico-gin. (5/29/2014)
- Co-hosted a meeting with Delta Council for the Southern Cotton Ginners Association, speaking to producers and ginners on the latest research in cotton ginning (7/24/2014)
- Along with the Cotton Technology Transfer Coordinator, hosted the 29th Annual cotton Ginner School in Stoneville. Attendees included gin managers and operators (over 100) with speakers (20) from ARS gin labs and the cotton industry (6/3-5/2014)
- Hosted a visit and tour for the Mississippi Farm Bureau Young Farmer and Ranchers Board of Directors. (8/15/2014)

Crop Production Systems Research Unit

- Delta Ag Expo – Set up a booth to demonstrate new technologies in irrigation and water management for Producers and Crop Consultants. (1/23/2014)

National Sedimentation Laboratory

- Hosted a visit and tour for the MRCS in Mississippi to promote collaboration. (3/21/2014)
- Hosted a workshop for the RUSLE2 (Revised Universal Soil Loss Equation, version 2) program team meeting. (7/14-18/2014)

Technology Transfer Office

- Delta Ag Expo – Organized with Cathy Cohn a listening session to discuss water issues, resistant weeds, and workforce development, 23 in attendance. (1/23/2014)

Thad Cochran Southern Horticultural Laboratory

- Hosted visitors and tours for the annual Blueberry Jubilee for approximately 200 visitors, and attracts over 10,000 visitors to the area. (6/14/2014)

Warmwater Aquaculture Research Unit

- Hosted a visit and tour for a delegation of the School of Fisheries, Huazhong University, Wuhan, China and discussed issues of common interest. (5/15/2014)

Missouri:

Biological Control of Insects Research Unit and Plant Genetics Research Units (Columbia, MO)

- Demonstrated the use of natural enemies for insect pest management at educational events for a People's Garden. Participants included parents of children in University of Missouri's Child Development Lab, as well as to students of local primary schools (multiple dates).

Montana:

Fort Keogh Livestock & Range Research Laboratory (Miles City, MT)

- On June 13, 2014 the Fort Keogh Livestock and Range Research Laboratory hosted the Montana Stockgrowers for a tour as part of their summer meeting. The tour consisted of a stop out at the Cover Crop Study and talk by Dr. Richard Waterman, a talk about the Water Quality work by Dr. Mark Petersen, A stop by the pasture where the beef cow longevity and efficiency with limited feeding management takes place and a talk by Dr. Mark Petersen, and the last stop was up at Upper Cottonwood with a talk on Fire Effects in the Northern Great Plains by Dr. Lance Vermeire. With three buses and several vehicles, over 200 people attended the talks.

- Impacts of ongoing range cattle production efficiency research and innovations for arid land management were evaluated by a wide-ranging focus group for the USDA-ARS Fort Keogh Livestock and Range Research Laboratory, located at Miles City, Montana in September of 2014. This group meets annually to critique and promote research conducted by the scientific staff at the Laboratory. The focus group is comprised of residents of four states, ranging in age from 38 to 84, are professionals in varied sectors of rangeland livestock industry (production, finance, allied industries, Montana State University extension etc.) and representative of a number of agricultural organizations. Scientists interacted with focus group members with brief presentations of important study results and analysis followed by questions, comments and impressions.

Northern Plains Agricultural Research Laboratory (Sidney, MT)

- The Northern Plains Agricultural Research Laboratory held its Fall Customer Focus Group meeting at the research facility on Nov. 25th. The Focus Group was given an overview of the previous year's research and accomplishments. A more in depth research presentation on existing grasshopper research at the lab was also presented.
- The Northern Plains Agricultural Research Laboratory hosts two half-day Field Days each year at its dryland research farms located near Sidney and Froid, MT. This year, the Laboratory also invited the Montana State University Sidney station to participate with in ARS' Sidney farm Field Day. Sidney ARS received several positive comments about the joint venture from members of the Focus Group and public.

Nebraska:

U.S. Meat Animal Research Center (Clay Center, NE)

- A Swine Focus group meeting was held November 21-22, 2013, which consisted of 12 outside industry collaborators and various U.S. Meat Animal Research Center scientists. Presentations of the research were made to the Focus Group and group discussions took place during a day and half. The intention was to gain insight into the swine industry needs and obtain feedback on the direction the research should go based on the industry needs and focus.
- ARS scientists at the U.S. Meat Animal Research Center (USMARC) in Clay Center, Nebraska, hosted the Nebraska Cattlemen's Annual Board Meeting on April 2. The Nebraska Cattlemen's Association is an organization dedicated to representing the beef cattle industry to legislative and administrative branches of state and federal government. They explain beef production to public and private organizations and provide economic and production information to members to aid in planning and management. The group consisted of approximately 40 members. Dr. John Pollak presented an overview of the Center's research related to beef cattle, swine, and sheep species along with a concentrated focus on the beef cattle research.
- To celebrate the 50th anniversary of the U.S. Meat Animal Research Center (USMARC) in Clay Center, NE, different special events have been taking place this year. One such event, the 50th Anniversary Symposium, was held on June 4, 2014, and was attended by over 80 legislators, agency leaders, retired MARC scientists and administrators, stakeholders, and other invited guests. The symposium commenced with presentations by Steven Kappes, ARS Deputy Administrator for Animal Production and Protection; Center Director Emil J. "John" Pollak; and Ronnie Green, former ARS National Program Leader for Food Animal Production. The theme of the presentations was "Value of Publicly Funded Research." Other activities included poster presentations by USMARC scientists and driving tours of the property. Attendees were also treated to a special presentation on the history of USMARC given by retired Research Geneticist Larry Cundiff, a 2012 ARS Science Hall of Fame inductee. USMARC encompasses 34,000 acres of land; boasts large populations of beef cattle, sheep, and swine; and is home to a premier research program focusing on solutions to high-priority problems in meat animal production.
- To commemorate its 50th Anniversary, the U.S. Meat Animal Research Center (USMARC) in Clay Center, Nebraska invited breed association groups to visit USMARC for presentations, meetings, and tours in 2014. Throughout the year, USMARC has welcomed representatives from several beef cattle breed associations, including:

- Ten members from the National Junior Red Angus Board of Directors on June 17
- Approximately 10 representatives of the American Akaushi Association on June 18
- Twenty-five American International Charolais Association members on June 18
- More than 20 members from the American Tarentaise Association on June 18
- Thirty representatives of the Western States Red Poll Association on July 25
- As part of the executive board meeting for the American Sheep Industry Association (ASI), the U.S. Meat Animal Research Center (USMARC) in Clay Center, Nebraska welcomed 17 ASI board members and staff for a visit on July 16, 2014. Upon arrival, Dr. Kreg Leymaster provided a welcome message and overview of the sheep research at USMARC.
- In conjunction with the annual Beef Improvement Federation (BIF) meeting, which was held in Lincoln, Nebraska June 18-21 2014, the U.S. Meat Animal Research Center (USMARC) in Clay Center, Nebraska hosted tours for BIF attendees. Close to 100 beef industry professionals, producers, and researchers took part in the post-conference BIF tour of USMARC on June 21.
- ARS Scientists at USMARC met with and discussed past and future research with 11 members of a Beef Focus Group on Sept. 15-16, 2014, Clay Center, NE. The group consists of commercial, seed stock and feedlot producers, stakeholder organizations (NCBA, breed association) and researchers. The intention was to gain insight into trends in the beef cattle industry that will create needs in research and obtain feedback on the value of research going on at the Center to the industry.
- ARS scientists at the U.S. Meat Animal Research Center (USMARC) in Clay Center, Nebraska, hosted the 10th Annual Katahdin Hair Sheep International (KHSI) Expo and meeting on August 7-8. The Katahdin Hair Sheep International Association registers Katahdin sheep, records performance data, assists in promotion and marketing, and encourages research and development of Katahdin sheep.

Grain, Forage, and Bioenergy Research Unit (Lincoln, NE)

- The Grain, Forage, and Bioenergy Research Unit held a number of field days around the State of Nebraska focused on establishing and managing perennial grasses for bioenergy and forage. Meetings were held in Chardron, NE, Kearney, NE, Beaver Crossing, NE, Humboldt, NE, and Lincoln, NE. Additional field days on hard winter wheat and sorghum were also held in 2014.

Agroecosystem Management Research Unit (Lincoln, NE)

- Scientists from the Agroecosystem Management Research Unit participated in the Antimicrobial Resistant Bacteria and the Environment - Nebraska Manure Demonstration Day in Lexington, NE. July 29, 2014. Workshop attended by producers, university extension educators, and consultants to learn about issues associated with antibiotic resistance in agricultural systems.

Nevada:

Great Basin Rangelands Research Unit (Reno, NV)

- Hosted a field tour for 68 individuals (ranchers, federal and state land management agencies) and demonstrated current technology to control cheatgrass and reestablish native sagebrush vegetation. (6/12-6/13/14)
- Hosted a field tour for 60 ranchers, federal and state land management agencies and Congressional representatives of the Porter Canyon Experimental Watershed and reviewed current research addressing Current techniques to quantify hydrologic budget of watersheds that have been encroached by Pinyon and Juniper trees. (6/12-6/13/14)
- Participated in the Natural Resource field day. Approximately 200 people stopped by the ARS booth and discussed current research on how to reduce impact of cheatgrass in the Great Basin. (9/20/14)

New Jersey:

Genetic Improvement for Fruits & Vegetables Laboratory

- Co-hosted the North American Blueberry Research and Extension Workers Conference. Atlantic City, NJ, with Rutgers University. (June 23-27, 2014)
- Co-hosted the Cranberry Growers Summer Meeting. Marucci Center, Chatsworth NJ, with Rutgers University. (August 22, 2014)

New Mexico:

Cotton Ginning Research Unit (Mesilla Park, NM)

- In May 2014 the Cotton Ginning Research Unit hosted a three day cotton ginning school and short course given in cooperation with the National Cotton Ginners Association. These classes are attended by gin operators and managers from across the cotton belt (about 40 in all this year). The instruction covers everything from safety to repair and operation and covers both roller and saw ginning.

Range Management Unit - Jornada Experimental Range (Las Cruces, NM)

- In February, April, May, June, July, and August of 2014 the Range Management Unit at the Jornada Experimental Range held Public Land Monitoring and Assessment Workshops. These workshops provided training for federal land managers on techniques for monitoring and assessing conditions of rangeland landscapes in the western US.
- In June 2014, the Range Management Unit at the Jornada Experimental Range held the SW Region USDA Climate Hub Workshop. The program was conducted by the University of Arizona Cooperative Extension in conjunction with SW Climate Hub on climate smart agricultural practices for agricultural producers in SE Arizona.

New York:

Plant Genetic Resources

- New licenses have been requested by newly formed nurseries in Virginia and well established nurseries like Sierra Gold in California. Internationally, UniViveros a Chilean subsidiary of the UniFrutti company visited Geneva in August with other Uruguayan and Chilean nurseries to understand stool bed establishment and production methods for Geneva rootstocks. Dutch nurseries, and Better3Fruit (producers of the Kanzi apple) also visited the breeding program looking to adopt Geneva rootstocks and to fund collaborative research on replant disease. (7/31-8/1/14)

Biological Integrated Pest Management (Ithaca, NY)

- Demonstrated approaches for microbial control of the coffee berry borer to agricultural producers and university scientists in Hawaii. (3/10-3/20/14)
- As part of a 'Science Without Borders' project in Goiania, Brazil, presented a 15 hour course on the collection and isolation of entomopathogenic fungi for 12 students and staff members in the Institute of Tropical Pathology and Public Health. (5/1-5/11/2014)
- Demonstrated techniques and transferred technologies for application and evaluation of microbial control agents of the walnut twig beetle to federal and university scientists in Tennessee and North Carolina. (8/11-8/14/14)

North Carolina:

Food Science Research Unit (Raleigh, NC)

- Dr. Ilenys Perez-Diaz from the in Raleigh, NC hosted an undergraduate student intern selected to participate in the USDA Wallace Carver internship program for the summer.

North Dakota:

Northern Great Plains Research Laboratory (Mandan, ND)

- The Customer Focus Group of the Northern Great Plains Research Laboratory at Mandan ND met with ARS scientists and administrators on February 6 and July 17, 2014. The focus group provided feedback on the lab's research program and held discussions on emerging research needs. On March 3, the Northern Great Plains Research Laboratory held its "Research Results Conference" sponsored by the Area IV Soil Conservation Districts Cooperative Research Farm at Mandan, ND. This year's event focused on the 30-year partnership between the Area IV farm and ARS. Seventy-five customers reviewed this year's research and took home new ideas. On July 17 the laboratory held its annual "Friends & Neighbors Day", which attracted nearly 1000 customers to the research campus. The ARS staff provided research tours, exhibits, demonstrations, and presentations, as well as kid-friendly science activities. The event provided the public an increased understanding of the contributions of public research.

The Red River Agricultural Research Center (Fargo, ND)

- The Red River Agricultural Research Center (RRVARC) Research Partners' Annual Meeting was held in Fargo, ND on December 19, 2013. In attendance were more than 30 representatives from all of the major agriculture sectors in ND and the upper mid-West States.

Grand Forks Human Nutrition Research Center (Grand Forks, ND)

- The Grand Forks Human Nutrition Research Center is developing content areas for focus groups that will be held at the Choice Health and Fitness Center. This is a collaborative effort with the Grand Forks Park District, University of North Dakota, and Simmons-Flint Marketing. The purpose is to receive feedback from the focus groups regarding how to best interact with the community to recruit human studies subjects, the quality of our interactions with study volunteers, and what we are doing well and what we could improve upon.

Ohio:

Office of Technology Transfer

- Developed a series of webinars on ARS bioproducts, soybean and wheat research. These webinars were held in collaboration with Ohio ARP member, Center for Innovative Food Technology. The webinars were edited and placed on the OTT website.

Corn, Soybean and Wheat Quality Research Unit (Wooster, OH)

- Presented a lecture and a lab titled "Virus disease diagnostics" Ohio State University, Plant Pathology, PP5685 Plant Disease Diagnostics, and Ohio State University, Pest and Disease Diagnostics for International Trade and Food Security short course. Wooster, Ohio (May 2014)
- Hosted the Soft Wheat Quality Laboratory Research Review in Wooster, Ohio. Presentations were given on Experimental high-ratio cake baking test procedure for non-chlorinated flour, and Mitigating the negative effects of pre-harvest sprout damage on processing quality of wheat by extended storage of grain or flour. (3/19/14)

Application Technology Research Unit (Wooster, OH)

- Gave a presentation entitled "Weed control in perennial plants" at the Maumee Valley Growers Association Annual Meeting, held at the Toledo Botanical Gardens, Toledo, Ohio. (3/6/14)
- Held field demonstrations and presentations titled "Intelligent spray technology to improve pesticide application efficiency, reduce pesticide use and safeguard the environment" at the Ohio Nursery and Landscaping Short Course in Columbus, Ohio (7/12-14/14) and the Oregon Nursery Crops Integrated Pesticide Management Workshop (Aug 12-13, 2014). USDA's U.S.-China Scientific Cooperative Exchange

Program in Beijing, China (Sep 12, 2014). Presentations only International Conference of Agricultural Engineering in Zurich, Switzerland; 2014 (Jul 5-10, 2014) Agrochemical Formulation Conference in Raleigh, North Carolina (7/23/14).

- Presented “Increase spray droplet retention on leaf surfaces” at the 2014 Agrochemical Formulation Conference in Raleigh, North Carolina (Jul 23, 2014), and the 2014 Ohio Produce Growers & Marketers Association Congress in Sandusky, Ohio (1/22/14)

Soil Drainage Research Unit (Columbus, OH)

- Presented “Balancing tile drainage for crop production and environmental impact” at the Annual FarmSmart Agricultural Conference, held in Guelph, Ontario, Canada. (1/18/14)
- Presented “A review of theoretical frameworks applicable for designing agricultural watershed restoration projects” at the 2014 Midwest Great Lakes Chapter of the Society for Ecological Restoration, held in Madison, Wisconsin. (10/8/13)

Oklahoma:

Office of Technology Transfer

- Co-hosted with ARP member, Center for Innovation, a listening session and forum on the control of aflatoxin contamination in crops.

Hydraulic Engineering Research Unit (Stillwater, OK)

- The Hydraulic Engineering Research Unit staff provided annual tours of the laboratory to several interest groups. Interest groups for FY14 have included Oklahoma State University faculty and students, NRCS New Employees Orientation participants, NW A&F University faculty and students, and the National Advance Operation and Maintenance of Dams Workshop, sponsored by the National Watershed Coalition, participants. Outreach was provided to approximately 250 participants in FY14.

Wheat, Peanut, and Other Field Crops Research Unit (Stillwater, OK)

- The Wheat, Peanut, and Other Field Crops Research Unit organized the Oklahoma/Texas Peanut Expo at the Quartz Mountain Lodge in March 2014. The Expo was attended by Peanut farmers, shellers, chemical companies, peanut product manufacturers, peanut researchers, local and regional press. ARS researchers gave in-depth research updates to approximately 150 attendees, as well as talked to the local and state press agents regarding a recent peanut variety release.

Grazinglands Research Laboratory (El Reno, OK)

- Between April and September 2014, Dr. Jeanne Schneider participated in meetings with Oklahoma producers and tribal groups related to the USDA Regional Climate Hubs.

Rangeland and Pasture Research Unit (Woodward, OK)

- On September 4, 2014 the Rangeland and Pasture Research Unit held their 100 year anniversary and field day. The celebration was attended by 175 customers and stakeholders. During the field day, participants learned about new drought tolerant varieties of grasses, rangeland management technologies that improve range condition and ecosystem services, small grain varieties that are more resistant to disease, and technologies that can be implemented to reduce greenhouse gas production by cattle.

Oregon:

Eastern Oregon Agricultural Research Center/Range and Meadow Forage Management Research Unit (Burns, OR)

- Bureau of Land Management (BLM) employees visited the center to receive input on their plans for post-wildfire management and rehabilitation of the 400,000 acres Buzzard Complex fire in southeastern Oregon. (8/7/14)

Horticultural Crops Research Laboratory (Corvallis, OR)

- Reported at numerous meetings on the performance of berry (raspberry, strawberry, blueberry, blackberry, black raspberry and cranberry) selections in ARS' breeding program and on cultivars to hundreds of members of industry (nurserymen, growers, packers, and processors) for their input on which genotypes hold the most promise. (12/5/13, 12/16/13, 12/20/13, 1/13/14, 1/16/14, 1/30/14, 2/19/14)
- Presented information about progress in the USDA berry breeding programs at the Washington Strawberry Commission research planning meeting, the Oregon Raspberry and Blackberry Commission annual meeting and the 2014 Pacific Northwest Blueberry Conference, with particular emphasis on the new releases. (12/17/13, 12/18/13, 1/27/14, 2/26/14)
- Presented at the Pacific Northwest Insect Management Conference in Portland, OR on the monitoring and biological control of brown marmorated stink bug. Approximately 30 growers and private company personnel attended. (1/7/13) Described how plants free of known viruses are produced, ensuring high quality plants are available to growers to: the National Clean Plant Network for Berries, the Wisconsin Fresh Fruit and Vegetable Conference, the Scotia Horticulture Congress, and at the Quebec Ministry of Agriculture in Saint-Bruno-de-Montarville, Quebec, Canada. (1/20/14, 1/27/14, 1/30/14)
- Presented information on berry viruses at the Wisconsin Fresh Fruit and Vegetable Conference, the Wisconsin Cranberry School, the Quebec Ministry of Agriculture in Saint-Bruno-de-Montarville, Quebec, Canada, the Oregon Wine Symposium and with grower groups (1/20/14, 1/22/14, 1/27/14, 1/30/14, 2/25/14, 2/26/14, 8/5-8/6/14)
- Presented at A Roadmap for Oregon Growers to the Fresh Strawberry Market, a state grant funded workshop, about fresh market strawberry cultivar choices for the Pacific Northwest. Approximately 80 researchers, commissioners and representatives of the commercial strawberry industry. (1/29/14) Summarized research findings and showed symptoms of anthocyanin accumulation in leaves caused by numerous biotic and abiotic stresses at the Washington Association of Winegrape Growers Meeting, Kennewick, WA. 100 professionals attended. (2/7/14)
- Provided a display table with light microscope and sections of wine grape canes and trunks at the Idaho Wine Commission Annual Meeting in Boise, ID to demonstrate how to evaluate cold injury to bud and trunk tissue. Approximately 50 growers and winemakers attended. (2/18/14)
- Presented information to over 800 attendees on recommended berry cultivars that are suited for commercial use on small farms at the Oregon Small Farms Conference in Corvallis, OR. (2/22/14)
- Presented information on grapevine red blotch virus at the Oregon Grape Day in Corvallis, OR, at a field day organized by a viticulturist from Southern Oregon Research and Extension Center in Central Point, Oregon and at Willamette Valley Grape Growers Tech Group at Chemeketa Community College in Salem, Oregon. (4/1/14, 7/17/14, 8/21/14)
- Presented information on powdery mildew, nutrition, nematodes and viruses of grapevines, at a Vineyard Scouting Workshop at Oregon State University's Woodhall Vineyard to approximately 45 industry members. (5/21/14)
- Presented at the Idaho Professional Technical Education Summer Conference tour in Parma, ID on the detection of anthocyanins to approximately 150 high school teachers involved in the National FFA organization attended. (6/17/14)
- Presented to approximately 75 blueberry growers, nursery owners, and fruit processors at the Oregon State University's North Willamette Research and Extension Center Blueberry Field Day. (7/16/14) Presented at a field day for the joint annual meeting of the California Rare Fruit Growers Association, the North American Fruit Explorers, and the Oregon Home Orchard Society on the merits of new berry and hardy kiwi cultivars to approximately 60 members of the three organizations. (8/8/14) Presented at the 2014 Farwest trade show in

Portland, OR on the Phytophthora root rot pathogens found in rhododendrons of the Pacific Northwest nursery industry and disease management recommendations. Approximately 120 growers attended. (8/22/14)

Forage Seed and Cereal Research Unit

- Presented at the GS Long Company grower meeting on the development of disease control measures to mitigate damage from hop powdery mildew, including emergent, virulent strains of the pathogen. Approximately 100 growers and private company personnel attended. (1/15/14).
- Presented at the Washington Hop Industry annual meeting and the Hop Research Council meeting on the development of cultural disease control measures, emergence of virulent strains of powdery mildew, mating type diversity of the pathogen, and conservation biological control of spider mites. Approximately 350 growers, brewers, private company personnel attended. (1/10/14) (1/22/14)

National Clonal Germplasm Repository (Corvallis, OR)

- Presented at the Plant and Animal Genome Meeting, San Diego, CA, on the development of SNP markers to construct an initial high density map of the octoploid genome. Approximately 50 private company personnel attended. (1/11/14)
- Hosted and trained three international visitors in germplasm conservation, specifically tissue culture techniques. (1/1/14 to 6/30/14)
- Hosted a visiting scientist from Western Kentucky State University to be trained in molecular analysis of Rubus (1/1/14 to 6/30/14) and two scientists from The Institute for Applied Ecology to train them in acid scarification of Rubus seeds. (9/1/14 to 9/30/14)
- Hosted visitors for an open house in the blueberry field collection. More than 350 genotypes of blueberry fruit were sampled by 30 members of the public. (7/17/14)

Columbia Plateau Conservation Research Center/ Soil and Water Conservation (Pendleton, OR)

- Presented a seminar on soil microbiology and soil health at the Oregon Horticultural Societies Tree Section at the Agriculture Expo in Portland Oregon to 15 producers and private company personnel. (1/28/14)
- Demonstrated combustion/color change reactions between different chemicals to 11 high school juniors and seniors for the Echo High School science class. (1/30/14)
- Presented a key note talk and a breakout session at the Precision Ag 2.0 conference in Calgary, AB, Canada on the development and use of a multi-sensor data fusion system in precision agriculture and on the development and use of combined vegetation indices for in-season N management in low rainfall areas. Approximately 100 crop consultants and industry personnel attended. (2/12/14)
- Presented at the 2014 Economic Outlook Luncheon on the use of unmanned aerial systems in agricultural research to approximately 300 individuals representing city businesses, city council, county and state agencies, tribal agencies, community college, extension, National Guard, and community members. (2/19/14)
- At the request of a farmer, participated in a meeting to discuss research on the effects of tillage and no-till systems on long-term winter wheat yields. Approximately 25 farmers attended. (2/27/14)
- Presented an invited seminar on soil microbiology and soil health to approximately 50 producers and students for the Sonoma County Vineyard Technical Group in Sonoma, California. (3/20/14)

Pennsylvania:

Genetic Improvement for Fruits & Vegetables Laboratory

- Participated Mid-Atlantic Fruit and Vegetable Convention Jan. 30, 2014 "What are you looking for in a blueberry variety? New choices and some time-tested ones."

Poultry Food Safety Laboratory (Princess Anne, MD)

- Presented a seminar as part of the U.S. Department of Agriculture, Food Safety Inspection Service (FSIS) Scientific Seminar Series titled: "*Prevalence, Number, and Type of Salmonella on Chicken Carcasses and*

Parts” to an audience comprised of FSIS staff including microbiologists, toxicologists, risk assessment scientists, food scientists, physicians, nurses, veterinarians, communication experts and policy makers. (3/5/14).

- Attended the Annual Meeting of the International Association for Food Protection and presented a paper titled: “*Use of enrichment real time-polymerase chain reaction to enumerate Salmonella on chicken parts*” to a group consisting of government, university, and private sector scientists from U.S. and foreign countries. (8/6/14)
- Presented a keynote address at 17th World Congress of Food Science and Technology titled “Past, Present, and Future Applications of Predictive Microbiology in Food Science and Technology” to an international audience composed of food scientists from around the globe. (8/20/14)
- Launched the Poultry Food Assess Risk Models website to transfer publications, data, models and presentations to food safety professionals in government, academia, food industry and allied industry in the U.S. and foreign countries. (3/21/14) (www.ars.usda.gov/naa/errc/PoultryFARM)

Molecular Characterization of Foodborne Pathogens Research Unit (Wyndmoor, PA)

- Gave two invited oral presentations on the management of indigenous populations of AM fungi and the on-farm production and utilization of AM fungus inoculum to farmers at the Southern Sustainable Agriculture Working Group annual meeting in Mobile, AL. (1/17-18/2014)
- Gave a lecture on the biology, structure, and function of AM fungi and demonstrated AM fungus research techniques, including the on-farm inoculum production method to the Horticulture Technology class of Delaware Valley College. (3/21/2014)
- Gave an oral presentation at the Rodale Institute Field Day on the basics of management of indigenous AM fungi and demonstrated the on-farm system of inoculum production. (7/18/2014)

Sustainable Biofuels and Co-Products Research Unit (Wyndmoor, PA)

- The pyrolysis team participated in the Farm Energy Day hosted by Penn State Extension at the McDonnell’s Farm in East Greenville, PA on September 9, 2014. The lead scientist, Akwasi Boateng and others within the group demonstrated the on-farm conversion of biomass to bio-oil through fast pyrolysis with the Combustion-Reduction Integrated Pyrolysis (CRIPS) unit electrically powered by biomass via a gasification system.

Puerto Rico:

Tropical Crops and Germplasm Research Unit (Mayaguez, PR)

- Scientists participated in activities targeting minority, historically under-served operators/stakeholders by providing information on alternative high-cash crops and best management practices to Hispanic producers in rural areas through farm visits, hosting growers at experimental sites, and on-farm research at Martex Farms and La Balear Farm in Santa Isabel and Adjuntas, Puerto Rico, respectively.
- Provided propagation material of superior varieties of rambutan, lychee, cacao, banana, plantain, mango, mangosteen and papaya from ARS research, hands on training on grafting and other propagation procedures, and technical expertise on crop nutrition to socially disadvantaged growers of tropical fruits in Puerto Rico.
- Hosted a cacao production workshop for extension agents and small, socially disadvantaged farmers to provide information on production practices of cacao. About 45 agents and growers attended the workshop.

South Carolina:

Coastal Plain Soil, Water and Plant Conservation Research (Florence, SC)

- Dr. William Wechter from the Vegetable Research Unit in Charleston, SC hosted an undergraduate student intern selected to participate in the USDA Wallace Carver internship program for the summer.

South Dakota:

North Central Agricultural Research Laboratory (Brookings, SD)

- The North Central Agricultural Research Laboratory's 20th Annual Field Day was held on June 17, 2014 at the Eastern South Dakota Soil and Water Research Farm, Brookings, SD. Approximately 50 attendees joined in discussions and demonstrations on building habitat on working land. Specifically, the program covered (a) Using winter crops, cover crops and no-till to create habitat on farms in South Dakota while improving soil health and (b) Using flowering oilseed crops to provide habitat for beneficial insects and for diversifying farm income.
- The North Central Agricultural Research Laboratory (NCARL) customer focus group met on January 15, 2014 at the NCARL in Brookings, SD. 30 persons attended, representing growers, South Dakota commodity groups (corn, wheat, and soybean), conservation districts, university partners including extension, and state staffers from Sen Johnson's and Rep Noem's offices. The customer focus group met again on June 17, 2014 at the NCARL in Brookings, SD. At that meeting, attendees (approximately 20) were asked to comment on the NCARL's pest management research program in the context of the lab preparing a plan for the next 5-year phase of research in this field. Customers provided valuable input on the lab's research portfolio.

Texas:

Cropping Systems Research Laboratory (Lubbock, TX)

- In August and September, the Cropping Systems Research Laboratory hosted several meetings on water and temperature stress on sorghum. The meetings were attended by the sorghum industry. The industry representatives learned about ongoing research efforts and how they might impact sorghum production in the future.
- In March the Cotton Production and Processing Research Unit hosted, coordinated sessions, and taught classes at the National Cotton Ginners Association's (NCGA) Southwestern Gin School. The class had 141 participants a majority of which were Hispanic. The participants were taught classes on Gin Safety, Hydraulics, Pneumatics, Gin Equipment Settings, Electricity, Current Research, Harvesting, Moisture, Drying, and Proper Storage of Cotton and Cottonseed.

Grassland, Soil, and Water Research Laboratory (Temple, TX)

- On September 2, 2014, the Grassland, Soil, and Water Research Laboratory hosted a Field Day "Building Soil Health with Grazing Management" at the USDA-ARS, Riesel Watersheds, Riesel, TX. Approximately 60 producers and USDA-NRCS personnel attended and were presented with practical applications for Central Texas farms and ranches along with research results including economic benefits of enhanced grazing management.

Conservation and Production Research Laboratory (Bushland, TX)

- The 2014 Ogallala Aquifer Program (OAP) Annual Workshop was held in Lubbock, TX on March 25 and 26, 2014. Approximately 80 scientists and students who participate in the OAP were in attendance. About 45 stakeholders also attended including representatives from media outlets, commodity groups, water conservation districts, and agribusiness companies, and farmers.

Southern Plains Agricultural Research Center (College Station, TX)

- Scientists from the Insect Control and Cotton Disease Research Unit participated at the Boll Weevil Research Review and Planning Meeting, College Station, TX, on Mar. 12-13, 2014, with approximately 40 participants including leaders from the U.S. Boll Weevil Eradication Program, U.S. Boll Weevil Action Committee, USDA-APHIS, Cotton Inc., university research and extension centers, pheromone lure companies, crop consulting companies, and the Mexico Boll Weevil Eradication Program.

- Scientists from the Insect Control and Cotton Disease Research Unit participated at a research discussion meeting with a scientific program leader from Cotton Inc., College Station, TX, on June 17, 2014. Participants included ARS Unit and Texas A&M University scientists. Participants identified collaborative research areas and funding opportunities for improving insect pest management in cotton through host plant resistance and other novel strategies that are cost effective and environmentally acceptable.
- The Pecan Breeding and Genetics program of the Crop Germplasm Research Unit hosted a field day at their Burleson County worksite from 1:30 to 5:30 on January 30 for ~100 attendees of the week-long Texas Pecan Short Course. The field day featured tours of the nurseries, greenhouses, plant collections and research test orchards maintained by the program in their role as the National Collection of Genetic Resources for Pecans and Hickories, as well as in their role as the USDA ARS Pecan Breeding Program.
- Scientists from the Aerial Application Technology Research Unit in College Station, TX hosted ~40 representatives from industry, agriculture, academia, government agencies, non-governmental organizations and other agricultural and environmental experts from the USDA Agricultural Air Quality Task Force (AAQTF) on 19 August 2014.
- Dr. Mike Kogut of the Food and Feed Safety Research Unit organized the 2nd Symposium on Gut Health in Production of Food Animals November 11-13, 2013 in Kansas City, MO. The aim was to bring together a group of scientists from academia, government, and industry to discuss the role of gut health in animal production and the essential role that the gut plays in establishing and maintaining animal health. The Symposium was attended by over 125 scientists including many industry representatives and sixteen universities.

Knippling-Bushland U.S. Livestock Insects Research Laboratory (Kerrville, TX)

- A field day regarding biological control of *Arundo donax*, giant reed was held in Edinburg, TX, at the ARS Cattle Fever Tick Research Laboratory on June 10, 2014. It was attended by stakeholders from DHS Customs and Border Protection (CBP) from California and Texas. Field impacts of the biological control agents on giant reed on the Rio Grande and integration with mechanical controls was discussed.
- The Screwworm Research Unit held a focus group meeting in Panama City, Panama June 2-6, 2014. Ministry of Agriculture Representatives from Panama, Ecuador, Peru, Brazil, Paraguay and Uruguay and Representatives from International Atomic Energy Agency, Vienna, Austria, along with the KBUSLIRL Screwworm Research Unit.

Utah:

Forage and Range Research Laboratory (Logan, UT)

- The Forage and Range Research Laboratory (FRRL) held a Focus Group Executive Committee Meeting on December 12, 2013. Information was presented on the state of the FRRL and new plant materials that were going to be released by the FRRL in the near future (grasses and legumes for improved rangeland and pasture productivity).

Poisonous Plant Research Laboratory (Logan, UT)

- Poisonous Plant Research Laboratory (PPRL) held a stakeholder meeting in Jackson Hole, Wyoming, October 30, 2013 in conjunction with The North American Invasive Species Association (NAISA) and Wyoming Weed Council annual meeting.
- PPRL Scientists conducted a workshop at a field day for hay and forage producers in Reno Nevada, Dec. 13, 2013. Educated hay and livestock producers about poisonous plants that may contaminate harvested forages and pastures. Over 600 forage and livestock producers attended.
- PPRL Scientists conducted a workshop and wet lab for approximately 250 Utah livestock producers and veterinarians in Provo, Utah, Feb. 12, 2014. A 1 hour lecture was given on poisonous plants and then a half day wet lab was conducted to teach poisonous plant identification, plant sample preparation for submission to

PPRL for analysis or identification, techniques to diagnose poisoned animals and management methods to avoid or reduce losses from poisonous plants.

- PPRL Scientists conducted a stakeholder meeting on selenium biochemistry and the effects of selenium accumulating plants on livestock production in Pocatello, Idaho, Mar. 31, 2014. Methods to improve utilization of forages on mine reclamation sites where high selenium soils exist were discussed. There were 35 stakeholders in attendance including sheep producers, land managers, Idaho Department of Environmental Quality regulators, Idaho Fish and Wildlife managers and Idaho Mining association executives.
- PPRL scientists conducted a workshop at the Park County Weed Fair in Livingston, Montana, May 12, 2014. Information was presented on poisonous plants in Montana, how to identify those plants and methods of preparation of plant samples for submission to herbaria or the PPRL for identification and or analysis.

Washington:

Vegetable and Forage Crop Research Unit (Prosser, WA)

- Presented information on weed management technology in organic vegetable crops at the Washington Tilth Conference; at the Pacific Northwest Vegetable Association Conference; and at the McGregor Grower Meeting. Several hundred growers, private company personnel, crop consultants, and researchers attended. (11/9/13, 11/14/13, 2/11/14)
- Presented at the Western Alfalfa Seed Growers winter meeting on weed management research in alfalfa seed. Approximately 150 growers and private company personnel, and researchers attended. (1/25/14)
- Presented at the Mint Industry Research Council annual meeting on the selectivity of pyroxasulfone in peppermint and spearmint. Approximately 200 growers, private company personnel, and researchers attended. (1/28/14)
- Presented on the incidence and management of herbicide resistant weeds in vegetable cropping systems. Approximately 175 growers, private company personnel, crop consultants, and researchers attended. (2/11/14)

Grain Legume Genetics Physiology Research Unit (Pullman, WA)

- Presented on historical trends of yield gains in grain legumes in the U.S. to approximately 150 growers, processors, and marketers of grain legumes at the annual meeting of Washington State Crop Improvement Association and North Idaho Seed Growers Association. (11/18/13)
- Presented results of field trials conducted in 2013 and provided information on varieties developed by the research unit and advances in the control of diseases of grain legumes at an annual meeting of growers associated with Blue Mountain Seed Inc. (2/18/14, 2/25/14, 2/28/14).
- Presented field plots and provided information on varieties developed by the research unit at an annual Field Day for growers associated with Pacific Northwest Growers Cooperative. (7/15/14)

Land Management and Water Conservation Research Unit (Pullman, WA)

- Organized a luncheon with growers to discuss canola production practices in the low rainfall, winter wheat fallow region. Eight growers and county extension personnel attended. (10/24/13)
- Gave a presentation on Nitrogen management in direct seed systems of eastern Washington to 10 growers and industry and university personnel. (10/30/13)
- Dr. Ann Kennedy hosted numerous tours, gave seminars and traveled to private companies on weed-suppressive bacteria, including as a means to reduce cheatgrass and medusahead to stakeholders, industry representatives, industry associations, counties, growers, land managers and producers. (11/1/13, 11/5/13, 11/30-12/1/14, 1/15-1/16/14, 2/12-2/13/14, 2/19/14, 2/25-2/28/14, 8/15/14, 8/20-8/22/14)
- Dr. Frank Young presented at conferences on feral rye control in winter canola to over 600 growers, industry personnel, scientists, and university administrators stakeholders. (11/7/13, 1/20-1/22/14)
- Dave Huggins presented talks on impact of climate change on agriculture to agribusiness, consultants, growers, federal project directors and university researchers. (12/10/13-1/7/14, 1/5/14, 1/20-22/14)

- Presented the history of the Ralston Project and no-till planting of winter canola in Stripper-header standing stubble to 50 growers, agribusiness personnel, and conservation district people at the Annual Conservation District meeting. (1/8/14)
- Met with university and federal researchers to discuss soil quality and soil microbiology (1/10/14, 1/13/14, 2/24/14)
- Held a workshop on Sustainable Agriculture Research and Education (SARE) program for grower participants to discuss results of SARE studies on their farms. (2/19/14)
- Presented and discussed Chemical fallow, herbicide/weed resistance, plant-back restrictions, cover crops with area growers and NRCS people at a meeting for Douglas County growers and NRCS (2/25/14)
- Presented on winter canola establishment and weed control to eight growers and a WSU Extension Agent. (9/15/14)
- Dr. Ann Kennedy collaborated with DePaul University to participate in a Chicago outreach program that teaches inner city K-12 students about the importance of growing healthy foods and techniques for growing their own food. That Project was featured on the Soil Science Society of America website.
<https://www.soils.org/discover-soils/story/battling-obesity-issues-shovel>

Wheat Genetics, Quality, Physiology, and Disease Research Unit (Pullman, WA)

- Presented at the National Association of Wheat Growers on the wheat research and improvement activities of the Unit. Approximately 50 growers and wheat advocacy group personnel attended (11/4/2013)
- Coordinated a workshop at the American Society of Agronomy meeting with invited speakers from diverse crop plants. (11/4-11/7/13)
- Dr. Xianming Chen sent wheat growers, consultants, extension and research scientists their first forecast of stripe rust for the 2014 growing season. The forecast is posted in their stripe rust website (<http://striperust.wsu.edu/news/2014/stripe-rust-news.html>) for people to search. (1/3/14)
- Hosted two tours: FFA students and their chaperones and a group of 10 high school teachers. (5/6/14, 6/25/14)
- Hosted the Washington Grain Alliance/Idaho Wheat Commission Wheat Workshop. 20 guests (growers, elevator operators, and others in the wheat marketing system) attended a tour of the lab and participated in workshops on milling, flour analysis, baking analysis, and wheat quality research. (6/6/14)
- Gave a tour to six Japanese flour-milling executives/owners, two farmers, a U.S. Wheat Associate rep and reps from the Washington Grain Commission. They discussed U.S. Wheat Quality and exports. (6/24/14)
- Gave a tour to a group with five persons from the USDA Foreign Agriculture Service, one from the US Embassy, Beijing, China, and the Deputy Administrator for Nutrition, Food Safety, and Quality (Dr. Pamela Starke-Reed). They were participating in the Washington Grain Commission's USDA PNW Wheat and Export Training. The tour included a discussion on wheat quality exports and classification. (6/24/14)

Yakima Agricultural Research Laboratory/Fruit and Vegetable Insect Research Unit (Wapato, WA)

- Presented results for the project "Pest risk analysis for temperate fruit flies in exported fruits", and results for the project "Identification of chemical lure for spotted wing drosophila". (11/12/13)

Physiology and Pathology of Tree Fruit Research Unit (Wenatchee, WA)

- Scientists presented at meetings of the Washington State Horticultural Society and the Washington Tree Fruit Research Commission on the development of non-fumigant alternatives for management of tree fruit replant diseases as well as postharvest technologies to manage fruit ripening and minimize fruit physiological disorders during storage to approximately 700 growers and private company personnel. (12/2-12/5/13, 1/29/14)
- Presented at the Soil Quality Network 2014 conference on the management of orchard soil microbiology resources as a means to manage diseases and to limit re-infestation of soils by plant pathogens and parasites to approximately 150 growers, extension and private company personnel. (2/13/14)

- Presented at meetings of the Washington Tree Fruit Research Commission in Yakima WA on the identification of a lethal canker disease of pear and factors influencing the spread and control of the causal pathogen to approximately 70 growers. (2/18/14)
- Presented research on temperate fruit maturation, ripening, and postharvest management of fruit quality at grower meetings organized by AgroFresh, Inc. in Yakima and Wenatchee, WA. Approximately 120 growers attended. (3/13-3/20/14)
- Presented at meetings organized by the California Department of Pesticide Regulation on the current knowledge of how soil microbial ecology in agro-ecosystems can suppress pathogens in Davis, CA. (6/17/14)
- Presented an informational seminar at a meeting of the California Strawberry Commission on Biologically-based soil-borne disease control strategies, Monterey, CA.(8/5/14)
- Presented at a grower/industry sponsored field day on how and why mustard seed meal and wheat cover crops might be used to manage soil-borne disease in strawberry in Watsonville, CA. (8/6/14)

Washington D.C.:

Genetic Improvement for Fruits & Vegetables Laboratory

- Participated in the American Society of Plant Biologist's diverse outreach activities including the 2014 Annual White House Easter Egg Roll helping young children understand why plants matter in their lives.

West Virginia:

Appalachian Fruit Research Station (Kearneysville, WV)

- In January 2014 the Genetic Improvement of Fruit Crops through Functional Genomics and Breeding RMU and the USDA-ARS Appalachian Fruit Research Station sponsored the First International Symposium on Rapid Cycle Crop Breeding. Scientists from the US, Canada, Germany, Italy, Indonesia, Spain, and New Zealand participated along with industry representatives, regulators and foreign agricultural policy experts.

Innovative Fruit Production, Improvement and Protection (Kearneysville, WV)

- Presented an invited paper at the 2014 Ohio Produce Growers and Marketers Association Congress in Sandusky, OH titled "Challenges and opportunities for growing blackberries in the Midwest" to about 75 growers, scientists and representatives from the berry industry in the Midwest. (01/22/2014)
- Attended the 2014 Gulf-South Blueberry Growers Association Education Workshop in Hattiesburg, MS in February 2014 and presented an invited paper titled "Machine harvesting blueberries for fresh market") to about 100 blueberry growers, scientists and representatives from the blueberry industry in the Mid-South region. (02/13/2014)

The National Center for Cool and Cold Water Aquaculture (Leetown, WV)

- Dr. Caird Rexroad, III and Dr. Tim Leeds hosted Dr. Steven Hart, the executive director of the Soy Aquaculture Alliance, and a Chinese Aquaculture Team of 14 visitors with interests in water re-use technologies and aquaculture research. (8/14/2104)

Wisconsin

U.S. Dairy Forage Research Center (Madison, WI and Marshfield, WI)

- Discussed impact of manure application in different seasons on phosphorus loss in runoff at the University of Wisconsin-Dane County Partnerships for the Yahara Lakes, Madison, WI (5/30/14)
- Discussed recent progress on research related to climate change mitigation and adaptation in dairy production systems of the Great Lakes region at the Dairy CAP Project Team meeting, Rosemont, IL (2-25/14)

- Trained technical personnel of multiple organizations (including seed companies) on paternity and SSR multiplexing techniques, Prairie du Sac, Madison, and Arlington, WI (May 2014)

Wyoming:

Rangeland Resources Research Unit (Cheyenne, WY)

- January 16, 2014 and April 23, 2014 and September 29, 2014 – Meetings of the Stakeholder Group with the Adaptive Grazing Management experiment at the Central Plains Experimental Range. The Stakeholder Group is making the management decisions on 10, 320 acre pastures for three desired outcomes (livestock production, wildlife habitat – mostly grassland bird focused, and vegetation heterogeneity), with the goal of improving upon the same outcomes compared to the traditional grazing management (season long grazing at moderate stocking rates).

3.11. Technology Transfer Award Winners

2014 ARS Technology Transfer Awards

Scientist: Dr. Mike Heaton and Dr. Kreg Leymaster

Lab: U.S. Meat Animal Research Center, Clay Center, NE

Title: Genetic and Management Tools to Address a Major Disease in Sheep

Award: ARS Outstanding Award

2014 Federal Laboratory Consortium for Technology Transfer (FLC) Awards

Lab: Center for Grain and Animal Health Research

Title: Development and Transfer of the Wind Erosion Prediction System

Award: National Excellence in Technology Transfer

Lab: Genetic Improvement of Fruits and Vegetables Laboratory

Title: Novel 'Black Pearl' Pepper Cultivar

Award: National Excellence in Technology Transfer

Lab: Natural Products Utilization Research Unit

Title: Pterostilbene: It's Role in Supporting Multiple Health Benefits

Award: National Excellence in Technology Transfer

Lab: Warmwater Aquaculture Research Unit

Title: Hatchery Technology for Hybrid Catfish Fry

Award: National Excellence in Technology Transfer

Lab: Conservation and Production Research Laboratory

Title: New Soil Water Sensing Technology for Environmental and Water Management

Award: Honorable Mention, Excellence in Technology Transfer

Lab: Eastern Regional Research Center

Title: Novel Biomaterials from Polysaccharides and Bioplastics for Repairing Human Skeletal Tissue

Award: Honorable Mention, Excellence in Technology Transfer

Lab: Grassland, Soil and Water Laboratory

Title: Development and Industry Implementation of the Haney Soil Health Test

Award: Honorable Mention, Excellence in Technology Transfer

Lab: Processed Foods Research Unit

Title: Commercialization of Novel Ultraviolet Technology to Enhance Vitamin D Content in Mushrooms

Award: Honorable Mention, Excellence in Technology Transfer

Lab: Roman L. Hruska Meat Animal Research Center

Title: Molecular Markers for Six Non-O157 Shiga-toxicogenic Escherichia coli Serogroups

Award: Honorable Mention, Excellence in Technology Transfer

Lab: USDA Agricultural Research Service, Foreign Animal Disease Research Unit – Department of Homeland Security

Award: Honorable Mention, Interagency Partnership

Lab: USDA Agricultural Research Service, Sedimentation Laboratory – USDA Natural Resources Conservation Service –Environmental Protection Agency

Award: Honorable Mention, Interagency Partnership

Lab: Land Management and Water Conservation Research Unit

Title: Weed-suppressive soil bacteria to reduce animal grass weeds

Award: Far-West Region, Outstanding Technology Development Award

Lab: Contaminant Fate and Transport Research Unit

Title: ASTM-Certified Test for Permeability of Agricultural Films

Award: Far-West Region, Outstanding Partnership Award

Lab: Office of the Director, Albany, CA

Name: Kristin Kimball

Award: Far-West Region, Technology Transfer Professional of the Year Award

Lab: Agricultural Systems Research Unit

Title: Wind Erosion Prediction System

Award: Mid-Continent Region, Excellence in Technology Transfer

Lab: Meat Safety and Quality Research Unit

Title: VBG2000: Beef Carcass Grading Camera

Award: Mid-Continent Region, Excellence in Technology Transfer

Lab: Genetic Improvement for Fruits and Vegetables Lab

Title: Novel 'Black Pearl' Pepper Cultivar

Award: Mid-Atlantic Region, Excellence in Technology Transfer

Lab: Fruit and Nut Research Unit

Title: In Vivo Production of Entomopathogenic Nematodes

Award: Southeast Region, Excellence in Technology Transfer

Lab: National Biological Control Lab

Title: Method for Encapsulation of Microparticles

Award: Southeast Region, Excellence in Technology Transfer

Other Awards:

Maryland Economic Development Association (MEDA)

Awardee: Mojdeh Bahar, Office of Technology Transfer

Award: 2014 Volunteer of the Year

American Seed Trade Association (ASTA)

Awardee: June Blalock, Office of Technology Transfer

Award: 2014 Distinguished Service

3.12. Selected Metric Charts.

Figure 1. Number of new and active CRADAs. Part of the trend in the decreasing number of CRADAs may be due to the fact that we have a new mechanism (Material Transfer Research Agreement, MTRA) for collaborative research that was previous carried out under a CRADA.

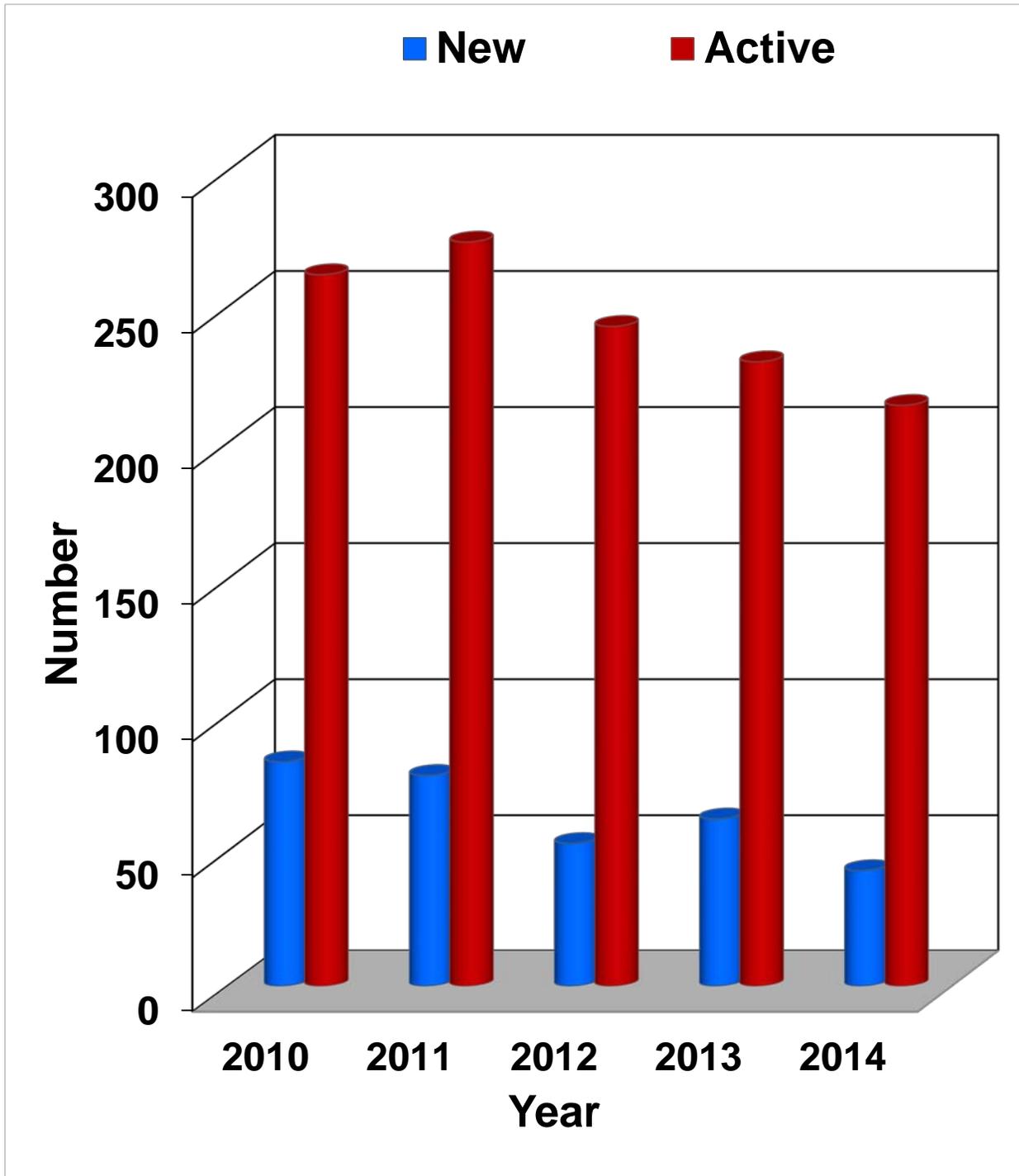


Figure 2. Number of collaborative research agreements by type in FY 2014.

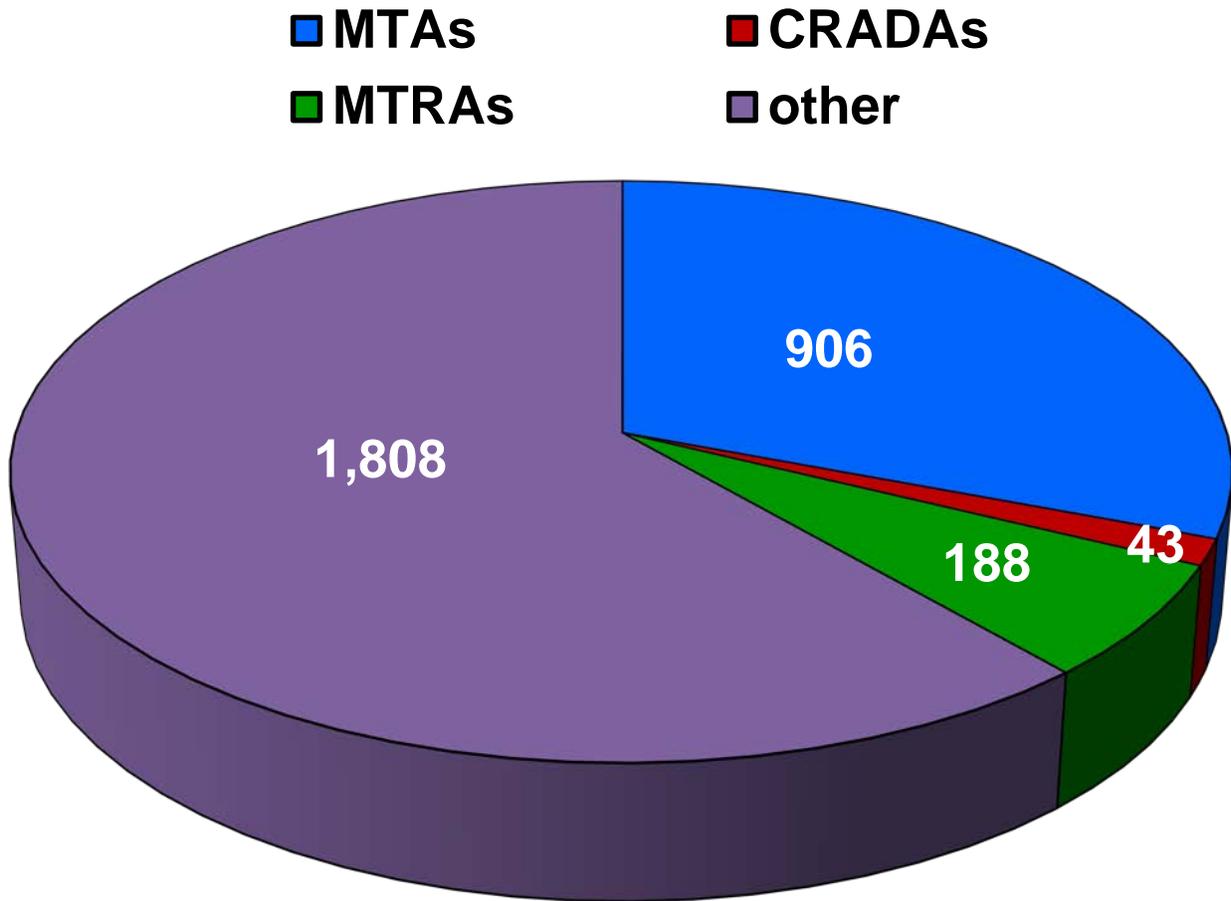


Figure 3. Number of new and active Trust Fund Cooperative Agreements, Reimbursable Agreements, Specific Cooperative Agreements and Non-Funded Cooperative Agreements.

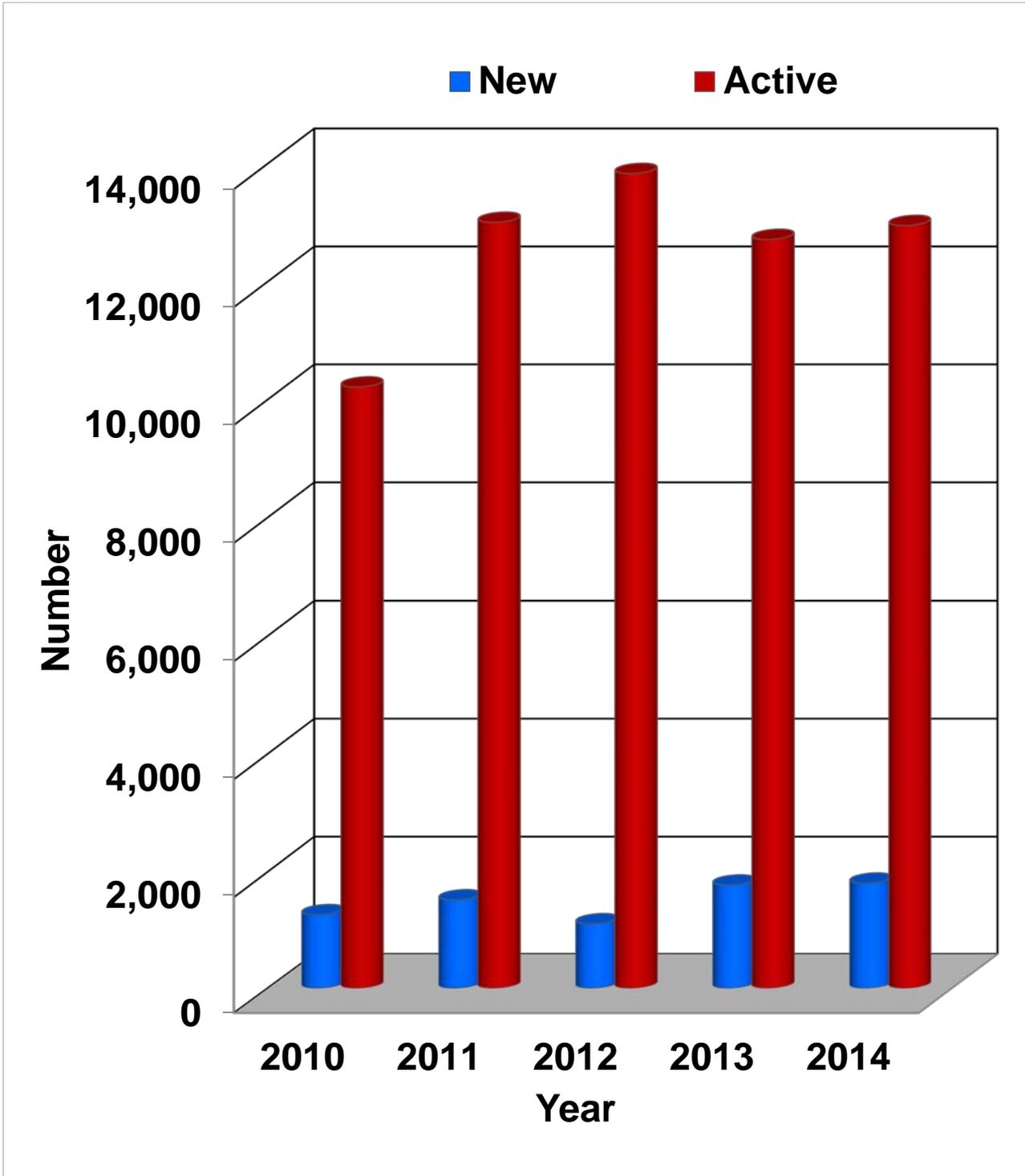


Figure 4. Number of invention disclosures, patent applications filed and patents issued. The year in which a patent issues is the not year in which the patent is filed.

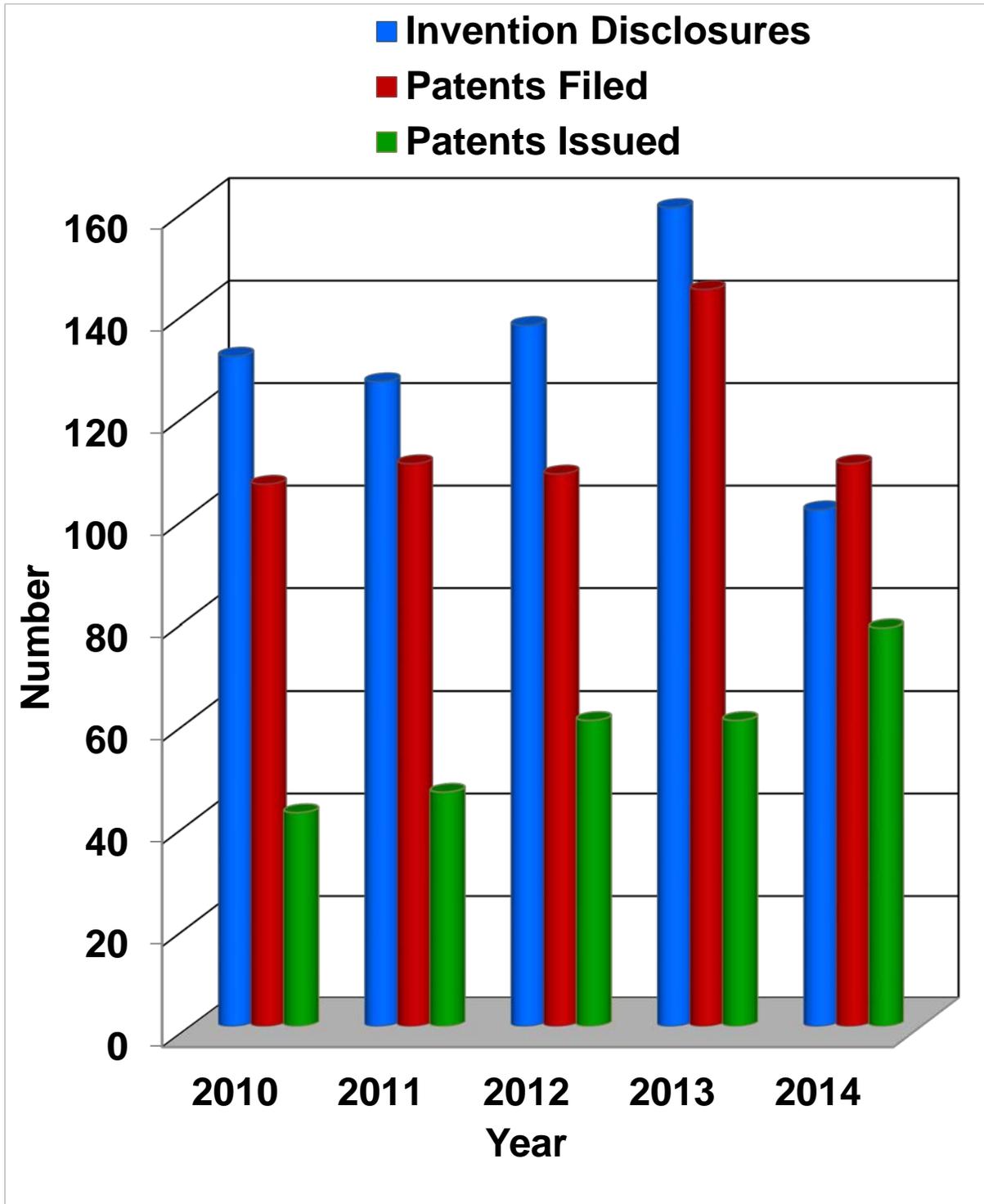


Figure 5. The ratio of patents issued over patent applications filed. While the year in which a patent issues is not the year in which the patent is filed, the ratio does represent a trend. The trend is “judicious” patenting to increase the percentage of patent applications that are issued. The decrease in FY2013 was due to the extra effort to file as many patent applications as possible before the new patent laws went into effect.

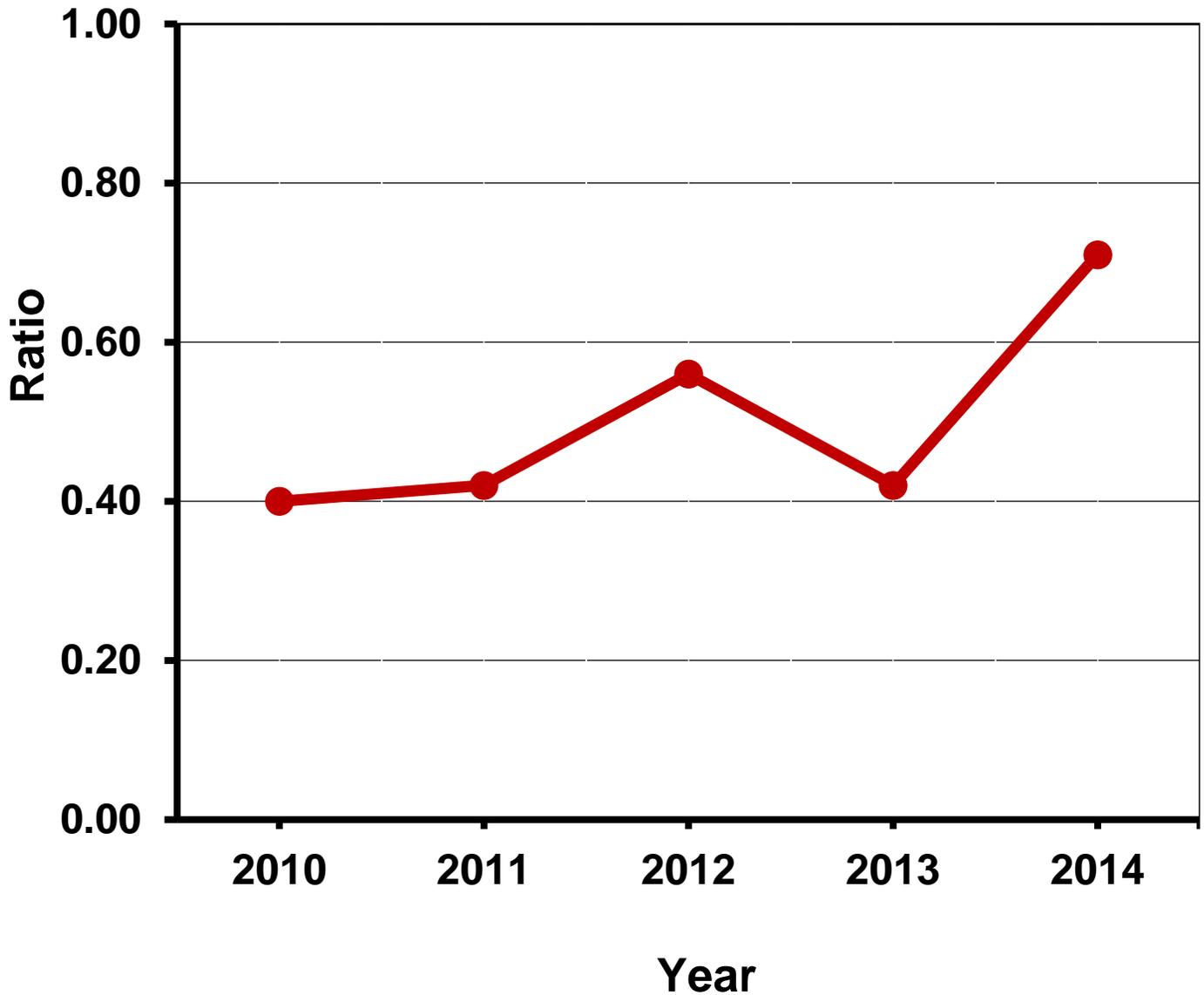


Figure 6. Number of patents issued in FY 2014 by scientific discipline.

- **Life Science**
- **Chemical**
- **Mechanical & Measurements**
- **Plant Patents**

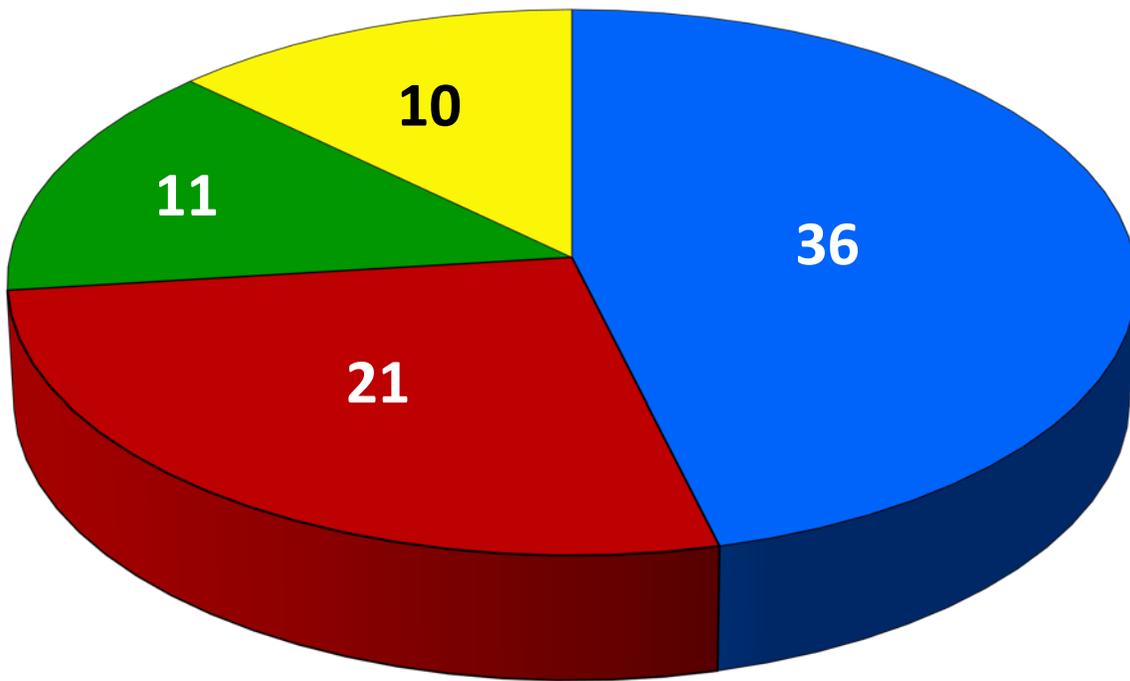


Figure 7. Number of license types per year.

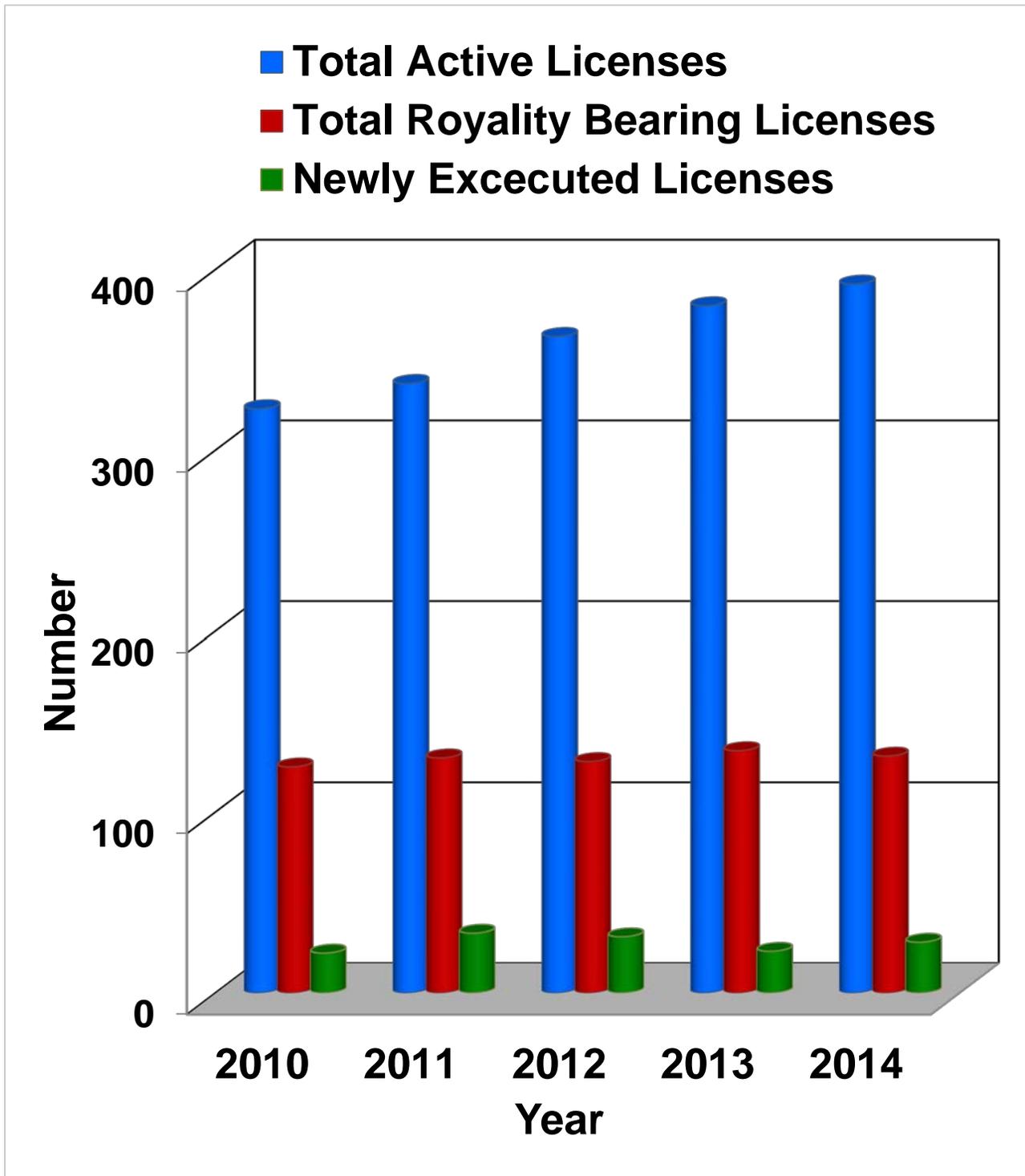


Figure 8. Earned license royalty income (ERI) over time.

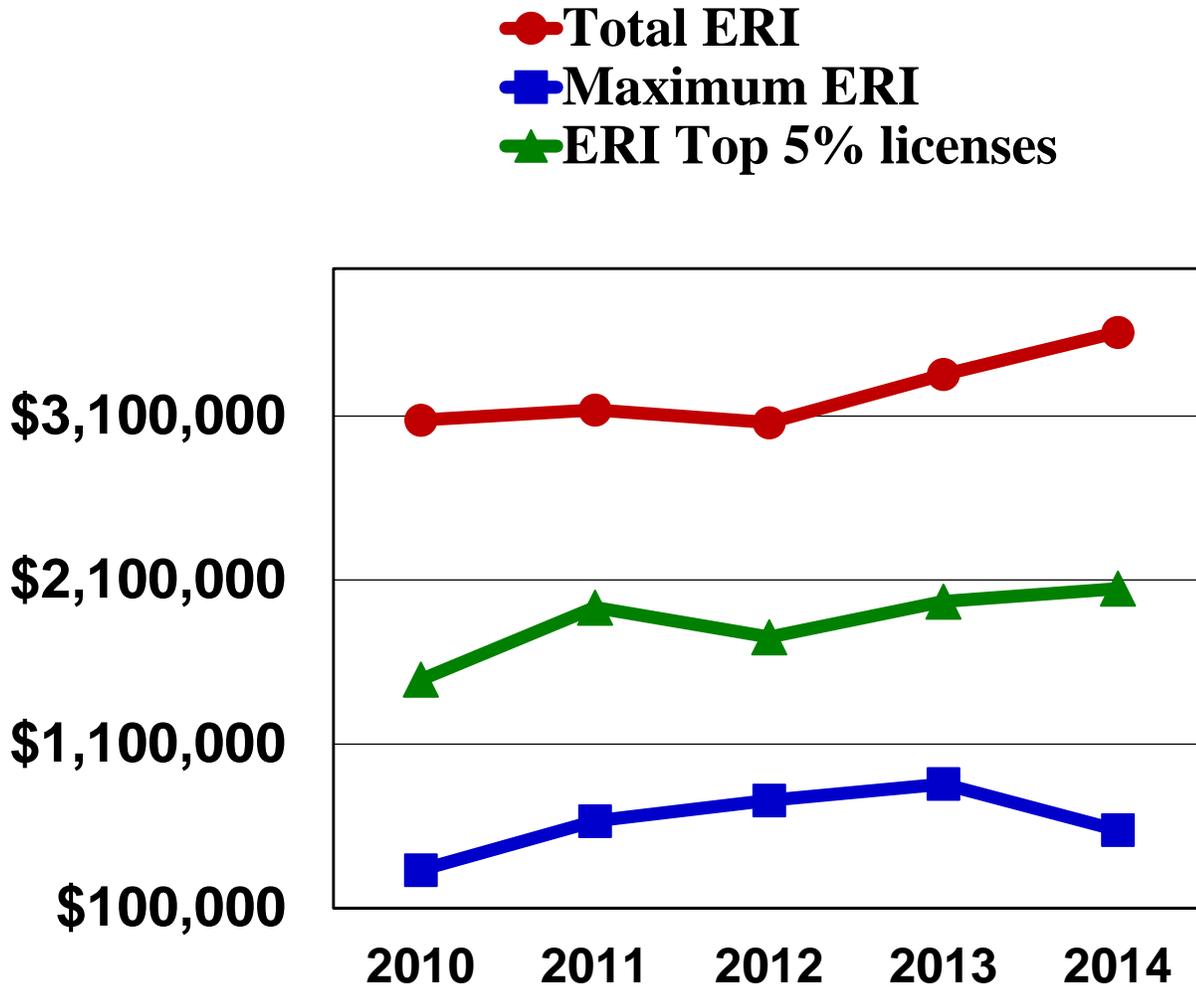


Figure 9. The number of new licenses executed in FY 2014 by business type.

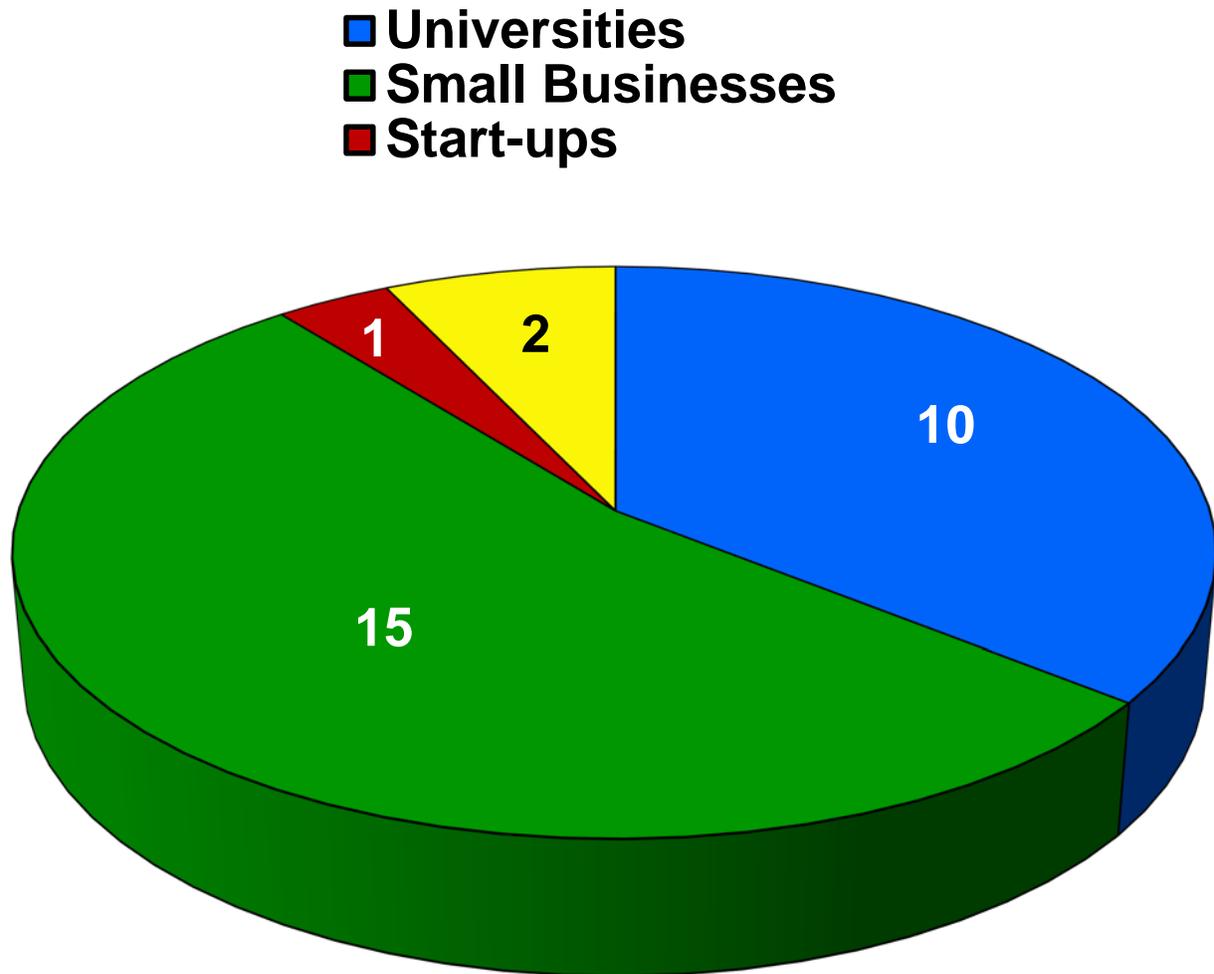
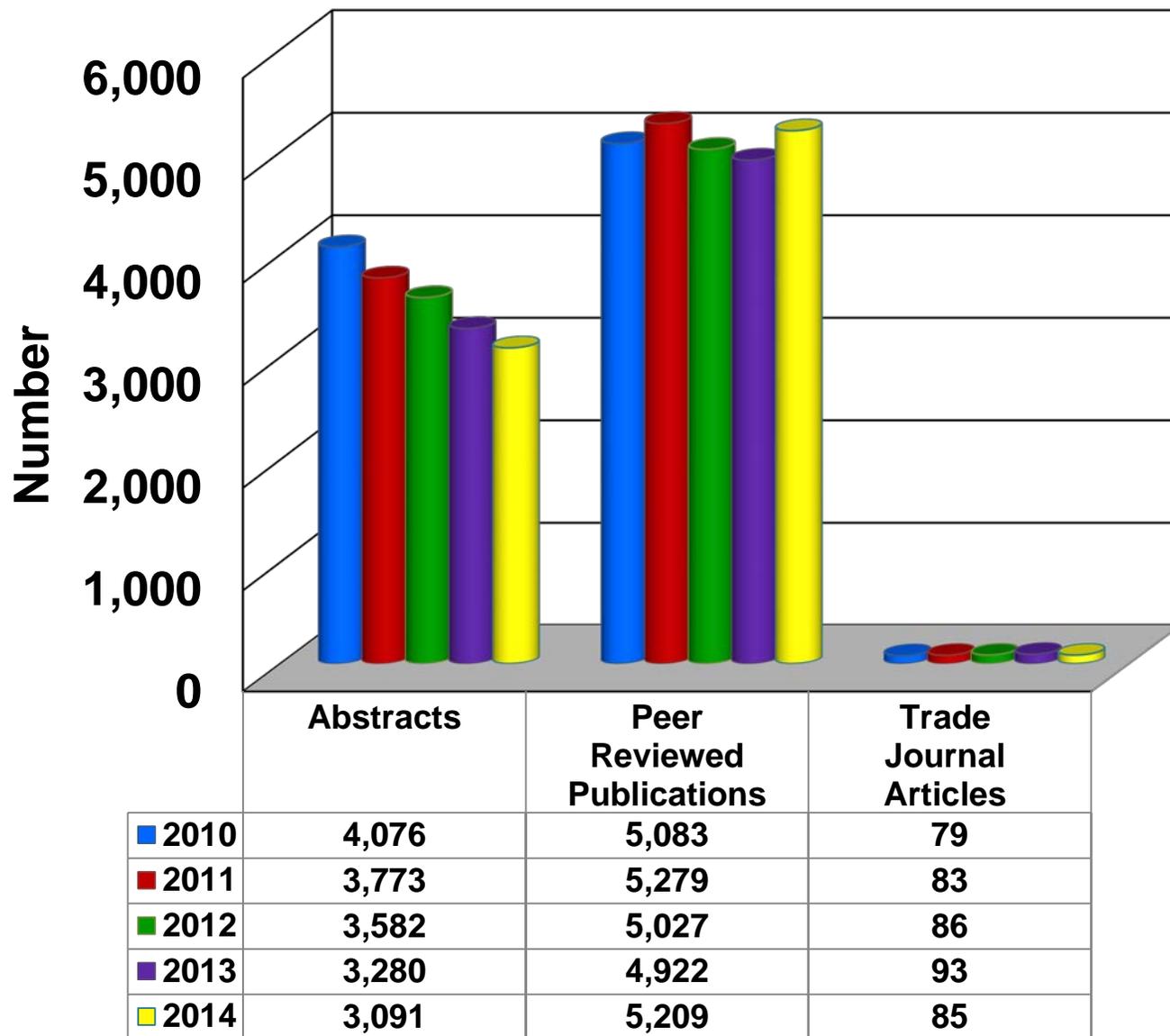


Figure 10. Number of ARS-approved publications per year.



4.0. Economic Research Service (ERS)

<http://www.ers.usda.gov/>

4.1. Mission Statement

The ERS mission is to anticipate economic and policy issues related to agriculture, food, the environment, and rural development, and conduct economic research that broadly and specifically informs public program and policy decisions.

4.2. Nature and Structure of Research Program

ERS follows the general USDA definition of technology transfer as the adoption of research outcomes for public benefit. ERS conducts relevant and objective economic research and policy analyses that inform program and policy decisions. ERS designs its research to demonstrate to its customers the consequences of taking alternative policy or programmatic pathways. Our data and market analysis program provides crucial market and trade outlook information to help farmers and agricultural companies run successful businesses and support jobs

ERS is also the primary source of statistical indicators that, among other things, gauge the health of the farm sector (including farm income estimates and projections), assess the current and expected performance of the agricultural sector (including trade), and provide measures of food insecurity here and abroad. ERS is one of the 14 officially designated (by OMB) federal statistical agencies.

ERS disseminates its research findings, market information, and statistical indicators in a variety of outlets including:

- Its website (www.ers.usda.gov);
- Its online magazine, *Amber Waves*;
- Outlook reports for specific commodity sectors
- ERS research and information reports; and
- Refereed journal articles, which assure the professional credibility of findings.

The ERS is located in Washington, DC, and has about 250 federal researchers working on socioeconomic research. Additionally, ERS seeks out academic and private sector collaborators through contracting and cooperative agreements to leverage external expertise to complement the knowledge of our intramural research staff.

4.3. Current Technology Transfer Goals, Objectives, and Measures of Success (Metrics)

ERS uses a web-centric approach to communication with customers. Our goal is to convey clear, objective, and transparent research, data, and analysis to decision makers, policy officials, industry, non-governmental organizations, and the general public. All ERS research, data, and other information disseminated by the agency are available through the ERS website. ERS measures customer satisfaction with the ERS website using a survey based on American Customer Satisfaction Index (ACSI). The measure tracks satisfaction of Web site users and provides a basis for comparison with similar government and private-sector Web sites. The target for this measure is at or above the average rating for government websites in the Information/News category.

4.4. Strengthening Current Activities

ERS is continues to enhancing and updating its website. ERS research, analysis and data will be easier to find,

and dynamically displayed in multiple locations. The website features more intuitive navigation for customers to enhance information delivery to customers. The website also features an enhanced experience for mobile users.

4.5. ERS response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

In the USDA's implementation plan for the Presidential Memorandum, ERS described one initiative to promote technology transfer and commercialization. The initiative and its implementation in FY 2014 are described below.

USDA 29: ERS is making wider use of social media and new technologies (such as mobile phone applications) to widen and expand the reach of our information services to the general public.

ERS is implementing wider use of social media and new technologies (such as mobile phone applications and open data methodologies) to widen and expand the reach of our information services to the general public. ERS has been a leading innovator in support of the Administration's Digital Strategy and Open Data initiatives, providing a wealth of products—including data and resources—designed to enhance delivery of information and services. In FY 2014, ERS used several new tools designed to help consumers more easily access critical programs and stimulate further innovation:

- **Responsive Design:** ERS has been working to optimize the website for mobile users, including developing a digital “eZine,” built with Responsive Design principles to automatically render on multiple devices/screen sizes, providing efficiencies in design/production (versus developing multiple style sheets for individual devices/platforms).
- **Web content APIs** (Application Programming Interface), offering digital professionals a machine-readable option for accessing publications, charts, and other website content. This allows external customers to integrate ERS information into their own website content.
- **APIs for select data and geospatial/mapping applications**, enabling researchers and developers to build applications using ERS data and process for additional insights.

The new products and tools extend and expand access to ERS research findings, market outlook, and data—making the Agency's information more readily available to the general public. These items were a first among USDA (and many government agencies), enabling USDA to meet its 12-month Digital Government Strategy goals to ensure high-value services and systems are available anywhere, any time, and on any device. The work also supports the President's Management Agenda to improve efficiency, share data with entrepreneurs and businesses, and stimulate job growth.

4.6. Downstream Outcomes

- ERS's Twitter feed continues to expand our reach: with over 16,000 followers signed up for our tweets in fiscal 2014--up from over 12,000 followers in 2013 and from 8,000 in 2012.
- ERS provided a new breakout of dairy industry commercial sales. For the first time, ERS has published new data on domestic commercial sales and commercial export sales for U.S. dairy products on a “milk-equivalent basis.” (<http://www.ers.usda.gov/data-products/dairy-data.aspx>) Historically, U.S. dairy product exports have been relatively insignificant and the U.S. was a net importer of dairy products. Since 2004, however, U.S. dairy product exports have soared in value, rising from \$1.4 billion to \$6.7 billion in 2013, and the U.S. is a significant net exporter. In response to these changes, ERS developed a new data series reporting both domestic commercial and commercial export sales, which had previously been combined as one category.

With the release of the new data, ERS now has a historically consistent estimate of monthly U.S. commercial export sales on a milk-equivalent basis going back to 1995. The data shows that by one measure of the amount of milk contained in these dairy product exports, exports account for 18.7 percent of total commercial disappearance (sales), up from 3.4 percent in 1995. The release of the improved dairy data was met with strong enthusiasm from academics and the industry as well as internally at USDA, underscoring the important role the ERS plays in providing key data and market information. Another illustration of the critical role the agency plays in providing data especially on dynamic and fast growing sectors is the increasing use of ERS Dairy data products. Between 2013 and 2014 the number of downloads of various dairy tables increased on average by 33 percent.

- Policy makers and the public are being provided with easily accessible data on rural areas through the ERS Atlas of Rural and Small-town America (<http://www.ers.usda.gov/data-products/atlas-of-rural-and-small-town-america.aspx>). The online mapping tool provides county-level information on over 60 statistical indicators on the people, jobs, agriculture, and county characteristics in nonmetropolitan America. The Atlas helps State and local decisionmakers pinpoint the needs of particular areas, recognize their diversity, and develop strategies to build on their assets by using location-based data on population, age structure, race and ethnicity, income, employment, agricultural well-being, and other measures. In FY 2014 the Atlas added updated information on education, employment by industry, and veterans from the 2008-12 American Community Survey (ACS). In addition, two maps showing deep poverty and deep child poverty from the 2008-12 ACS have been added to the Atlas.
- Local officials throughout the country can now easily gauge the characteristics of their food environment and target actions that alleviate problems with the availability of healthy food options for the people in their counties or State using the ERS Food Environment Atlas (<http://www.ers.usda.gov/data-products/food-environment-atlas.aspx>). The Atlas maps 168 different factors that contribute to U.S. counties' and States' food environments – from the number of fast food outlets per capita, to average food prices for various products, and the rate of diabetes. Because ERS determined the location and derived the characteristics of the nation's food deserts – places where grocery stores do not exist or are not easy to get to -- national, State and local governments can target food access investments so that the 23 million people with low access will have better choices and better health in the future. In FY 2014 ERS released an update of the Atlas, with many variables being updated to 2012 and farmers' market variables to 2013. In addition, new variables include SNAP policy variables, the Food Distribution Program on Indian Reservations (FDPIR), very low household food security, characteristics of farmers' markets, and State-level obesity rates for 2012.

5.0. Foreign Agricultural Service (FAS)

<http://www.fas.usda.gov/>

5.1. Mission Statement

The Foreign Agricultural Service (FAS) links U.S. agriculture to the world to enhance export opportunities and global food security.

5.2. Nature and Structure of Program

FAS Washington, D.C. staff and a global network of 96 offices with Foreign Service Officers and locally engaged staff cover over 160 countries. FAS supports U.S. foreign policy, identifies problems, provides practical solutions, and works to advance global food security and opportunities for U.S. agriculture. Within USDA, FAS serves as the principle coordinator of international activities, drawing on the broad expertise of USDA and U.S. agricultural organizations.

Trade Policy

FAS expands and maintains access to foreign markets for U.S. agricultural products by providing expertise in international trade policy negotiations and enforcement, and in working to reduce or eliminate technical barriers to trade and sanitary and phytosanitary trade restrictions. FAS works closely with other USDA agencies, federal and state governments, the U.S. agricultural industry, foreign governments, and international organizations to help ensure a level playing field for U.S. agricultural products in the international marketplace.

Market Development and Export Assistance

FAS partners with more than 75 cooperator groups, representing a cross-section of the U.S. food and agricultural industry, and manages a toolkit of market development programs to help U.S. exporters develop and maintain markets for hundreds of U.S. products. FAS also supports U.S. agricultural exporters through export credit guarantee programs and other types of assistance.

Data and Analysis

FAS's network of global contacts and long-standing relationships with international groups contribute to the agency's unique market intelligence capacity for all major agricultural commodities. FAS collects data and its analysts generate objective intelligence on foreign market opportunities, prepare agricultural production forecasts, assess marketing opportunities for U.S. exports, and both identify and monitor changes in policies affecting U.S. agricultural exports and imports. Agricultural markets and key private sector constituents rely on FAS data and analyses to develop and implement domestic and international programs and make business decisions.

Capacity Building and Development

FAS leads USDA's efforts to help developing countries and emerging market economies improve their agriculture and food systems and build their agricultural development and trade capacities. FAS administers international fellowships and other agricultural science and trade technical assistance, including non-emergency food assistance programs to help meet recipients' nutritional needs and support agricultural development and education.

5.3. Response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

USDA 31: Engage in consultation with the Agricultural Technology Innovation Partnership program (ATIP) to assist in establishing U.S. commercial partners with foreign entities.

New Title: Engage in consultation with the Agricultural Research Partnerships Network to assist in establishing U.S. commercial partners with foreign entities.

The Agricultural Research Partnerships (ARP) Network succeeded the Agricultural Technology and Innovation Partnership (ATIP) Program as a primary structure for transfers and commercialization of USDA technologies. In 2014 FAS provided updated talking points to the ARS/Office of Technology Transfer to disseminate information about FAS to ARP Network members that were interested in establishing commercial partners with foreign entities. In addition, FAS continued direct consultations with the Center for Innovation (Arlington, TX) about concepts for potential collaboration on international capacity building for transfer and commercialization of USDA technologies.

USDA 32: Provide assistance to ATIP members and their U.S. business clients in finding export opportunities for goods and services arising from USDA innovations.

New Title: Provide assistance to ARP Network members and their U.S. business clients in finding export opportunities for goods and services arising from USDA innovations.

As noted above, the ARP Network succeeded the ATIP Program as a primary structure for transfers and commercialization of USDA technologies. ARS scientists and two U.S. land-grant universities continued collaborating with FAS in a technical assistance project that showcases collaborative demonstration projects in Colombia and Panama to accelerate agricultural production and usage of biomass for clean energy. In addition, FAS and the Center for Innovation continued exploring opportunities to showcase and potentially transfer USDA innovations to East African partners to mutually benefit local food and agriculture systems in the region.

5.4. Downstream Outcomes

Energy and Climate Partnership of the Americas.

Under the ECPA framework and with funding provided by the U.S. Department of State, FAS continued its implementation of a technical cooperation project to increase the agricultural production and usage of biomass for renewable energy in the Western Hemisphere. This project included country-level demonstration projects and a regional policy and technology forum- similar to ATIP workshops- for innovators, policy-makers and entrepreneurs to advance development, transfer and commercialization of biomass energy technologies. Through this project, participating scientists from ARS, Washington State University (WSU) and Texas A&M University (TAMU) diffused knowledge on the chemical processes, institutional framework, and mechanical engineering for converting renewable feedstock into clean fuel and other economic co-products. In Panama, a scientist from the the Panamanian Institute for Agriculture Research (IDIAP) completed a scientific exchange at WSU, where he tested agricultural biomass feedstock using the pretreatment process “Wet Explosion – O₂”. Concurrently in Panama, Eco-Australis Latinoamerica drafted an economic feasibility study for the potential of the SER Alcohols to use US technology to produce cellulosic ethanol from local agricultural biomass. While the feasibility study report was still being finalized, the study estimated that \$3.50/gallon was the minimum ethanol price for the profitable application of local biomass for cellulosic ethanol production. Their study also included an Excel spreadsheet that can be used as a tool by those interested in adapting the feasibility study’s method to other contexts for biofuel production. In Colombia, USDA/ARS collaborated with National Center for Coffee Research (CENICAFÉ) on gasification and fast pyrolysis to convert coffee waste to clean energy. With this technology developed, Colombia’s use of coffee waste for renewable energy could still be affordable and could reduce air and water pollution associated with the current practice of using wood from the coffee pruning process for the production and burning of charcoal and burning coffee husks to fuel coffee bean driers. FAS procured a 20kw Power Pallet gasifier from the US manufacturer All Power Labs to test the gasifier at a CENICAFÉ research station in Colombia. The equipment is scheduled to arrive in Colombia at the end of November 2014. In February 2015, an ARS scientist will travel to Colombia to provide technical assistance to CENICAFÉ to ensure that gasifier is working properly to convert agricultural waste to heat and electricity. In March 2015 this ECPA project will close, though the international partnerships cultivated are anticipated to continue indefinitely to promote innovation, and commercialization of technologies for renewable energy and agricultural co-products.

Technical Assistance for Specialty Crops.

The Technical Assistance for Specialty Crops Program (TASC) continued investing in the development and transfer of innovative USDA post-harvest irradiation phytosanitary treatments for U.S. specialty crops (e.g., fruits, tree nuts, vegetables, and greenhouse and nursery crops). In 2014 TASC funded ARS-Hawaii to continue working on a project for development and transfer of such irradiation phytosanitary treatments. These TASC investments were critical in helping U.S. exporters preserve a \$12 billion annual market for U.S. exports of specialty crops. By collaborating with sister USDA agencies, U.S. universities and specialty crops industries to develop and commercialize post-harvest phytosanitary irradiation treatments, TASC directly helped to promote the transfer and commercialization of these new technologies and, overall, expand the variety, quantity and value of U.S. specialty crops for export markets. With TASC's support, the development, transfer, application, and commercial value of irradiation phytosanitary treatments was expected to continue increasing over the coming years.

Food For Progress.

The Food for Progress Program (FFPr) helps developing countries and emerging democracies to modernize and strengthen their agricultural sectors. U.S. agricultural commodities donated to recipient countries are then sold on the local market and the proceeds are used to support agricultural, economic or infrastructure development programs. In some cases, FFPr activities help accelerate the transfer and commercialization of U.S. technology in partner countries. For example, in FY 2014 Catholic Relief Services (CRS) was awarded a cooperative agreement to help improve Nicaragua's dual purpose cattle (i.e., beef and dairy) and cacao sectors in partnership with the Ministry of Agriculture and Forestry, the National Institute for Agricultural Technology, the Foundation for the Autonomy and Development of the Atlantic Coast of Nicaragua and national, regional and local cacao commissions and local producer organizations. On the cattle side, in addition to technical assistance on cattle breeding and health services, CRS will help in-country partners develop cold chains and processing and storage technologies that will increase quality and profitability of their meat and dairy products. On the cacao side, CRS will provide cacao propagation and production training to growers and simultaneously strengthen local institutional capacity by supporting the University of the Autonomous Regions of the Nicaraguan Coast to expand its new cacao technical assistance program. CRS will work with producer organizations and private enterprises to identify domestic and international buyers, research buyers' specific requirements, and develop options for financing needs and supply chains. CRS will disseminate and adapt U.S. technologies with local partners to improve core sectors of Nicaragua's agricultural economy, build Nicaragua's institutional capacities for agricultural technology transfers and ultimately lead toward increased opportunities for Nicaragua's agricultural trade with the United States and other partners.

Norman E. Borlaug International Agricultural Science and Technology Fellows Program.

In 2014 the Norman E. Borlaug International Agricultural Science and Technology Fellowship Program ("BFP") supported 41 Fellows to help transfer new science and agricultural technologies to eligible developing countries. Since the program's inception in 2004, BFP provided training to more than 750 Fellows from 64 countries and facilitated ongoing relationships between Fellows and their U.S. mentors to promote the adoption or commercialization of U.S. technologies in their respective countries. For example, in 2014 a Borlaug alumnus in India reported that he was able to secure funding to establish the Centre of Food Science and Technology at Banaras Hindu University (BHU), which awards undergraduate, master, and doctoral degrees in food science. His 2006 Fellowship at Cornell University enabled him to create a state-of-the art food and science program, which did not previously exist at BHU. As the coordinator for the Centre, he has developed international linkages, faculty exchanges between European Institutions and BHU, and an MOU between BHU and the National Dairy Research Institute in Karnal, India. The Center continued working with local farmers to reduce food waste and improve livelihoods. In 2014 a BFP alumnus from Bangladesh reported that he started the Asian Food Safety and Security Association (AFSSA), a non-profit organization facilitating collaborative research to address food safety and food security issues throughout Asia. His 2011 Borlaug Fellowship at University of Nebraska-Lincoln focused on food safety and, since then, he has continued independently collaborating with his

Fellowship mentor and another researcher from the University of Nebraska-Lincoln to support AFSSA, including presentations at the 2013 AFFSA conference in Japan. They were planning another presentation for the 2015 AFSSA conference in Vietnam. These AFSSA research projects and collaborations on food safety issues and new technologies benefit Bangladesh and other partner countries in Asia. These exemplary Fellows, their U.S. mentors and other BFP participants are continuing to learn, disseminate and apply U.S. technologies to improve agricultural sciences, trade, and food security throughout the developing world. needs and support agricultural development and education.

Global Partnership for Pesticide Standards.

With funding provided by the FAS Emerging Markets Program, U.S. Department of State and the U.S. Agency for International Development and with technical cooperation from the IR-4 Project, crop protection industries and the Food and Agriculture Organization of the United Nations (FAO), FAS continued to lead a global partnership for transferring and commercializing U.S. crop protection technologies to partner countries in a manner that is concurrently helping to establish Codex standards for innovative pesticide-crop combinations and, ultimately, share costs of generating the data that leads to such standards. Codex standards are international food standards, guidelines and codes of practice contribute to the safety, quality and fairness of this international food trade. Currently, NIFA spends approximately \$17 million each year on IR-4 to conduct pesticide residue field trials for U.S. specialty crops. The IR-4 Project is highly successful to generate data for review and acceptance by the U.S. Environmental Protection Agency. Thus, pace of the registration and commercialization of new pesticides for use by U.S. growers far exceeds the pace of Codex and most U.S. trading partners. As a result, many chemicals approved for use by U.S. growers are not yet approved abroad, often creating situations where affected U.S. products are banned from their intended foreign markets. The FAS-led global partnership is working with stakeholders in partner countries in Africa, Asia, and the Western Hemisphere to fill the gap. In short, through policy dialogue, technical training and cooperative research, the global partnership is enabling coordination among the United States and 20 other countries to conduct field trials on pesticides and crops and then jointly submit the data packages to Codex. In 2014, the partnership successfully completed field and laboratory studies in 2 countries, initiated studies in 10 countries, and provided training to 8 additional countries that planned to initiate studies. Additionally, FAS coordinated the nomination process between the United States, partner countries and FAO for the scheduling of residue data review for establishment of Codex standards by 2017. In addition to ongoing technology transfer activities in 2015, FAS and the IR-4 Project will host a global meeting to identify future projects that will support new pesticide standards and plan ongoing global coordination of that work. By transferring these policy concepts and technical skills to foreign partners, the global partnership for pesticide standards continued complementing the IR-4 Project by supplementing US-generated data or completely shifting to a partner country the responsibilities for generating pesticide data from field trials. In addition to economizing U.S. resources for development and commercialization of pesticides, this global partnership continued to promote common standards among the United States and our agricultural trading partners and, overall, provide modern pest control tools that may be safely used by growers world-wide.

6.0. Forest Service (FS)

<http://www.fs.fed.us/>

6.1. Mission Statement

The overall mission of the FS is to “sustain the health, diversity, and productivity of the nation’s forests and grasslands to meet the needs of present and future generations.” Established in 1905, FS is an agency of the U.S. Department of Agriculture that directly manages 193 million acres of public land in national forests and grasslands and works with state forestry agencies and other partners to assist in managing 491 million acres of state and private forest lands. Gifford Pinchot, the first Chief of the Forest Service, summed up the mission of the Forest Service —“to provide the greatest amount of good for the greatest amount of people in the long run.” FS is composed of four deputy areas: National Forest System (NFS), Research and Development (R&D), State and Private Forestry (S&PF), and Business Operations.

The R&D mission is to “develop and deliver knowledge and innovative technology to improve the health and use of the Nation’s forests and grasslands – both public and private.” R&D provides this information to landowners, managers, policymakers, and the American people to help inform their decisions and actions.

6.2. Nature and Structure of Research Program

The FS R&D mission area develops and delivers the scientific information and technology needed to manage, protect, use, and sustain the natural resources of forests and rangelands. Research is conducted by more than 550 scientists and several hundred technical and support staff. The FS R&D deputy area includes five research stations (Northern, Pacific Northwest, Pacific Southwest, Rocky Mountain, and Southern), the Forest Products Laboratory, the International Institute of Tropical Forestry in Puerto Rico, and two Technology and Development Centers run by NFS located in Missoula, Montana and San Dimas, California.

Ninety-two research work units are located at 67 sites throughout the United States. The system provides sites for long-term science and management studies of major vegetation types found on the 193 million acres of public land administered by the Forest Service.



The research program is organized among seven Strategic Program Areas: wildland fire and fuels; resource management and use; wildlife and fish; recreation; water, air, and soil; inventory and monitoring; and invasive species.

FS R&D maintains a vital network of 80 Experimental Forests and Ranges, 29 of which were established in the 1930s. Long-term records from some of these forests can provide unprecedented insights into global climate change, watershed function, disturbance recovery and many other areas. Major research themes at the Experimental Forests and Ranges include developing systems for management and restoration of forests, range lands, and watersheds; investigating forest and stream ecosystems; characterizing plant and animal communities; observing and interpreting long-term environmental change and many other themes.



FS R&D is currently placing special emphasis on climate change, biomass to energy, watershed restoration, urban natural resource stewardship, and nanotechnology. FS R&D seeks to achieve excellence in conducting high-quality research on relevant topics in natural resource sciences.

6.3. Current Technology Transfer Goals, Objectives, and Measures of Success (Metrics)

The FS uses many means of technology transfer, including marketing efforts at tradeshow and with universities; patents; webinars; workshops; social media posts; conservation education and citizen science; public outreach; and publications both electronic and paper. Many metrics associated with these efforts are currently being tracked, and FS plans to track new metrics such as social media, web hits and citation indexes within the next five years.

One measure of success currently used by FS R&D is the Customer Satisfaction Survey sent out every three years to the various individuals and groups who use our research information and products. The survey uses econometric models developed collaboratively with FS R&D staff and customized for our products and services. The results are presented as a score based on the American Customer Satisfaction Index methodology, which enables users to compare the scores of other Federal R&D agencies. The three main components measured were relevant activities in each area that drive customer satisfaction, satisfaction itself, and desirable customer

behaviors and outcomes. The FY 2012 survey scored 79 percent, exceeding its target and scoring significantly better than the average score of 67 percent for all other Federal agencies. Results from this survey were incorporated into FS R&D program planning to ensure that the work we do is relevant to customers' needs. The survey will be repeated in FY 2015.

The principal contact for technology transfer via patents and licensing within the FS is the Patent Program reporting to the Washington Office and located at the Forest Products Laboratory in Madison, Wisconsin. The FS Patent Program receives and tracks all invention disclosures, providing guidance to scientists regarding all aspects of intellectual property protection. The Patent Program directs prior art searches and prepares FS invention disclosures for review by the FS Patent Review Committee (PRC), a multidisciplinary committee with members from R&D, NFS, and S&PF. The Patent Program also oversees contract law firms drafting patent applications, and files and prosecutes applications in the U. S. Patent and Trademark Office. Draft patent licenses are prepared by the FS Patent Program and reviewed by ARS OTT Licensing Specialists. CRADAs and other technology transfer agreements for the FS are handled by the FS Grants and Agreements Specialists, with patent marketing responsibilities falling to the FS Patent Program.

The PRC meets bimonthly to evaluate and decide whether to file patent applications on FS invention disclosures. The criteria used by the committee include the invention's relationship to the overall mission of the Forest Service, its potential to further national forest resource goals and objectives, the advancement of the state of the art, and economic concerns such as market potential, costs of production, and licensability. Once the decision to patent an invention has been made, the FS Patent Program handles filing and prosecuting patent applications, and/or working with the joint owner (such as CRADA cooperator or university) to pursue patent protection.

The Forest Service is the only land management agency within USDA and is responsible for managing 193 million acres. Forest Service R&D provides high-quality scientific information and applications that help land managers restore and maintain healthy forests and grasslands for community protection; multiple environmental and social benefits, such as clean air and clean and abundant water; a great array of recreational opportunities; and a wide range of ecosystem services.

The following table illustrates trends in FS R&D performance outcomes, the average of these years will be used as a baseline for the period from 2013-2017.

Performance measure	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
Customer satisfaction index score - (60,000 - 80,000 customers surveyed every three years)	75	75	75	79	79	79

6.4. FS response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

In the USDA's implementation plan for the Presidential Memorandum, FS described six initiatives to promote technology transfer and commercialization. The initiatives and their FY 2014 updates are described below.

Strengthening Current Activities

USDA 14: Accountability of Scientists and Engineers in Technology Transfer Accomplishments

In 2012 the annual performance standards for scientist evaluations were revised to include technology transfer elements. In FY2014, two new performance metrics were employed to measuring the number of technology transfer units performed at each station. These new Performance Accountability Measures are Science Delivery Products and Science Delivery Activities. Science Delivery Products are products developed to enhance the usefulness of scientific information, including synthesized information from a wide range of disciplines that are delivered to clients in clear and accessible formats. Science Delivery Activities are activities undertaken to enhance the usefulness of scientific information that are delivered to clients in clear and accessible form. Information about these products and activities are recorded by Stations in the Research Information Tracking System (RITS), and are retrieved by WO R&D staff for accomplishment reporting.

USDA 15: New uniform metrics for Forest Service Outcomes

During FY 2014, ten new performance metrics were put into use, five existing metrics were revised, three metrics were retired, and ten existing metrics were not changed. This occurred after a review and reevaluation of all performance metrics was performed during FY 2013 with the intent of standardizing performance reporting across units. In addition to the metrics review and the development of new metrics, major changes were made to the Research Information Tracking System (RITS) to make it more effective, accurate, and uniform in the way accomplishments are reported. The revisions to RITS not only provided for more standardized reporting among stations, it provided easier access to accomplishment data by leadership and staff in the Washington office and in the field.

Starting in 2014, only information entered into RITS was considered for inclusion in some of the metric accountability estimates. Also, definitions were revised and new metric categories were developed to better define metric categories and this improved accuracy in reporting. In addition, this new process for reporting reduced the reporting burden in the field and provided an effective way for employees and leadership to quickly produce performance reports tailored to each need.

During 2014 two metrics for scientific publications were re-defined:

- Formally refereed publications are published scientific papers or similar documents, usually in journal or similar quality outlet, that are the result of material support from FS R&D, and on which the decision to publish is based on the results of a formal peer review and independent editorial decision
- Informally refereed publications are the number of published scientific papers or similar documents that are the result of material support from R&D, and on which the decision to publish is made after peer reviews that are not independently commissioned (reviewers are selected by author or line officer).

Also during 2014, new metrics were used to better define the information that sometimes was listed as publications.

- Science delivery products are products based on original research that are developed to enhance the usefulness of scientific information, regardless of durable delivery format, that are delivered to clients in clear and accessible formats.
- Science delivery activities are activities based on original research that are undertaken to enhance the usefulness of scientific information and that are delivered to clients in clear and accessible formats.

Regarding the patent process, new metrics were developed in 2014 to better quantify the entire patent process. These additional metrics describe accomplishments from the first step of application through licensing.

The current metrics being used for this purpose include:

- Patents issued that are assigned to USDA, on a five year rolling average.
- Patent licenses executed based on Forest Service discoveries, developments and applications to industrial

- interests, universities, or other entities, on a five year rolling average.
- New patent applications filed which have been assigned to USDA, on a five year rolling average.
- New invention disclosures received from Forest Service scientists and engineers, on a five year rolling average.

In 2014, performance accountability for three of the performance metrics was calculated using queries from the RITS to generate the estimate. As was done in 2013 the estimate for Invasive Species tools was generated this way, and in 2014 that metric and two additional metrics involving fire science (fire science output efficiency index and the fire science quality index) were calculated that way.

To better account for the funding provided to universities and other organization, additional performance metrics were developed to bring to twelve the number of metrics used for reporting funding to other organizations. These metrics are:

- Federal research funding provided to institutions of higher learning
- Federal research funding provided to Historically Black Colleges and Universities (HBCUs)
- Federal research funding provided Hispanic Serving Institutions (HSIs)
- Federal research funding provided to minority serving institutions
- Federal research funding provided to HBCUs, TCUs and HSIs
- Federal research funding provided to Tribal Colleges and Universities (TCUs)
- Federal research funding provided to 1862 land grant colleges and universities
- Federal research funding provided to 1890 land grant colleges and universities
- Federal research funding provided to 1994 land grant colleges and universities
- Federal research funding provided to non-academic institutions
- Total amount of grants and agreements awarded to other organizations and institutions
- Leveraged funds from Grants and Agreements

The third “Chief’s Science Delivery Award” was presented in February 2014 for a FS employee’s work in the area of ecology and specifically work with amphibians and reptiles.

Forest Service is currently reporting the number of citations of Station scientist’s publications as indices of the impact of Forest Service science. These indices are the average number of times FS scientists’ papers are cited in the Science Citation Index during the previous 10-year period beginning two years after publication. These include the average annual number of high impact papers (papers cited more than 20 times) and the average annual number of very high impact papers (papers cited more than 50 times). As reported in the Web of Science, over the period from 2005 through October 2014, publications authored by FS R&D scientists were cited in peer reviewed scientific journals an average of 12,410 times per year for a total of 136,515 citations over the ten year period. There were 1,815 high impact papers and 536 very high impact papers. This was a 4% increase in citations, 8% increase in high impact papers, and an 18% increase in very high impact papers for FY2014 compared to FY2013.

FY 2014 marked the fifth year of operation for the Forest Service Research Data Archive (<http://www.fs.usda.gov/rds/archive>). It added 34 research data sets to its catalog in FY 2014, and now offers 137 research data sets to the public and global science community. The catalog is also searchable via science.gov (using its new ‘Data’ tab). Twelve of the new data sets resulted from the archive’s service agreement with the Joint Fire Science Program (<http://www.firescience.gov>). Over 1,680 people downloaded a published data set in FY 2014 (> 50 percent increase relative to FY 2013); 70 percent of the data sets have been downloaded by a customer at least once. The archive expects to begin tracking citations of its published data sets in FY 2015 using the digital object identifiers (DOIs) it assigns to each data set.

USDA 16: New metrics on research outcomes related to intellectual property (patents)

FS R&D developed and implemented the RITS, which became the official FS reporting vehicle for all science publications in FY 2010. RITS improves the quality and consistency of data, provides transparency to the public, and reduces the need for burdensome data calls. The newest version of RITS incorporates patent data which is connected to related publications on specific technology focus areas. Patent data in RITS has now been updated to include the last 20 years of information. Going forward, patent data will be entered in RITS annually. Additional updates to improve the patent portion of RITS are planned for future releases.

Facilitating Adoption Through Partnerships

As part of the USDA, the Forest Service Patent Program has enjoyed a close working relationship with ARS and the Office of Technology Transfer (OTT) for many years. This partnership has grown and expanded to include FS access to the Agriculture Research Information System (ARIS) database for patent and license tracking, inclusion in OTT teleconferences, and ARS Licensing Associates assisting the FS Patent Program with license negotiations.

USDA 17: Explore additional ways FS and ARS can work together on intellectual property and related matters

Cooperative Research and Development Agreements (CRADAs) are widely used within the FS to enable researchers to work with university partners and industry leaders and are drafted by the FS Grants and Agreements Specialists. Recognizing efficiencies that could be gained by having standardized agreement language and procedures, FS has used ARS as a CRADA resource in FY 2014 to assist with CRADA questions. The ARS Partnership Liaison and Deputy Assistant Administrator, Office of Tech Transfer, held an in-person training session on CRADAs for FS Grants & Agreements Specialists in FY 2014.

Further collaboration on various technology transfer agreements, such as Material Transfer Agreements (MTAs) and CRADAs is planned for the next FY, as are collaborations involving jointly owned inventions and patent prosecution matters.

USDA 18: Enhance education and extension outreach efforts

FS R&D has a focused effort to educate children about science, technology, engineering, and mathematics (STEM), ecology, and conservation of natural resources. In partnership with the Cradle of Forestry in America Interpretive Association (CFAIA), the Forest Service has created and distributed two *Natural Inquirer* monographs in celebration of the Wilderness Act's 50th anniversary. Additionally with CFAIA and the U.S. Geological Survey, FS R&D created and distributed a "Scientific Models in Adaptive Management" *Natural Inquirer*. In FY2014, close to 80,000 journals were distributed to students and home schools. In partnership with CFAIA, the FS distributed 200,000 scientist cards to student participants at the 2014 National Science and Engineering Fair. These cards, which are similar to baseball trading cards, feature Forest Service scientists and introduce students to natural resource science careers.

USDA 19: Enhance FS interactions with entrepreneurship activities at educational institutions

During FY2014, ten performance metrics were used to evaluate the level of interaction the Forest Service has with activities at educational institutions. Prior to 2014 we measured the amount of funding provided to: all institutions of higher learning; minority institutions; historically black colleges and universities; Hispanic serving institutions; and Tribal colleges and universities. Also the percent of Forest Service funding going to colleges and universities was tracked. Starting in FY 2014, additional performance metrics were employed to track funding to Land Grant Colleges and Universities; 1862 Land Grant Colleges and Universities; 1890 Land Grant Colleges;

and 1994 Land Grant Colleges and Universities. During FY2014, colleges and universities were provided more than \$35 million, with almost \$1million going to minority colleges and universities. Funding to colleges and universities accounted for 2.6% of the total Forest Service budget.

6.5. Metric Tables.

TABLE 1. Collaborative Relationships for Research and Development.

*ND-no data available.

Forest Service (FS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total number active CRADAs	7	9	22	20	44
Active traditional CRADAs	7	9	22	20	24
Active non-traditional CRADAs	0	0	0	0	20
Active CRADAs with small businesses	0	0	0	0	0
Number newly executed CRADAs	6	6	3	10	16
Newly executed amendments ¹	N/A	N/A	N/A	6	N/A
Newly executed traditional CRADAs	6	6	3	10	9
Newly executed non-traditional CRADAs	0	0	0	0	7
Newly executed CRADAs with small businesses	0	0	0	0	0
Total number active MTRAs²	0	0	0	0	0
Newly executed MTRAs	0	0	0	0	0
Total number of active other agreements³	1,727	1,636	807	3,179	2550
Newly executed other agreements	1,110	1,038	63	1,380	701
Number newly executed MTAs	ND*	ND	ND	8	7
Newly executed outgoing MTAs	ND	ND	ND	8	7
Total number of publications	2,877	4,261	3,699	3,460	2083
Peer-Reviewed Scientific Publications ⁴	1,884	3,083	3,049	3,014	1285
Trade Journal Publications ⁵	993	1,178	650	446	798
Abstracts	N/A	N/A	N/A	N/A	N/A

1. Amendments extend existing CRADAs for additional years to a maximum of five years, and/or change Statements of Work, and/or change funding levels.
2. Material Transfer Research Agreements. Involves collaborative research on a specific material.
3. Includes mostly Trust Fund Cooperative Agreements, Reimbursable Agreements, Material Transfer Research Agreements, Specific Cooperative Agreements and Non-Funded Cooperative Agreements, Challenge Cost-Share Agreements, Collections Agreements, Cooperative Agreements, Inter-agency & Intra-agency Agreements, Joint Venture Agreements, Participating Agreements, Research Cost-Reimbursable Agreements, Research Joint Venture Agreements.
4. Numbers for FY14 are less than last year in this category because the definition for this metric and the means of accounting for publications was changed and these factors can explain the large reduction in number of accomplishments. Instead of manually reporting the number of publications from each unit, publications are now entered by category in the online Research Information Tracking System, and each publication can only be entered once. This has eliminated the potential for duplicate counting of the same publication when there is more than one author. In addition, there is reduced room for interpretation about this category of publications:

It is now called “Formally Reviewed Publications” and is defined as “documents, usually in journal or similar quality outlet, that are the result of material support from FS R&D, and on which the decision to publish is based on the results of a formal peer review and independent editorial decision.”

5. The definition for this metric changed in FY14 to “Informally Reviewed Publications” and is defined as “scientific papers or similar documents that are the result of material support from R&D, and on which the decision to publish is made after peer reviews that are not independently commissioned (reviewers are selected by author or line officer). In past years, these publications may have been counted as journal publications, but from now forward, the new definition will apply. Those products are now included in a separate category, ‘Science Delivery Products’ and include: Scientific or policy reports, articles, proceedings or similar publications that have not been formally or informally refereed prior to publication, or that are published in trade journals or other professional and lay outlets and information that was previously published; Interactive programs, software and models that are persistently accessible and support the development of natural resource management plans; Guidebooks, technical notes, brochures, and interpretive publications available either online for downloading or in hardcopy or both; new online and downloadable or searchable databases on natural resource information; formal agreements such as a CRADA ; Webinars or any recorded and persistently accessible science based presentations, workshops, or other video sessions for science delivery or communication. The number of Science Delivery Products for FY2014 is 49.

TABLE 2. Invention Disclosure and Patenting

*ND-no data available.

Forest Service (FS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total number new invention disclosures¹	18	31	23	24	13
University co-owned	ND*	ND	ND	7	4
Based upon scientific discipline					
Life science	ND	ND	ND	3	4
Chemical	ND	ND	ND	8	4
Mechanical & measurement	ND	ND	ND	13	5
Plant patents				0	0
Total number patent applications filed²	6	13	13	13	9
University co-owned	ND	ND	ND	9	6
Based upon scientific discipline					
Life science	ND	ND	ND	0	5
Chemical	ND	ND	ND	8	4
Mechanical & measurement	ND	ND	ND	5	0
Plant patents	ND	ND	ND	0	0
Total number patents issued	2	3	8	4	4
University co-owned	ND	ND	ND	1	1
Based upon scientific discipline					
Life science	ND	ND	ND	1	4
Chemical	ND	ND	ND	0	0
Mechanical & measurement	ND	ND	ND	3	0
Plant patents	ND	ND	ND	0	0

Annual Reporting on Technology Transfer in USDA, FY 2014

1. Inventions arising at the federal lab.
2. Includes U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, continuation-in-part applications, and provisional applications.

TABLE 3. Profile of Active Licenses

*ND-no data available.

Forest Service (FS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total number active licenses	20	20	20	19	21
Executed to small businesses ¹	ND*	ND	ND	1	3
Executed to startup businesses ²	ND	ND	ND	2	1
Executed to universities	ND	ND	ND	14	17
Invention licenses³	20	20	20	19	21
Executed to small businesses	ND	ND	ND	1	3
Executed to startup businesses	ND	ND	ND	2	1
Executed to universities	ND	ND	ND	14	17
Other IP Licenses⁴				0	0
Executed to small business	ND	ND	ND	0	0
Executed to startup businesses	ND	ND	ND	0	0
Executed to universities	ND	ND	ND	0	0
Total number newly executed licenses	0	2	3	2	2
Executed to small businesses	ND	ND	ND	0	0
Executed to startup businesses	ND	ND	ND	1	0
Executed to universities	ND	ND	ND	1	2
Invention licenses	20	20	20	19	21
Executed to small businesses	ND	ND	ND	1	3
Executed to startup businesses	ND	ND	ND	2	1
Executed to universities	ND	ND	ND	14	17
Other IP Licenses	0	0	0	0	0
Executed to small businesses	ND	ND	ND	0	0
Executed to startup businesses	ND	ND	ND	0	0
Executed to universities	ND	ND	ND	0	0

1. A small business, together with its affiliates, must not have more than 500 employees.
2. For the purpose of this report, a startup company is a privately-held, U.S., for-profit company operating for less than five years and actively seeking financing to commercialize a federal scientific work product.
3. Invention licenses refer to licenses resulting from a patent.
4. Other IP licenses included biological materials licenses and plant variety protection licenses.

TABLE 4. Characteristics of Income Bearing Licenses

Forest Service (FS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total number of income bearing licenses	18	18	18	18	21
Exclusive	17	17	17	17	20
Partially exclusive	0	0	0	0	0
Non-exclusive	1	1	1	1	1
Invention licenses¹	18	18	18	18	21
Exclusive	17	17	17	17	20
Partially exclusive	0	0	0	0	0
Non-exclusive	1	1	1	0	1
Other IP Licenses²	0	0	0	0	0
Exclusive	0	0	0	0	0
Partially exclusive	0	0	0	0	0
Non-exclusive	0	0	0	0	0
Total number royalty bearing licenses	18	18	18	18	21
Invention licenses	18	18	18	18	21
Material transfer licenses	0	0	0	0	0

1. Invention licenses refer to licenses resulting from a patent.

2. Other IP licenses included biological materials licenses and plant variety protection licenses.

TABLE 5. Income from Licensing (\$ reported in thousands)

*ND-no data available.

Forest Service (FS)	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
Total income all active licenses	\$5,506	\$5,920	\$12,733	\$3,763	\$2,230
Invention licenses	\$5,506	\$5,920	\$12,733	\$3,763	\$2,230
Biological materials licenses	0	0	0	0	0
Total earned royalty income (ERI)	\$2,006	\$810	\$658	\$1,763	\$230
Median ERI	\$268	\$212	\$329	\$340	\$230
Minimum ERI	\$95	\$187	\$312	\$256	\$230
Maximum ERI	\$1,152	\$411	\$346	\$827	\$230
ERI from top 1% of licenses	\$1,152	\$411	\$346	\$827	\$230
ERI from top 5% of licenses	\$1,152	\$411	\$346	\$827	\$230
ERI from top 20% of licenses	\$1,152	\$411	\$346	\$827	\$230
Total income distributed	\$5,506	\$5,810	\$0	\$10,788	\$2,230
Inventors	\$5,506	\$5,810	\$0	\$10,788	\$2,230
Salaries of some technology transfer staff	ND*	\$194,496	\$194,496	\$194,496	\$194,496
Patent filing preparation, fees, & annuity payments	ND	ND	\$46,445	\$15,144	\$15,600
Other technology transfer expenses (plaques)	\$686	\$800	\$926	\$665	\$910

1. Not presented, represents one license.

2. Invention licenses refer to licenses resulting from a patent.

3. Other IP licenses included biological materials licenses and plant variety protection licenses.

6.6. Downstream Outcomes



FOREST PRODUCTS LABORATORY

Novel technology uses waste wood to make bioenergy while sequestering carbon

A new technology has been developed that converts wood residues into high-value products such as biochar while producing bioenergy. Researchers are measuring the environmental impacts of this new wood technology compared to current fossil-fuel technologies. Science-based assessments such as life-cycle assessment (LCA) of new bioenergy technologies or systems are essential tools for policy makers working to expand renewable energy production, including production of electricity from biomass.

The Tucker Renewable Natural Gas (RNG) unit is a new bioenergy technology that uses wood such as forest biomass as its fuel source. The Tucker RNG unit operates at high temperatures and an extremely low oxygen environment to convert wood into a synthesis gas (similar to natural gas) and biochar (similar to charcoal). Measuring the inputs and outputs of the Tucker RNG system, LCA finds its environmental performance so it can then be compared to fossil-fuel alternatives such as natural gas and coal. The synthesis gas produced can be burned to produce electricity just like natural gas, while the biochar can be added to soil which is then considered sequestered.

Forest Products Laboratory, Madison, WI, Richard Bergman, 608-231-9477

Cellulose Nano-Enabled Products: Applications and Volume Estimates

Cellulose nanomaterials are the next big (well, small) thing in wood. They can be combined in numerous ways to change the way many products work. This research identified potential end product markets and provided estimates of the potential demand for wood-based cellulose nanomaterial.

Cellulose nanomaterials have enormous potential to enable sustainable production for a range of high-performance nano-enabled products for industries and end consumers. Cellulose nanomaterials can replace products that have higher environmental impact such as those made from fossil fuels. This work provides transparent methods and estimates of the potential annual tonnage production of cellulose nanomaterials for previously identified market applications in the United States. First, potential market applications for cellulose nanomaterials are identified from published data as well as expert input. Those potential uses are categorized as high- or low-volume applications, or as novel applications, which are considered niche markets. For each market the percent adoption of nano cellulose materials is estimated along with the tonnage of cellulose nanomaterials that would be required. Annual U.S. market potential for identified applications of cellulose nanomaterials is estimated to be 6.4 million metric tons (7.1 million short tons), with a global market potential of 35 million metric tons (38.2 million short tons). The greatest volume potential for use of cellulose nanomaterials is currently in paper and packaging applications. Other potentially high-volume uses are in the automotive, construction, personal care, and textile sectors.

Forest Products Laboratory, Madison, WI, Ted Bilek, 608-231-9507

“Smart Sponge” Soaks Up Pollutants: Nanocellulose-Based Aerogel Takes on Oil and Chemical Spills

This “smart sponge” is one of a number of applications under development for the tiny wood fibers known as cellulose nanofibrils (CNF). CNFs possess a number of unique properties including renewability, high surface areas, high aspect ratios, and excellent mechanical properties. CNF-based superabsorbent aerogels exhibit ultralow density, high porosity, high specific surface area, high flexibility, and low thermal conductivity. Aerogels have received considerable interest in recent years because they can be used for a broad range of applications, including thermal and acoustic insulation, energy storage, catalyst support, and sensing. FPL researchers have recently developed a series of cellulose nanofibril (CNF)-based organic aerogels using an environmentally friendly freeze-drying process. Preliminary studies fully demonstrate that rationally engineered CNF-based aerogels can be used for a number of applications including as superabsorbents, thermal insulation, polymer nanocomposites, and supercapacitors.

Forest Products Laboratory, Madison, WI, Zhiyong Cai, 608-231-9446

3D Engineered Panels from Laminated Paper Composites have Broad Potential

Researchers are studying using high-strength laminated paper composite material as a low-cost replacement for aluminum and synthetic fiber-based composite panels for a variety of applications. Through proper 3D engineered placement and design, panels made from wood-based composite materials have demonstrated high-strength potential, including water and limited fire-resistance. The core geometry is being studied to improve performance through optimized multi-axis orientation and material alignment

3D Engineered Panel research began as a response to the National Fire Plan to improve resource utilization through optimized placement and utilization of fibrous materials. Trial applications have been initiated with the Department of Defense. For example, US Army Natick was looking to provide a lower cost replacement for their tactical shelters. The shelters are currently made using high-cost aircraft aluminum and nomex honeycomb panel materials. Prototype ends were fabricated for the US Army and scheduled for testing. Commercially available laminated composite paper material was used to produce a 3D engineered fiberboard end-panel. Also, the US Air Force was to develop a disposable pallet, or a one-way pallet, using the 3D engineered fiberboard concept using laminated composite materials. Current pallet design was made from aluminum skins and synthetic honeycomb core that cost about \$2000/pallet. The goal was to develop a lower cost pallet using wood-based materials.

Forest Products Laboratory, Madison, WI, John Hunt, 608-231-9433

Assessment Manual for Timber Structures Helps Building Inspectors

The Wood and Timber Condition Assessment Manual has become an extremely valuable resource for wood design professionals. FPL scientists are leading experts in this field and are the “go-to source” for information regarding condition assessment. The new edition contains information on the latest techniques and technology for inspecting wood structures, as well as information on estimation of allowable properties for in-service wood.

The Wood and Timber Condition Assessment Manual serves as a primary reference document for a wide variety of users—from the general public through architects and design engineers who inspect highly engineered wood structures. It is a widely used document and serves as the primary reference tool for the general public, trade associations, industry personnel, research scientists, and others who need information on inspection of wood structures. This comprehensive manual includes chapters on visual inspection, drilling/coring/probing techniques, and ultrasound techniques. Chapters on post-fire assessment of structural members and estimation of allowable properties for in-service wood are included. This user-friendly manual includes many color photographs of wood and various wood-based products and structures.

Forest Products Laboratory, Madison, WI, Robert Ross, 608-231-9221

The Xylotron: A Field-Deployable Machine-Vision Wood Identification System

Illegal logging is a major contributor to global carbon emissions; threatens biodiversity conservation; is linked to various social, economic, and political disruptions around the world; and can be in part combated by empowering law enforcement agents to make field identifications of wood. The Xylotron is a machine-vision-based wood

identification system that uses a custom-designed wood imaging device (the Xyloscope), image analysis, and statistical processing software run from a laptop/netbook. With it, users can identify over 150 species of wood more accurately than trained law enforcement personnel.

Traditional field-level wood identification can play an important role in combating illegal logging by helping law enforcement officers determine which wood shipments should be detained and submitted for full forensic analysis. Wood identification in general, whether in the field or the laboratory, is based on human-mediated recognition of macroscopic biological patterns in wood. Recognition of biological structures is complex, often subjective, difficult to quantify, and requires costly and intensive training.

To objectively quantify the macroscopic biological structure of wood and to eliminate the expensive training of field personnel, researchers developed the Xylotron, a machine-vision system using biology-independent signal processing algorithms (wavelets) to form a reference database of woods. This approach removes human subjectivity from the data acquisition process, but requires control over objective factors influencing the image, especially the optical properties of the system. To establish this control, we developed the Xyloscope, a custom-designed system to capture images of wood for the Xylotron.

Currently, the Xylotron is able to identify over 150 neotropical woods. The system makes correct identifications with greater than 80% accuracy - an accuracy greater than that of trained field agents. Currently the system is in a prototype status and is being tested in five other laboratories around the world.

Forest Products Laboratory, Madison, WI, Alex Wiedenhoft, 608-231-9384

Climate and Wood Anatomy

Examination of the presence, abundance, and distribution of cells and tissues in assemblages of wood (wood physiognomy) can be used to infer the climate conditions under which the woody plants grew. Due to the adaptive value of wood characteristics, these inferences presumably hold for ancient wood, in the form of fossils, as it does for modern woods. Inferred wood physiognomies can also be used to predict the effects of climate change on the future forest resource.

By measuring a variety of wood anatomical features from assemblages of woody plants collected from sites with known climate conditions (in the form of weather data taken over a long period), researchers can determine which anatomical features are associated with which climate conditions. Because climate and anatomy variables are correlated with each other, multivariate methods that integrate many anatomical features give better climate estimates than univariate methods. Wood physiognomy, the aggregate effect of wood anatomical features, often results in more useful descriptions of wood than features considered individually. Likewise, climate variables cannot be considered independently, because a given temperature can present different wood physiognomies depending on precipitation. Furthermore, different temperature measures, such as mean annual temperature, cold month mean temperature, and temperature range, have different effects of wood physiognomy. This is also true for precipitation, whose distribution throughout the year is as important as the mean annual total.

This research uses wood anatomical features to determine the past climates of now-unforested areas, and to predict the effects of climate change on future wood structure.

Forest Products Laboratory, Madison, WI, Mike Wiemann, 608-231-9258

Enhancing High-Performance Plastics with Nanocellulose

Researchers are using nanocellulose to improve the performance of engineering plastics. By applying advanced processing methods, scientists are able to temporarily reduce the melting point of the engineering plastic so that nanocellulose can be blended with it without degrading the nanocellulose.

Nanocellulose represents a new type of forest product that could offer a potential high-value outlet for a variety of underutilized wood-based resources and allow wood to enter entirely new applications and markets because of its

unique characteristics. For example, nanocellulose can be used to reinforce plastics, enhancing their performance and providing a favorable balance of properties for a wide variety of applications.

Forest Products Laboratory scientists are collaborating with University of Wisconsin researchers to combine nanocellulose with high-performance engineering plastics, which usually have too high of a melting temperature to be used with nanocellulose (i.e. the heat causes the nanocellulose to degrade before the plastics melts). The researchers are investigating new, advanced processing methods using benign materials such as water and nitrogen at high temperatures to temporarily reduce the melting point of the engineering plastic so that nanocellulose can be blended with it without degrading the nanocellulose. The researchers are targeting composites with a fine foam structure for lightweight automotive applications, for example.

Forest Products Laboratory, Madison, WI, Craig Clemons, 608-231-9396

Field and Laboratory Decay Evaluations of Wood-Plastic Composites

Wood-plastic composites deck boards were manufactured and then evaluated in the laboratory and the field (Hilo, Hawaii and Vancouver, British Columbia). Water absorption, biological activity, density change, and optical and scanning electron microscopy were used to monitor the field boards. The laboratory soil block test was performed with modifications to preconditioning the samples. Weight loss and density decrease were determined in the lab samples and then compared to the field results. The research in this study was used to change the AWWA Standard E10 to add wood-based and WPC's to the standard and to recommend conditioning of the specimens prior to decay evaluations in order to better correlate with the actual field durability.

Forest Products Laboratory, Madison, WI, Rebecca Ibach, 608-231-9472

Inspection of Ancient Chinese Structures

Forest Service scientists worked with Chinese scientists and engineers to develop inspection procedures to aid in the preservation and restoration of historically significant wood structures. Ancient architecture is an important piece of the cultural heritage of China. Recently, preservation and restoration of historically significant timber structures has received much attention. Leading scientists and engineers from Beijing Forestry University and Beijing Research Institute of Architectural Heritage worked in cooperation with Forest Products Laboratory scientists to develop state-of-the-art inspection procedures for significant Chinese structures, specifically the Ming Dynasty Tombs and the Palace Museum located in the Forbidden City, Beijing.

Forest Products Laboratory, Madison, WI, Xiping Wang, 608-231-9461



INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY

Migratory bird research in the Bahamas

During six winters of field studies in the Bahamas, a new study found that the endangered migrant Kirtland's Warbler's food resources (fruit and arthropods) typically declined during a winter, but not always consistently due to yearly variation both within and between study sites. Despite variation in food availability as driven by rainfall, the proportions of fruit and arthropods in the warbler's diet varied little within a winter or with sex or age class. Site fidelity within and between winters as well as late winter body mass and fat varied by sex (males > females) and age class (adults > juveniles), consistent with expected outcomes of dominance and experience. However, knowledge of only sex and age was insufficient to predict site fidelity in a model-selection framework in the absence of other contributing variables such as food resources and/or habitat structure. These analyses further indicated that measures of either arthropods or fruits were reliable positive predictors of site fidelity. Birds that shifted between study sites within a winter moved to sites with higher biomass of fruit and ground arthropods, such that late winter warbler densities were positively related to the biomass of fruits and ground arthropods. Late winter rain had a positive effect on fruit abundance and corrected body mass; corroborating previous Kirtland's Warbler studies that showed carryover effects on the breeding grounds and that survival in the following year was positively correlated with March rainfall in The Bahamas. Given that drought reduces food resources and body condition of the warbler in The Bahamas, which negatively affects its survival and breeding in North America, conservation efforts in the Bahamas archipelago should focus on protecting the least drought-prone early successional habitats with favored fruit species. Kirtland's Warblers, their winter habitats and commonly consumed fruits are illustrated in Figure 1.

Figure (above) Photos clockwise from upper left corner illustrate the fruits most commonly consumed by Kirtland's Warblers during the winter in the Bahamas including wild sage (*Lantana involucrata*), snowberry (*Chiococca alba*), and black torch (*Erithalis fruticosa*). Beneath the black torch fruit is a male Kirtland's Warbler and below it is typical winter habitat at Madiera Rd., where Bahamian student intern, Scott Johnson, provides scale for this site, estimated to be 28 years after disturbance. Next photo illustrates Bahamian student intern, Ingeria Miller removing a bird from a mist net at the DD Rd. site (21 years post-disturbance) followed by a photo of a female Kirtland's Warbler. Photo at the bottom left shows Scott Johnson and project field director, Dr. Jennifer White, at a goat farm site (11 years after clearing) where the Kirtland's Warblers were abundant. Photo left center shows Bahamian student intern, Zeko McKenzie at the Ocean Hole site (4 years after clearing) where warbler abundance was related to an abundance of fruit of *Lantana involucrata*. All photos were taken on Eleuthera, The Bahamas.

International Institute of Tropical Forestry, San Juan, PR, Ariel Lugo, alugo@fs.fed.us, 787-766-5335

Aldo Leopold Wilderness Institute established arts and science residency in El Toro Wilderness in El Yunque National Forest

As part of the celebration of the 50th Anniversary of the Wilderness Act, the Aldo Leopold Wilderness Institute established arts and science residencies in six biomes across the US that would represent a variety of ecosystems and partner agencies. El Toro Wilderness in El Yunque National Forest (Luquillo Experimental Forest) was selected, a unique location that is the first designated wilderness in Puerto Rico and first designated tropical wilderness in the national forest system. The residency took place in March, 2013. After the residency, and in collaboration with the Museum of Contemporary Arts of Puerto Rico, a Poetic Science exhibit was developed to present the artwork that was conceptualized after the experiences and knowledge learned through the Aldo and Leonardo arts and science residence in El Toro Wilderness. As part of this exhibition educational workshops were provided to students and teachers, and a total of 6 articles and three books related to the residency and the exhibition were produced.

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New study shows that tropical forests recovering after deforestation are nutrient-rich

Fallen leaf chemistry provides a window into the various and often complex factors affecting the availability of nutrients to trees. Institute collaborators and scientists analyzed 11 elements in forest floor (fallen) leaves and additional litter components from 143 Forest Inventory and Analysis (FIA) plots systematically located across Puerto Rico, a tropical landscape recovering from large-scale forest clearing. Across several scales, fallen leaf N concentration was positively related to the basal area of putatively N-fixing tree legumes, which were concentrated in lower topographic positions, providing for the first time a biological explanation for the high N concentrations of fallen leaves in these landscape positions that can be linked to land-use patterns. Phosphorus concentrations in fallen leaves by forest assemblages were also correlated with the basal area of N-fixing legumes and decreased with mean age of assemblage, as did fallen leaf N concentrations. The findings suggest that N and P availability may currently be greater on the island than before deforestation when older and presumably native forests dominated the landscape, because the island forests are now dominated by younger and often novel forests. We also found that three existing landscape classifications (Holdridge Life Zones, remotely sensed Forest Types, and plot-based forest assemblages) can be used to identify and map unique differences in fallen leaf chemistry.

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Social ecological studies of a tropical city

This year, San Juan Urban Long Term Research Area published a synthesis of its social-ecological systems research as a Special Feature in the scientific journal of Ecology and Society, a first of its kind in the city of San Juan and Puerto Rico in general. The Special Feature, titled *Understanding vulnerability and sustainability of urban social-ecological systems in the tropics: perspectives from the city of San Juan*, featured eleven research articles and a guest editorial. The set of articles covered a wide range of topics analyzed from an integrated ecological and social perspective, including vulnerability of urban residents to climate change effects, socioeconomic drivers of household yard practices, food sources and waste disposal patterns, trends in precipitation, the state of green areas in neighborhoods and in the city, aquatic species diversity, social networks, and visions of stakeholders for the future of the city, among others. Individual articles can be accessed through this link <http://www.ecologyandsociety.org/issues/view.php?sf=88>.

The Special Feature, summarizes five key synthesis themes that emerged from the social-ecological system research in San Juan including:

- The city is subject to multiple vulnerabilities, such as hurricanes and the rise in fossil fuel costs, but socioeconomic factors and education level affect the perception of citizens to those vulnerabilities, even in the face of imminent threat.

- In light of the social-ecological conditions of the city, how its citizens and institutions deal with knowledge to respond to vulnerabilities becomes critical to the adaptive capacity (ability to recognize, anticipate, and respond to future change) of the city.
- The relationship between socioeconomic factors and green cover, which in 2002 covered 42 percent of the city, was not what has been reported for other temperate zone cities. In San Juan, neighborhoods with households of high socioeconomic level were not necessarily associated with greater green cover. However, in adjacent neighborhoods within the densely populated zones of the city, households with high socioeconomic level did preserve green cover better than households in lower socioeconomic level neighborhoods.
- Tropical conditions, such as climate may explain some of the unique aspects of the social-ecological system of San Juan. The most obvious is the exuberance of tropical biota in the city that not only forms novel species assemblages but also provides many ecological services (benefits derived from ecosystems), including food production for up to 60 percent of the members of particular neighborhoods. Ecosystem resilience, or the ability of ecosystems to withstand disturbances, is particularly high in aquatic and terrestrial ecological systems in San Juan.
It appears that the emergence of novel systems in the city represent adaptive responses to the social and ecological conditions in the city.

The study of tropical cities from a social-ecological perspective lags behind the study of temperate cities as in the US and Europe, thus expanding our assumptions of how urban social-ecological systems behave. Knowledge of tropical cities can help advance the dialogue on how cities function in light of environmental change. As such, tropical cities deserve more social-ecological research through long-term integrated scientific activity that advances both the theory and application of urban social-ecological systems.

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NORTHERN RESEARCH STATION

Scientists Collaborate to Deliver Best Science on Climate Change and Forests

More than 130 scientists and natural resource managers collaborated to provide high-quality information on the effects of climate change on forest ecosystems.

USDA Forest Service scientists are working with a diverse network of partners to develop and deliver key information about climate change impacts to forest ecosystems. Forest managers working on public, private, and tribal lands are most interested in specific, local information, that helps them understand the effects of climate change on the places where they work. Until recently, this information was not easily accessible to managers because it was dispersed across many complex scientific papers and studies. Forest Service scientists and their partners hosted a series of workshops that interpreted the latest information on climate change impacts and assessed the vulnerability of different ecosystems to climate change. The result is a series of vulnerability assessment reports summarizing current scientific knowledge about climate change in different forested regions of the Midwest and Northeast. Each assessment provides information on past and projected climate change, as well as expected changes in forests based on modeling studies and other research. Most important, information is provided for individual forest communities, increasing relevance and usefulness for forest managers. This assessment series will also form a core product for the newly created USDA Regional Climate Hubs, which are designed to aid forest managers in making climate-informed decisions.

Northern Research Station (NRS), Newtown Square, PA; Christopher Swanston, 610-557-4017

Biocontrol Agent for the Invasive Ailanthus Tree Will Be Tested

Forest Service scientists are studying a North American fungus that selectively kills ailanthus trees. Test sites were selected in Ohio forests and trials will begin in spring 2015 to test the effectiveness of the fungus on controlling Ailanthus.

Ailanthus, a nonnative invasive tree from Asia, is a prolific sprouter that is difficult to control with herbicides or cutting. However, there may be an alternative control method in the near future. In 2002, Penn State researchers isolated the fungus *Verticillium nonalfalfae* from dead and dying ailanthus trees within forested areas of Pennsylvania. After rigorous testing and numerous trials, this soil-borne fungus was found to be very specific and deadly to ailanthus. In 2008, the same fungus was also found in Virginia and in 2012 Forest Service scientists isolated it in Ohio. In 2013, they began greenhouse tests to verify that native tree species are not susceptible to the fungus. After two growing seasons, no signs of wilt have been observed in seedlings from native Ohio sources of ash, beech, elm, and oak (black, chestnut, northern red oak, and white). In summer 2014, forest sites were selected and plots were installed in preparation for inoculation trials to begin in spring 2015. Trials will test the effectiveness of the fungus in killing ailanthus as well as monitoring subsequent regeneration in areas once the ailanthus is eradicated. Restoration plantings of native tree species in these same forest sites are also planned.

Northern Research Station (NRS), Newtown Square, PA; Joanne Rebbeck, 610-557-4017

Best Management Practice Monitoring Training Delivered to National Forests

The Forest Service's National Best Management Practices Monitoring Protocols were rolled out in fiscal year 2013. Agency directives require use of these protocols on all National Forest System units to meet Clean Water Act objectives. The Northern Research Station played the lead role in training National Forest System specialists in the use of the protocols to meet this responsibility.

Best management practices (BMPs) include planning and field techniques to control pollutants attributable to diverse types of land uses. For the Forest Service, the largest land management agency in the United States, BMPs are fundamental to protecting water quality and aquatic health. The National BMP Monitoring Protocols were developed to monitor BMP use and effectiveness for all of the major types of land-disturbing activities and features managed by the Forest Service. As the result of several directives, including the new planning rule, all agency units are now required to conduct monitoring annually. National Forest System field personnel identified training as a priority need to implement BMP monitoring. Forest Service scientists who played a lead role in the development of the monitoring protocols, are also leading the training efforts. A Forest Service scientist worked with a soil scientist from the Kaibab National Forest to conduct 2-day training sessions during summer 2014 at more than a dozen locations, from Georgia to California and from Alaska to Louisiana. Each training session was followed by field site monitoring at locations chosen by the host unit. Overall, more than 150 Forest Service employees participated in the training, and some of those individuals will help train others in future sessions.

Northern Research Station (NRS), Newtown Square, PA; Pamela Edwards, 610-557-4017

Fewer Pests Found in Wood Packaging Material Following New International Standards

Wood packaging material such as pallets and crating must be treated for pests prior to export when used in international trade. A Forest Service researcher, working with U.S. and international researchers, analyzed data on pest interceptions on imported cargo from before and after the United States implemented the International Standards for Phytosanitary Measures No. 15 (ISPM 15) in the mid-2000s and found that the incidence of live wood-infesting pests fell by as much as 52 percent. This is welcome news given that exotic borers such as the Asian longhorned beetle and the emerald ash borer most likely entered the U.S. in untreated wood packaging from overseas.

A new international standard for treating wood packaging material, now in use in international trade for items such as pallets and crating, was first adopted by the world community in 2002. This standard, known as International Standards for Phytosanitary Measures No. 15 (ISPM 15), stipulates how wood packaging material should be treated prior to use in packing goods for export. The United States started requiring foreign countries to comply with ISPM 15 when shipping goods to the United States in 2005. A Forest Service research entomologist and his colleagues found as much as a 52 percent drop in the infestation rate of wood packaging material associated with international imports entering the United States following implementation of ISPM 15. This is encouraging news given that many of our invasive bark- and wood-infesting insects, such as the Asian longhorned beetle and the emerald ash borer, likely entered the U.S. as stowaways in untreated wood packaging from foreign ports. The study – “Effectiveness of the International Phytosanitary Standard ISPM No. 15 on Reducing Wood Borer Infestation Rates in Wood Packaging Material Entering the United States” – was published online in the journal PLOS ONE.

Northern Research Station (NRS), Newtown Square, PA; Robert Haack, 610-557-4017

Identifying Policy Tools That Encourage Community-Level Defensible Space in Six U.S. Communities

A Forest Service scientist and partners assessed outreach programs in six different communities and identified outreach tools that were effective in encouraging defensible space. Community members and agency personnel who are seeking to engage residents to reduce individual and collective wildfire risk can be guided by these findings. Understanding the diversity of approaches and activities that have fostered mitigation can help managers choose what will work best for their specific communities.

Numerous factors contribute to whether or not an individual will take action to reduce his or her wildfire risk. When an individual opts to not implement risk mitigation measures, community leaders can use a variety of

policy tools to encourage that person to adopt an action or change behavior. These tools included passing rules or regulations, building capacity to act, providing incentives, and establishing community norms. A Forest Service scientist and partners reviewed approaches used by six communities in Idaho, Oregon, and Utah that have been effective at encouraging homeowners to adopt and maintain mitigation activities. Each community's approach was different. Each was tailored to meet specific community needs, and ranged from collective efforts organized locally to efforts developed externally to provide incentives or potential punishments for not adopting treatments. The most consistent policy tool across communities was capacity building, primarily raising awareness of the fire hazard and potential mitigation behaviors and leveraging external resources, generally obtaining grant funding to assist with vegetation reduction efforts. Another commonality was the involvement of a central group or individual that provided leadership by initiating and championing the mitigation effort and serving as a link to external resources.

Northern Research Station (NRS), Newtown Square, PA; Sarah McCaffrey, 610-557-4017

Municipal Cooperation in Managing Emerald Ash Borer Increases Urban Forest Benefits

A regional plan for managing an EAB infestation of an urban forest greatly improves the percentage of healthy ash trees and the value of their services

A new analysis of emerald ash borer (EAB) spread in urban forests shows that a regional management and funding strategy would control the infestation more effectively than city-by-city responses or no response. A Forest Service scientist and partners analyzed EAB management plans and budgets for Minneapolis, St. Paul, and 15 Minnesota cities with recent EAB infestations. They projected tree mortality and the costs of tree removals, replacement trees, and pesticide treatments and calculated how trees increase property values. The first scenario assumed none of the cities committed funds and the EAB population spread unmitigated. The second scenario assumed the 17 cities managed the infestation independently with their own city budgets. The third scenario assumed the 17 cities pooled resources to manage the infestation on a regional scale. In the first scenario, removal and replacement costs far exceeded the amount the remaining trees improved property values. The second scenario returned a similar result. When the cities pooled resources in the third scenario, increased property value benefits of the surviving trees far exceeded the costs of treatments, removals, and replacement trees. Comparing the second and third strategies show definitively that regional cooperation and implementation of EAB management greatly improves urban forest benefits.

Northern Research Station (NRS), Newtown Square, PA; Robert Haight, 610-557-4017

Northeast Climate Hub, university partners developing state-specific climate change science and tools

The USDA Northeast Climate Hub, a collaboration of United States Department of Agriculture agencies, has announced new partnerships with 12 land grant universities in the Northeast that will give the region's farmers, foresters, and land managers better access to information and tools for adapting to climate and weather variability.

Based in Durham, N.H., the Northeast Climate Hub is one of seven hubs around the country formed to address increasing climate and weather related risks to agriculture such as devastating floods, crippling droughts, extreme storms, fires, and invasive pests. Hosted by the USDA Forest Service's Northern Research Station, the Northeast Climate Hub is a partnership among the Forest Service, Agricultural Research Service, Natural Resources Conservation Service, and other federal, state and private organizations within the northeast region.

The overall purpose of the agreements is to create a network for information sharing and exchange. Universities will be active partners in developing, implementing, and evaluating decision support materials for producers that describe how to best cope with and even take advantage of increasing variability in weather. Universities with which the Northeast Climate Hub has entered into agreements are:

- University of Maine
- University of New Hampshire
- University of Vermont

- University of Rhode Island
- Cornell University
- Rutgers University
- West Virginia University
- University of Delaware
- University of Maryland
- Pennsylvania State University
- University of Massachusetts
- University of Connecticut

The Climate Hub will fund university projects geared toward solutions and adaptation tools that are applicable to farming and forestry practices at regional and local scales.

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Release of the newest version of the free mobile forestry software, i-Tree 2014

The Forest Service is making it easier than ever for homeowners and urban planners to discover the economic and ecological value of their trees, with the release of the free mobile software tool i-Tree 2014

Since it was first released in 2006, the free tools found in the i-Tree suite have made it possible for communities, non-profit organizations, consultants and students to analyze individual trees, parcels, neighborhoods, cities and entire states. The software has also become a global ambassador for the Forest Service – the world’s largest forest research organization – where it is put to work in more than 100 countries. What’s new in 2014? Two of i-Tree’s most popular tools, Design and Canopy, have been expanded with new features and another tool, Hydro, has been redesigned.

i-Tree Design allows users to evaluate the benefits of a single tree or multiple trees using Google Maps. Design currently allows users to identify location, species and size of trees on the property and get a snapshot of how that tree is benefiting the homeowner today. In the new version, Design also allows homeowners to estimate not only current benefits, but also potential future benefits and the benefits they have received over the life of the tree. These benefits include energy savings, pollution removal and rainfall interception. One of i-Tree’s most popular tools, Canopy, is used in many countries to create quick estimates of tree canopy cover. In the 2014 version, Canopy includes estimates of ecosystem services and values related to carbon sequestration and storage, and pollution removal. Hydro, one of i-Tree’s most sophisticated tools, estimates tree impacts on stream flow and water quality. Receiving a thorough make-over in the new version, the tool was made more user-friendly and its capabilities were broadened from only watershed level analyses to city scale analyses. Users will also be able to produce new reports and an executive summary of hydrologic results.

The Northern Research Station of the Forest Service, Davey Tree Expert Company, the National Arbor Day Foundation, the Society of Municipal Arborists, the International Society of Arboriculture, and Casey Trees established a cooperative partnership to further develop, disseminate and provide technical support for the i-Tree suite.

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Improved Automated Detection of Surface Defects on Hardwood Logs

In less than one second, a new parallel computer algorithm processes more than a million surface data points on a hardwood log to find the defects.

Determining the size and location of surface defects is crucial to evaluating the potential yield and value of hardwood logs. A Forest Service scientist and partners recently developed a surface-defect detection algorithm that harnesses the analytical power of improved logging scanning systems. The higher resolution of the newer laser scanning system captures 192 scan lines per foot, compared with the older system’s 15 scan lines per foot.

The revised algorithm was designed around this higher resolution data and employs parallel processing technology. The improved processing power permits a more in-depth analysis of the higher resolution scan data, leading to improved detection results.

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Optimizing Trap Designs for Emerald Ash Borer

Traps with higher detection rates lead to earlier detection and implementation of control tactics to manage new emerald ash borer infestations.

Early detection of emerald ash borer is notoriously difficult, and an effective artificial trap for the insect is a high priority for national detection surveys and regulatory programs. Numerous studies have evaluated various trap designs, colors, and lures for attraction and detection of emerald ash borer with inconsistent results, possibly due to differing emerald ash borer population densities and tree conditions at the different study sites. Emerald ash borer is attracted to volatiles from ash leaves and from ash bark. Forest Service scientists and partners developed a trap incorporating all of the known visual and olfactory cues attractive to emerald ash borer. They then compared detection rates and numbers of emerald ash borers captured on green or purple double-decker traps or prism traps hung in the ash canopy at field sites with different emerald ash borer population densities and found that purple double-decker traps were most effective. These are in use currently.

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PACIFIC NORTHWEST RESEARCH STATION

Regional fire professionals use new field guide to learn about conducting fuel inventories

Some of California's most destructive and expensive wildfires have occurred in wildlands that abut San Francisco and surrounding cities. The 1991 East Bay Hills Fire in Oakland and Berkeley, for example, killed 25 people and destroyed more than 3000 structures.

Scientists photographed and inventoried sites characteristic of fuel types found throughout the East Bay area of California. This information was published as a field guide to assist regional fire management staff with fuel planning and fire hazard assessment in the wildlands and adjoining urban interface areas.

Following publication of the field guide, fire management staff from the East Bay Regional Park District and the Hills Emergency Forum conducted two training sessions for 35 regional fire professionals from local fire departments, the East Bay Municipal Utility District, Lawrence Livermore National Lab (DOE), the City of Oakland, and CalFire. Training included basic fuels concepts, then moved on to how the field guide was constructed, and finally how to conduct a fuels inventory using the field guide.

Citation: Wright, C.S.; Vihnanek, R.E. 2014. Stereo photo series for quantifying natural fuels. Volume XIII: grasslands, shrublands, oak-bay woodlands, and eucalyptus forests in the East Bay of California. General Technical Report PNW-GTR-893. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Partners: East Bay Regional Park District, Hills Emergency Forum

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Offshore abundance of marbled murrelets is most strongly associated with amount and pattern of adjacent suitable forest nesting habitat

The marbled murrelet is a threatened species of seabird that forages on small fish and invertebrates in nearshore marine waters and nests on limbs of large coniferous trees. A major objective of the Northwest Forest Plan is to conserve the bird's nesting habitat. However, because the bird forages in ocean waters, managers have not been certain if conservation of nesting habitat is key to the species conservation or if marine factors that influence the bird's prey might be more important.

Scientists developed a model that evaluates the relative contributions of a set of marine variables and nesting habitat variables. They found that the nesting habitat variables were the strongest contributor to predictions of murrelet abundance, which means that conservation of nesting habitat does indeed seem to be essential to conservation of murrelet populations.

This work has been immediately applied by U.S. Fish and Wildlife managers who are tasked with consulting on projects that may harm marbled murrelets. It has been applied by National Forest and U.S. Fish and Wildlife

managers in setting policy for management of nesting habitat within the range of the murrelet. The work also has informed the marbled murrelet effectiveness monitoring group about the relevance of habitat monitoring in assessing effectiveness of the Northwest Forest Plan.

Citation: Raphael, M.G., A. J. Shirk, G. A. Falxa, S. F. Pearson. In press. Habitat associations of marbled murrelets during the nesting season in nearshore waters along the Washington to California coast. *Journal of Marine Systems*.

Partners: California Department of Fish and Wildlife, Oregon Department of Forestry, U.S. Fish and Wildlife Service, USDI Bureau of Land Management, Washington Department of Natural Resources

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Panel evaluates techniques to control raptors predating on western snowy plovers

Raptors, particularly northern harriers and great horned owls, prey on western snowy plovers—a federally threatened bird that lives along the Oregon coast. A seven-member expert panel reviewed the feasibility and efficacy of 26 humane raptor-control techniques. The panel also identified information and monitoring methods to help inform raptor control management as well as extenuating considerations for policy application such as cost consideration, training personnel, workloads, and information management.

The raptor control techniques identified with the highest potential feasibility and effectiveness included lethal removal and use of various traps including a cube trap, a Swedish style goshawk trap, and a dho-gaza net trap. The panel also identified a need for monitoring plover nest sites with cameras and observers.

The U.S. Fish and Wildlife Service is applying these findings at designated western snowy plover recovery sites along the Oregon coast. The findings have also been shared with the U.S. Forest Service and Bureau of Land Management for use at their sites. To date, several instances of potential raptor predation have been thwarted by using the identified techniques, and plover monitoring is being refined based on the panel's suggestions.

Citation: Marcot, B.G.; Elbert, D.C. In press. Assessing raptor management for western snowy plover recovery. *Gen. Tech. Rep. PNW-GTR*. Portland, OR: USDA Forest Service.

Partner: U.S. Fish and Wildlife Service

Contact: *Bruce G. Marcot*, bmarcot@fs.fed.us, *Pacific Northwest Research Station*

New tool: A self-adjusting, expandable telemetry collar for elk

Forest Service scientists at the Starkey Experimental Forest and Range in eastern Oregon collaborated with Oregon Department of Fish and Wildlife to successfully develop and deploy a novel expandable telemetry collar for male elk. The collar is safe, humane, and effective in collecting location and survival data for research and management of wild male cervids (deer and elk families).

Successful placement of telemetry collars on male deer and elk has been extremely challenging because their neck size can increase substantially during the rut, and their bodies grow substantially as they mature. The new expandable collar is used on yearling or adult male elk for telemetry tracking of animal locations and survival estimation. The majority of collars were successfully worn by elk over a 1- to 3-year period. No deaths or injuries were attributed to the collars, and re-captured animals were in excellent health after wearing the collars for long periods. This new expandable collar technology can be used for effective research and management of male cervids.

This new technology represents a breakthrough opportunity to gain desired knowledge on ecology of male cervids throughout the world, which has been difficult in the past. Use of the expandable collar technology will allow implementation of important new lines of research needed to address long-standing knowledge voids of keen interest regarding ecology and management of male deer and elk.

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Methods for genetically analyzing plants adapted for prenatal screening

About 6 years ago, a Forest Service scientist and his colleagues developed a low-cost method for conducting plant genetic analyses. This method has now been adapted create low-cost genetic markers for screening species of conservation concern and for forest genetic applications. For example, the Hardwoods Genomic Project, funded by the National Science Foundation relied on this Forest Service expertise and methods to develop genomic markers for 10 different hardwood tree species. The methods have also been adapted for a noninvasive prenatal screening for human trisomy mutations.

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PACIFIC SOUTHWEST RESEARCH STATION

Hurricane Damage in the Hawaiian Islands Prompts Science-based Solutions to Remove Invasive Albizia Trees

When Hurricane Iselle struck the Hawaiian Islands in August 2014, high winds caused substantial damage to Hawaii's infrastructure, primarily due to the multitude of tall, poorly-rooted, non-native albizia trees felled by the storm. In response to repair costs reaching well into the tens of millions of dollars, a coalition of Hawaii's residents; national, state, and county legislators; governmental agencies; and public and private utility companies galvanized around the critical need to eliminate stands of this highly invasive tree that poses threats to public health and welfare. Over the past decade, Forest Service scientists have developed effective means to control albizia in both suburban and forest settings. They quickly responded to the need by providing science-based direction about how to reduce albizia's threats to Hawaii's citizens and forests.

Pacific Southwest Research Station, Albany, CA, 510-559-6300

Trees in Los Angeles: Carbon Dioxide Sink or Source?

Tree planting is considered to be among the most effective approaches to cooling urban environments and mitigating carbon dioxide emissions from a variety of sources. Los Angeles' tree program, City Plants, is one of several mayoral tree planting initiatives. The assumption behind these tree planting initiatives is that trees efficiently store carbon, providing a net long-term carbon dioxide sink. But because there has never been a full accounting of carbon dioxide emissions for a tree-planting initiative, some question its effectiveness. To address this issue, Forest Service scientists simulated carbon dioxide emissions and reductions from storage, as well as avoided emissions from energy savings for the 40-year City Plants period for about 100,000 trees planted from 2006 to 2010. Early results suggest that the estimated total amount of carbon dioxide emitted (83,408 tons) from mulch decomposition, wood combustion, and irrigation water was slightly more than the amount of carbon dioxide that trees were projected to store (77,942 tons). However, City Plants will be a carbon dioxide sink if 40-year projections of avoided fossil fuel carbon dioxide emissions from energy savings (101,679 tons) and biopower (1,939 tons) are realized. These findings suggest that this tree planting initiative, and possibly others, can be net carbon dioxide sinks, especially if trees are strategically located to reduce energy consumed for air conditioning and heating.

Pacific Southwest Research Station, Albany, CA, 510-559-6300

FireBuster Tool Helps Firefighters Battle Blazes

The complex terrain in mountainous areas has multifaceted impacts on wind and weather, which affect wildland fire behavior and consequent risks to people and infrastructure. Because the National Weather Service's forecasts do not capture terrain details, regional computer models are used to enhance the official forecasts. Unfortunately, high-resolution weather information usually is not available until after a severe fire event is over, so the benefits of these models for fire management have been limited. To address this limitation, Forest Service scientists developed an experimental system called FireBuster, designed to produce forecasts at 5 km (~3 mile) resolution over Southern California. For even greater detail, a field forecaster can request a special 1 km (~0.6 mile)

resolution, 72-hour forecast with only a few clicks on a Google map. Through the FireBuster web interface, firefighters can retrieve detailed location-specific weather forecasts, including wind predictions, to better fight fires, protect communities, and save lives.

Pacific Southwest Research Station, Albany, CA, 510-559-6300

Fishers, Forests, and Fire: Can't We All Just Get Along?

The fisher, a mid-sized mammalian carnivore, is currently being considered for both California and Federal endangered species listing. The fisher's association with dense, structurally-diverse forests presents a conservation challenge: How do we conserve dense habitat when fuels reduction carries the risk of short-term impacts to habitat suitability, but lack of fuels reduction carries the risk of long-term habitat loss through high intensity fire? Investigation of the effects of forest management on fishers has resulted in predictive models that project forest response to various fuels reduction scenarios and the associated changes in risk of high intensity fire. Forest Service scientists found that, with careful consideration to location, extent, and timing, fuels reduction activities can lower the long-term risk to conserving fisher habitat and populations. This information has contributed to multiple large-scale collaborative projects, and PSW models are providing a foundation for a regional fisher conservation strategy. The fisher story in the southern Sierra Nevada is an example of researchers and land managers working together successfully to address complex interdependent forest restoration objectives.

Pacific Southwest Research Station, Albany, CA, 510-559-6



ROCKY MOUNTAIN RESEARCH STATION

The Human Side of Restoration – Webinar Series reaches hundreds of federal, state, and tribal land managers

The “[Human-Side of Restoration Webinar Series](#)” was launched in 2014 as a collaboration among the U.S. Forest Service Rocky Mountain Research Station, [National Forest Foundation](#), and the [Colorado Forest Restoration Institute](#) at Colorado State University. The series of six webinars provides a forum for managers and social scientists to share their insights and experiences with the “human side” of restoration, including the interface among ecological restoration, human communities, and individual values, public opinions, and social structures. Ecological restoration is a value-laden endeavor; nature has no intrinsic concept of “healthy” ecosystems. Managers, researchers, and the public must define the goals of restoration projects, prioritize values at risk, and determine relevant temporal and spatial scales. Defining desired (or undesirable) future conditions for ecosystems raises ethical and social questions—desired by who and for who?—making it necessary that natural resource managers appreciate the human side of restoration. Each webinar in the Human-side of Restoration Webinar Series has brought together dozens, and sometimes over a hundred, resource managers and scientists to share social science research and dialogue about ecological restoration-related topics such as legal issues, values and perceptions, traditional ecological knowledge, and the restoration economy.

Rocky Mountain Research Station, Fort Collins, CO, 970-498-1100

Delivering scientific information to those making and influencing land management decisions

The bimonthly [Science You Can Use Bulletin](#) is a USDA Forest Service Rocky Mountain Research Station publication providing synthesized scientific information for high-priority management needs. The bulletin is distributed electronically to approximately 2,300 land and resource managers throughout the Intermountain West. It synthesizes current research conducted by Station scientists and collaborators on hot topics, and delivers key science findings and management implications to people who make and influence decisions about managing land and natural resources.

Those who manage our public lands, including National Forest System lands, are required to make science-based decisions that balance multiple management objectives while maintaining or enhancing the many benefits that our public lands provide. Land managers are increasingly faced with questions about how to maintain and enhance ecosystem resilience, make wise resource investments, and promote adaptation in an era of climate change. The amount of scientific information available to help address management questions is tremendous, but at times overwhelming and piecemeal. Time-limited managers need access to synthesized, credible, relevant information that addresses some of their most pressing management needs. The bimonthly Science You Can Use Bulletin is a USDA Forest Service Rocky Mountain Research Station publication providing synthesized scientific information for high-priority management needs. The bulletin is distributed electronically to approximately 2,300 land and resource managers throughout the Intermountain West.

Rocky Mountain Research Station, Fort Collins, CO, 970-498-1100

Forest Service Researchers Focus on Firefighter Safety

Wildland firefighters continue to be injured or killed in fire entrapments. Past entrapment data indicates that policy changes, work practices, and new technology can reduce entrapments. For the past six years, Forest Service Scientists at the Rocky Mountain Research Station have worked to develop new information on safety zones and escape routes that can help keep firefighters safe.

Analysis of firefighter entrapments over the past 90 years suggests that advances in understanding of fire, changes in fire management policy, and better firefighter work practices can save lives. Data over the past 30 years suggest that firefighter injury and deaths can be attributed almost uniformly to aircraft accidents, driving accidents, heart attacks, and fire entrapments. The term safety zone was first introduced into the official literature in 1957 in the aftermath of the Inaja fire that killed 11 firefighters. Since then identification of safety zones has been an integral task for all wildland firefighters. The work that resulted in the current guidelines used officially in the U.S. is based on radiant heating, flat ground and no wind—conditions, which really are not practical for most high intensity fires. This project explored the impact of wind and slope on safety zone size and location. Ultimately, measurements, literature review, and simulations suggest that current guidelines should be modified to account for flame size, slope, and wind. The work has resulted in new understanding about how energy is released from fires and its implications to firefighter safety. In many cases when wind or slope influence fire behavior, the size of the safety zone must be increased significantly. The implications are that in some cases alternate fire management tactics will be needed to keep firefighters safe.

Rocky Mountain Research Station, Fort Collins, CO, 970-498-1100

New research on resilience of sagebrush ecosystems used for improving sage-grouse habitat

New research from the Rocky Mountain Research Station on sagebrush ecosystems is being put to use to benefit Greater Sage-Grouse habitat on federal lands across the intermountain west. An interagency effort initiated by the Western Association of Wildlife agencies and led by Grasslands, Shrublands, and Deserts Program Scientist, Jeanne Chambers, was used to develop a strategy for decreasing the impacts of invasive grasses and wildland fire on sage-grouse habitat. In August 2014, the Bureau of Land Management issued guidance through an instructional memorandum (IM 2014-134) to its offices across California, Idaho, Nevada, Oregon and Utah to begin implementing the report's findings.

Conservation efforts are underway across the western U.S. to reduce threats to Greater Sage-grouse and the sagebrush ecosystems on which they depend. The 2010 determination that sage-grouse warrant protection under the Federal Endangered Species Act has accelerated such work, including a multi-agency effort to provide a strategy for conserving sagebrush ecosystems and greater sage-grouse populations. The strategy, provided in a USDA-FS Rocky Mountain Research Station scientific report, focuses on mitigating the threats posed by invasive annual grasses and altered fire regimes. Recent research shows that resilience to wildfire and resistance to invasive annual grass differs across sage-grouse habitat. Resilience and resistance of sagebrush ecosystems typically increase as environmental conditions become more favorable for plant growth and reproduction. Also, sage-grouse are more likely to be resilient if they exist in large populations across large landscapes that have continuous sagebrush cover. Thus, the strategy is based on those factors that influence (1) sagebrush ecosystem resilience to disturbance and resistance to invasive annual grasses, and (2) the distribution, relative abundance, and persistence of sage-grouse. A sage-grouse habitat matrix links relative resilience and resistance of sagebrush ecosystems with sage-grouse habitat requirements for landscape cover of sagebrush. The matrix is used to help decision makers assess risks and determine appropriate management strategies at large landscape scales. Focal areas for management are further defined by assessing sage-grouse Priority Areas for Conservation (PACs), breeding bird densities, and specific habitat threats. The report concludes with decision tools to help managers determine both the suitability of focal areas for treatment and the most appropriate management treatments. Emphasis is placed on fire operations, fuels management, post-fire rehabilitation, and habitat restoration activities.

Rocky Mountain Research Station, Fort Collins, CO, 970-498-1100

Seeding Techniques for Restoring Sagebrush Ecosystems Following Wildfire

Sagebrush ecosystems of the Great Basin are rapidly being converted to annual grasslands dominated by invasive weeds such as cheatgrass (*Bromus tectorum* L.), which thrives following wildfire and competes with native plants. Restoring diverse plant communities containing perennial grasses, shrubs and forbs is an important priority in this region. Scientists in Boise have partnered with public and private agencies to evaluate the effectiveness of seeding techniques designed to re-establish native plants following fire.

Thousands of acres of public land have been seeded following wildfire in recent years for the purpose of mitigating wildfire impacts. Post-fire seeding is especially important in sagebrush ecosystems where grazing disturbance has often depleted native perennial plants while favoring invasive annuals such as cheatgrass. Although techniques for seeding non-native forage plants are well established, these techniques are not always effective for seeding the native plants that are increasingly sought by land management agencies. Innovative modifications of conventional seeding equipment and strategies have the potential to increase success when seeding mixtures of native species with different germination requirements. Newer models of rangeland drills, for example, are able to handle seeds of different sizes, planting larger seeds at precise depths in furrows and pressing smaller seeds onto the soil between furrow rows. Many newer drill models are minimum-till drills that have the potential to reduce soil disturbance compared to conventional models. Experiments have been replicated at multiple sites in the northern Great Basin to compare the effectiveness of these different drill types for seeding mixtures of native grasses, forbs and shrubs following fire. The minimum-till drill was found to be especially effective for small-seeded species such as Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), an important ecosystem component that is otherwise slow to re-establish following fire. Other experimental comparisons highlight effects of seeding in different seasons, different seed quantities, and differences due to site-specific conditions and weather patterns. This research will assist managers in making informed decisions about when, what and how to seed to enhance post-fire recovery in sagebrush ecosystems.

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SOUTHERN RESEARCH STATION

Climate Change and United States Forests - New Book Focuses on Forest Ecosystems and Ecosystem Services

Climate Change and United States Forests, a newly published book edited by U.S. Forest Service scientists Jim Vose (Southern Research Station), David Peterson (Pacific Northwest Research Station), and Toral Patel-Weynand (Washington Office), provides resource managers, researchers, and the interested public with a comprehensive science-based assessment of the effects of climate change and variability on U.S. forests. Book chapters are derived from the assessment the editors developed to serve as the primary input from the Forest Service for the 2013 National Climate Assessment conducted by the U.S. Global Change Research Program.

“Forest ecosystems are very complex, and it can be difficult to tease out which of the recently observed changes in them come from human-caused climate change, regular climate variability, or other causes,” said Vose, project leader of the Forest Service Center for Integrated Forest Science based in Raleigh, North Carolina. “No matter the cause, by the end of the century U.S. forest ecosystems will likely be very different due to climate change, and that this will affect the ecosystem services they provide.”

The books’ authors focus on direct and indirect factors—altered disturbance regimes and stressors such as insects and diseases—that have the greatest potential to alter the structure and function of forest ecosystems by 2100. The book is divided into four parts:

- Part I provides the environmental context for assessing the effects of climate change on forest resources, summarizing changes in stressors and providing state-of-science projections for the future climatic conditions that will affect forests.
- Part II assesses the vulnerability of forest ecosystems and ecosystems services to the altered disturbance regimes and stressors that will have the biggest effects on forest ecosystems.
- Part III outlines possible responses to climate change, including adaptation strategies, a proposed framework for risk assessment, and case studies.
- Part IV describes how the sustainable forest management that now guides activities on most public and private lands in the U.S. can provide the overarching structure for mitigating and adapting forest ecosystems to climate change through the 21st century.

“In addition to demonstrating the continuing need for research in this area, the book shows that the best approaches for adaptation to climate change will come from strong partnerships between research and management,” said Vose. “We must keep finding new ways for scientists, managers and citizens to work together to observe, examine and proactively adapt to the realities of our changing forest systems.”

[Climate Change and United States Forests](#)

Southern Research Station, Jim Vose, jvose@fs.fed.us

Forest Service Involved in the Food and Agricultural Organization-United Nations Economic Commission for Europe (FAO-UNECE)

The Forest Service has provided leadership and technical expertise to the Food and Agricultural Organization-United Nations Economic Commission for Europe (FAO-UNECE) for several decades. In June 2014, the Working Party on Forest Statistics, Economics and Management at the FAO-UNECE elected U.S. Forest Service scientist Jeffrey Prestemon as incoming Chair for 2015. Prestemon was also re-elected Vice Chair of the Team of Specialists on Forest Sector Outlook, which the Working Party oversees, in preparation for the next North American Forest Sector Outlook Study.

Forest Service participation in the Food and Agricultural Organization-United Nations Economic Commission for Europe (FAO-UNECE) enables closer cooperation among member nations and facilitates scientific exchange. It also provides a voice for the United States in international deliberations regarding standards and policy analyses that may affect laws and regulations governing markets and trade and urgent issues affecting the health and welfare of forests and the forest sector.

In 2009, Southern Research Station forest economist Jeffrey Prestemon was nominated to serve as the Vice Chair of the Team of Specialists on Forest Sector Outlook. In this role, he brought together the expertise of university professors in the United States and agency leaders in Canada to develop an outlook study for 2006 to 2030 recently published by the United Nations. Prestemon has served as the U.S. Government representative to successive meetings of the Working Party on Forest Statistics, Economics and Management. He was voted the Chair-Elect of the Working Party at the 2014 meeting held in Geneva. The Chair-Elect oversees and tracks the activities of nine teams of specialists who work to provide information, technical analyses, standards guidance, and spearhead governance development activities in all of Europe, North America, and nations of the Russian Federation.

Southern Research Station, Jeff Prestemo, jprestemon@fs.fed.us

North American Bat Monitoring Program

Bats are the second most diverse group of mammals on earth and play a critical role in the maintenance of healthy ecosystems. Though it's well known that bats in North America are declining rapidly from white-nose syndrome (WNS), wind energy development and other causes, the full extent of the decline has only been estimated.

The North American Bat Monitoring Program (NABat) provides the statistical and logistical architecture for coordinated bat monitoring to support local, regional, and range-wide inferences about trends in bat distributions and abundances in response to WNS, climate change, wind energy development, and habitat loss. Results from this program will provide managers and policy makers with the information they need on bat population trends to effectively manage bat populations, detect early warning signs of population declines, and estimate extinction risk.

A U.S. Forest Service General Technical Report that describes the NABat sampling frame, survey protocols, and statistical analyses is currently in production and will provide partners with the guidance they need to conduct surveys and provide data to the Bat Population Database, an online data management system designed by the U.S. Geological Survey for this and other programs.

Southern Research Station, Susan Loeb, [Susan Loeb](#)

One-Two Punch Slows Down the Hemlock Woolly Adelgid - Study documents impact of predator beetles in tree canopies of natural forest

Recently published research by U.S. Forest Service scientists and collaborators offers hope that integrated management can provide sustained protection for an iconic tree. In an article published in the journal *Forest Ecology and Management*, Forest Service and university researchers provide findings based on data collected from a natural stand of hemlocks in Georgia that suggest chemical and biological control can be successfully integrated to help prolong hemlock health.

“Our study demonstrated that populations of beetle predators can successfully establish and increase on hemlocks previously treated with insecticide after the chemical protection wears off and adelgids infest the trees,” said Bud Mayfield, research entomologist with the Forest Service Southern Research Station and lead author of the article.

First found in the eastern U.S. in the 1950s, the nonnative hemlock woolly adelgid now infests hemlock trees from the U.S.-Canada border south to Georgia, in some areas killing 95 percent of eastern and Carolina hemlocks. This is particularly devastating to the Southern Appalachians, where eastern hemlock is considered a “foundation” species because of the important role it plays in streamside ecosystems. Mayfield and fellow researchers used a stand of 60 trees in northern Georgia that were treated in 2006 with low rates of the insecticide imidacloprid (10 and 25 percent of label rate) to improve crown health while allowing a low rate of adelgid infestation needed to establish predator beetles.

In February 2008 and October 2010, they released *Laricobius nigrinus*, predator beetles originally from the U.S. Northwest found to be effective in controlling hemlock woolly adelgid, on the same trees. In December 2012, they also started a predator exclusion study in the crowns of selected trees to study the impact of predator beetles on adelgid populations at that level.

The researchers were interested in finding out:

- The longer-term (5 to 7 years after treatment) effects of imidacloprid treatments on tree health, adelgids, and predator beetles;
- The effect of the established predator beetle populations on the density of adelgids on the hemlocks; and
- The extent of hybridization between predator beetles and their local counterparts.

Hybridization adds a new wrinkle to the introduction of predator beetles. In the years since the 2003 introduction of *Laricobius nigrinus*, researchers at various locations have found evidence of the insect hybridizing with *Laricobius rubidus*, an eastern native that feeds primarily on the pine bark adelgid found on white pines. Finding out the extent of hybridization is important. “For the predator beetle releases to be successful, their populations cannot be replaced or diluted by the native insect,” said Mayfield. Findings from the study are encouraging, but cautionary.

By year seven, the hemlocks treated with 25 percent imidacloprid rate lost their insecticide protection, but had better crown health and supported as many predator beetle larvae as untreated trees, and larvae showed no sign of insecticide residues. Most (77 percent) of the predators collected on study trees were identified as *Laricobius nigrinus*, 12 percent as the native species, and 11 percent as hybrids, with the hybridization rate remaining the same over time. Importantly, the cage exclusion studies showed twice as many undisturbed adelgid egg sacs on the branches protected with cages as on unprotected branches, clearly showing the effectiveness of the predators in the crowns of the trees. Nearly 70 percent of the uncaged branches harbored predator beetle larvae.

“To our knowledge, ours is the first published study to quantitatively document the impact on hemlock woolly adelgid populations of *Laricobius* predator beetles established on eastern hemlocks in a natural forest setting, as well as the first to examine predation throughout the canopies of mature trees,” said Mayfield. “Our results show that chemical and biological control of hemlock woolly adelgid can be integrated to promote hemlock health and reduce numbers of adelgids,” said Mayfield. “That said, the *Laricobius* beetle only feeds on adelgids that are active from fall through early spring. Sustained protection of hemlock through integrated management in the Southern Appalachians may require the addition of an effective predator on the second adelgid generation that is active in late spring and early summer.”

[Establishment, hybridization and impact of *Laricobius* predators on insecticide-treated hemlocks: Exploring integrated management of the hemlock woolly adelgid](#)

Southern Research Station, Bud Mayfield, amayfield02@fs.fed.us

Planning for Future Forests with Help from the TACCIMO Tool

From the North Carolina mountains to South Carolina's coastal plain to the tropics of Puerto Rico, climate change is on the minds of forest planners. National forest planning teams in these areas are among the first few to revise their land and resource management plans under the U.S. Forest Service's new [Planning Rule](#) released in 2012. These "early adopters" from the Nantahala, Pisgah, Francis Marion, and El Yunque National Forests who are developing plans to guide sustainable forest management through changing conditions are finding assistance with the [Template for Assessing Climate Change Impacts and Management Options \(TACCIMO\)](#).

Emphasizing both science and public input, the Planning Rule breaks new ground by requiring planning teams to complete broad assessments of available information about climate change effects on national forests. [Eastern Forest Environmental Threat Assessment Center](#) researchers collaboratively developed the TACCIMO tool to streamline this part of the plan revision process by providing in-depth scientific literature reviews and climate projections specific to forest-level issues. TACCIMO's public-facing website puts these resources at the fingertips of forest planning teams as well as stakeholder groups and the general public to support the collaborative planning process envisioned by the Planning Rule.

To provide additional support, members of the TACCIMO development team have created custom, user-friendly fact sheets aimed at communicating key climate science findings during public forums for engaging national forest stakeholders in the Southern Region. Ruth Berner, a forest planner with the National Forests in North Carolina, says, "TACCIMO's climate change fact sheet is just what we needed in terms of level of detail appropriate for collaboration with the public and stakeholders, while still presenting the best available science on climate change required for the assessment." Fact sheets are now available on the TACCIMO website for the [El Yunque National Forest](#), [Nantahala and Pisgah National Forests](#), and [Francis Marion National Forest](#).

Because of the complex and often large-scale issues that forests face in a changing climate, collaboration among neighboring land management groups is key. In consultation with National Forest planners and managers, the TACCIMO team has also assisted in facilitating interactions at public forums with key stakeholders from local, state, and federal agencies. For example, land managers with the Cape Romain National Wildlife Refuge adjacent to the Francis Marion National Forest are working to create corridors to assist coastal species migrating inland from barrier islands and salt marshes as sea levels rise. The TACCIMO team presented site-specific information on sea level rise projections and models of future vegetation to aid collaborators in meeting "all lands" management objectives.

This fall and winter, the early adopters will release full assessments, including climate change effects and projections generated with the use of TACCIMO. When the assessments are rolled out, the TACCIMO team will continue to provide support at public meetings to address comments about climate change issues. The TACCIMO tool will also assist planning teams entering the next phase of plan revisions during which specific management options are identified to reach goals aligned with the new Planning Rule. These management options—intended to promote healthy forests that are able to adapt to changing conditions—will ensure that national forests continue to provide critical goods and services that people across the nation expect and enjoy.

Southern Research Station, Emrys Treasure, etresure@fs.fed.us

The rise of the mediocre forest: why chronically stressed trees may better survive extreme episodic climate variability

In 2001, when large numbers of red spruce trees began dying atop Mt. Mitchell in western North Carolina, U.S. Forest Service researchers stepped in to investigate. During the four years before the researchers' arrival, unusual drought and abnormally high air temperatures combined with acid rain pollution and a rare outbreak of southern pine beetles to wreak havoc in those forests covering the tallest peak in the eastern United States. Some red spruce trees survived through it all, providing a unique opportunity for the researchers to examine the differences between the live and the dead trees.

As the significance of these differences became clear, the researchers formulated an idea that could redefine forest health and management in a world with increasing climate variability. Much of the discussion on climate change impacts to forests has focused on long-term shifts in temperature and precipitation. However, individual trees respond to the much shorter impacts of climate variability. Historically, fast growing, fully canopied, non-chronically stressed (NCS) trees (e.g., those with minimal insect or disease damage, growing on high nutrient, moist soils), have been considered the model of individual health, while slower growing, broken crown, chronically stressed (CS) trees growing on nutrient poor, or dry soils, were considered to be unhealthy and prone to stress related mortality. If the ‘mediocre forest’ scenario is correct, management strategies will need to evolve to reduce mortality in traditionally healthy forests during periods of acute stress.

Link to Publication: [The rise of the mediocre forest: why chronically stressed trees may better survive extreme episodic climate variability](#)

Southern Research Station, Steve McNulty, smcnulty@fs.fed.us.

Where Does That Infested Firewood Come From? - New Recreational Travel Model to Help States Stop Firewood Assisted Insect Travel

The spread of damaging invasive forest pests such as the emerald ash borer is only partially powered by the insects’ own wings. People moving firewood for camping can hasten and widen the spread of insects and resulting forest destruction. A new U.S. Forest Service study provides a tool for anticipating the most likely route of human-assisted spread, giving state planners and land managers a tool they can use to enhance survey and public education efforts.

The study, [published July 9 in the journal PLOS ONE](#), is designed to help agencies enforcing or considering firewood bans determine how to deploy resources for surveillance, firewood inspections, or other activities.

The role of humans in the spread of invasive insects such as the emerald ash borer and Asian longhorned beetle is well established, according to the study’s lead author, [Frank H. Koch](#), a research ecologist with the Forest Service’s [Eastern Forest Environmental Threat Assessment Center](#). “Although more than 65 percent of campers carry firewood from home, and that wood often comes from dead or dying trees that may be infested, the dispersal of invasive insects via recreational travel has not been well studied.”

Previous research shows that firewood harbors many bark- and wood-boring insects. In 2008, co-author [Robert Haack](#) of the Forest Service’s [Northern Research Station](#) found that nearly 25 percent of firewood intercepted at the Mackinac Bridge between Michigan’s Upper and Lower peninsulas carried live bark- and wood-boring insects, and an additional 41 percent displayed evidence of prior borer infestation.

Scientists used U.S. National Recreation Reservation Service data documenting more than seven million visitor reservations (including visitors from Canada) at federal campgrounds nationwide to construct their model, which can be used to identify likely origin and destination locations for a camper-transported pest. Summary maps for the 48 contiguous U.S. states and seven Canadian provinces showed the most likely origins of campers traveling from outside the target state or province.

In the eastern United States, the most common and thus potentially riskiest out-of-state origin locations were usually found in nearby or adjacent states. In the western United States, the riskiest out-of-state origin locations were typically associated with major urban areas located far away from the state of interest.

“Damaging nonnative forest insects are a serious issue for public and private land managers,” said SRS Director [Rob Doudrick](#). “Forest Service research is providing tools and information that strengthen policies aimed at controlling and slowing the spread of invasive insects.”

In addition to Haack, co-authors of the study include Denys Yemshanov of the Canadian Forest Service and Roger D. Magarey of North Carolina State University.

Southern Research Station, Frank Koch, fhkoch@fs.fed.us

With Privet Gone, Native Plants and Pollinators Return

Forests infested with privet invoke a kind of despair in people attuned to the problem of invasive plants. Privet invades a forest quickly, sprawling across the understory and growing into thickets that crowd out native plants and change the very ecology of an area. Even if the woody shrub can be removed effectively, can a forest return to any semblance of its previous condition?

Results from a five-year study by U.S. Forest Service researchers shows that a thorough removal of privet can last at least five years without a follow-up, and that native plant and animal communities steadily return to areas cleared of the invasive shrub.

In 2005, Forest Service Southern Research Station (SRS) and State and Private Forestry started an experiment to assess the long-term effects of removing Chinese privet from streamside forest land in northern Georgia. SRS research entomologist Jim Hanula and entomologist Scott Horn, both based in Athens, Georgia, as part of the SRS Insects, Diseases, and Invasive Plants unit, worked with John Taylor (retired, Forest Service, Region 8, State and Private Forestry) to set up plots to test methods of removing privet and to document the return of native plant communities and the response of insect pollinators.

They also wanted the project to have a strong educational component, so they teamed up with the University of Georgia's State Botanical Garden and Warnell School of Forestry, the Sandy Creek Nature Center, and the Oconee National Forest. That allowed the plots they established to be widely dispersed and representative of the region, as well as readily available for education and outreach. "The plan has worked very well," said Hanula. "Now hundreds of school children tour the plots every year to learn about invasive species, and college classes conduct lab exercises in them."

First introduced into the U.S. as an ornamental in 1852, Chinese privet (*Ligustrum sinense*) escaped cultivation by the 1930s and spread across the Southeast. "It's common in streamside areas, possibly because they're similar to its native habitat in China," says Hanula. "Chinese privet is the primary cause of the decline in the abundance and diversity of native herbaceous plants and tree seedlings in the areas along streams and rivers it infests."

Researchers tested two methods for removing privet. In one set of plots, they used a mechanical mulching machine to grind up privet to the ground level, leaving the mulch on the plots. In the other set of plots, crews with chainsaws and machetes felled privet by hand. Stumps in both sets of plots were initially treated with herbicide to prevent resprouting, and the areas were treated again with a foliar spray a year later to address new sprouts. By 2007, the plots had less than one percent of their surfaces covered by privet compared to over 60 percent on control plots where privet was left untreated.

Hanula and Horn began investigating how privet removal affected the recovery of plant and animal communities by comparing the treated plots to reference areas that had never been invaded by privet and control plots that were invaded and not treated. They published their initial findings on plant communities two years after control in 2009.

"The results were dramatic," said Horn. "The hardwood forests we're working on are some of the most beautiful places in the South when they're not choked with privet. We saw the return of native plant species in all of the treated plots."

Results from their studies on pollinators were even more dramatic. "After only two years, there were four to five times more bee species in privet-free areas, 40 or 50 compared to the 10 on control plots infested with privet," said Hanula. "We caught three times as many butterfly species on the mulched plots and nearly seven times as many individuals."

This year, five years after treatment, University of Georgia graduate student Jacob Hudson, along with Hanula and Horn, published an article in the journal *Biological Conservation* documenting the continued long-term benefits of removing privet to both bees and butterflies.

In an additional article just out in the journal *Forest Ecology and Management*, Hudson, Hanula and Horn also reported on the status of plant communities and the growth of canopy trees five years after complete removal of privet. This is one of the longest studies on the effects on forests of removing invasive plants. “Long-term monitoring of native plant recovery and potential reinvasion after invasive plant removal is crucial for determining the efficacy of removal efforts and for justifying future control efforts,” said Hanula.

At five years, approximately seven percent of the mulched plots were covered with privet seedlings, higher than the three percent in the hand-felled plots. Both were much lower than the 34 percent cover in the control plots. Native plant species richness also differed among treatments. Mulched plots had the highest number of species, significantly higher than in felled and control plots, but comparable to the uninfested reference plots. Removal of Chinese privet caused no detectable changes in the growth of trees.

“Overall, these results are encouraging, since we expected to have to re-treat the privet more frequently to preserve the integrity of the removal plots,” said Horn. “These results show that control following one removal event lasts at least five years. We plan to continue to document reinvasion to decide when follow-up treatment is needed.”

[*Removing Chinese privet from riparian forests still benefits pollinators five years later*](#)

Southern Research Station, Jim Hanula, jhanula@fs.fed.us or Scott Horn, shorn01@fs.fed.us.

Coastal Plain Forests: The Next 50 Years - Subregional report from the Southern Forest Futures Project

What will our Southern coastal forests look like in 50 years? With a myriad of factors involved—including climate change, population growth, economic outlooks, and more—it’s not a simple question. However, forest researchers have provided what they believe is a comprehensive answer to that question in the new general technical report *Outlook for Coastal Plain Forests*.

The report is the third in a series of five subregional reports on the forests of the South compiled by scientists for the Southern Forest Futures Project (Futures Project), a multi-agency effort led by the U.S. Forest Service Southern Research Station (SRS). As the name implies, the Coastal Plain subregion encompasses the South’s Atlantic and Gulf coasts, its 188 million acres stretching from the Virginia coastal plain southward through the Florida peninsula, then along the Gulf coast to Texas. (A single “cut-out” from the region, along and immediately west of the Mississippi River, makes up the Mississippi Alluvial Valley subregion.) The Coastal Plain area also extends as far inland as western Kentucky.

The Coastal Plain subregional report details a range of scenarios expected to affect the region in the next 50 years.

- Temperatures are likely to increase. Researchers used several scenarios to model future climate; the scenarios combined results from four global circulation models with two “emission storylines” involving higher or lower rates of economic and population growth. Each scenario indicates warming across the entire Coastal Plain by 2060. One scenario predicts average temperatures nearly 5 °F higher across parts of the region in 50 years. Results were inconclusive regarding annual precipitation changes, but warmer temperatures alone would stress the forest environment, notably in water availability.
- Rising oceans may damage millions of forested acres. With the world warming, models show sea-level rise ranging from around a foot to as much as 6 feet above current mean sea level—or even higher, depending on the assumptions used. A projected rise of 1.5 meters (about 5 feet) would affect some 3.7 million acres of Coastal Plain forests, with saltwater intrusion harming coastal forests and wildlife.
- Urbanization will significantly reduce forested land. By 2060, urban development may reduce forest land by nearly 18 million acres in the Coastal Plain. Peninsular Florida will experience the largest urban growth in the entire South, with forests expected to dwindle there by 34 percent.

- Population will rise. The report predicts a 68-percent increase in Coastal Plain population. This increase, especially near public lands and water, would put added pressure on limited recreational resources.
- Fresh water will be in demand. The combination of higher temperatures, reduced forest land, and a larger population will combine to increase water stress regionwide.
- Biodiversity will decrease, while invasive species spread. Rising sea levels and urbanization will contribute to the loss of some native animal and plant species. Meanwhile, expected increases in the impacts of invasive plants—particularly of notoriously aggressive cogongrass—would degrade the benefits provided by Coastal Plain forests.

Other report findings include the potential for increased forest harvest for biomass-based energy, shifts in habitat range for various plant and animal species (native and invasive), and longer wildfire seasons. Despite uncertainties in some findings, one thing is certain—the South’s coastlines will look very different in 50 years.

[Outlook for coastal plain forests: a subregional report from the Southern Forest Futures Project](#)

Southern Research Station, Kier Klepzig, kklepzig@fs.fed.us

Outlook for Appalachian-Cumberland Forests: A Subregional Report from the Southern Forest Futures Project

Knowing more about how the future might unfold can improve decisions that have long-term consequences. The Southern Forest Futures Project, a multi-agency effort led by the U.S. Forest Service, aims to forecast and interpret changes in southern forests under multiple scenarios over the next several decades. The first of five sub-regional reports to explore these futures on smaller scales was recently published. The report describes possible futures and management implications across the U.S. Appalachian-Cumberland highland.

The Appalachian-Cumberland highland consists of about 62.3 million acres in parts of Alabama, Georgia, North Carolina, Tennessee, Kentucky, and Virginia. These forests are dominated by hardwoods and contain a highly diverse suite of plant and animal communities, along with many endemic species. Forecasted scenarios suggest that a variety of pressures could create novel conditions that affect ecosystem structure and function. Over the 50-year horizon, dramatic changes in land uses are predicted for the subregion.

Key points

- Urban land use is expected to increase from about 4.3 million acres to about 6.7 million acres, and loss of non-Federal forested area is expected under all projections.
- Urbanization-driven changes in land use coupled with loss of forests near metropolitan areas could threaten the diversity and abundance of bats, salamanders, and other species.
- Habitat fragmentation could make migration in response to climate and disturbances difficult.
- The effects of population change are also predicted to increase water stress. Water stress may be most visible around larger cities, but rural communities could well experience increased stress as well because groundwater is the primary source of potable water in rural areas.
- The interacting effects of climate change, population growth, and increased urbanization—and the accompanying expansion of the wildland-urban interface—will require land managers to address the increase in the potential, severity, and extent of wildfire throughout the Appalachian-Cumberland highland.
- Insects and diseases are prominent disturbances in Appalachian-Cumberland forests and will continue to influence forest structure, function, and composition during the next 50 years.
- The invasion of forest communities by nonnative invasive plants is driven largely by habitat fragmentation, parcelization, increasing population, recreational use, and forest disturbance, all of which are forecasted to increase.
- Restoring ecosystem structure and function and improving forest resilience could be the keys to mitigating the negative effects of the changes that are predicted.



TECHNOLOGY AND DEVELOPMENT CENTERS

R&D Snippets Successfully Transfer Technology by a Convenient Email

Since 2006, the National Technology and Development Program has “advertised” new products to exclusive internal and external audiences through snippets. What is a Snippet? Snippets are email announcements about completed products. Project and program leaders determine which reports, tech tips, videos, training programs, flash presentations, notices, and alerts are selected for this golden opportunity. To date, 125 of the most popular and important products have been featured in snippets.

You can sign up for the snippets mailing list by calling *Missoula Technology and Development Center (MTDC)* at 406-329-3978 or by emailing wo_mtdc_pubs.

Dam Safety

Uncontrolled release of a reservoir resulting from a dam failure can have a devastating effect on people and property downstream. Safely maintaining a dam is a key element in preventing dam failure and limiting the liability a dam owner could face.

Project leader Scott Groenier, sociologist Lisa Outka-Perkins, and several other employees of the National Technology and Development Program have developed three products that emphasize dam safety.

- **Assessing Dams and Impoundments: A Beginner’s Guide** (1473-2F01-MTDC) is a Web-based training that provides basic assessment practices for Forest Service employees who work around low hazard dams and impoundments. The program is available in HTML media format at <http://www.fs.fed.us/eng/dams/>.
- **Pocket Safety Guide for Dams and Impoundments** (1273-2805P-MTDC) is a quick reference for carrying to the field. The guide has illustrations and photographs of problems to look for, information about the probable causes, possible consequences, and recommended actions to take. View it at <http://www.fs.fed.us/eng/dams/> and obtain a copy through the Federal Emergency Management Agency at Ready.gov by calling 1-800-237-3239.
- **Dam Safety** poster (1473-2M06-MTDC) is a colorful visual reminder of possible causes of dam failures for all U.S. Department of Agriculture, Forest Service employees and dam owners. View it at <http://www.fs.fed.us/eng/dams/> and download an 11- by 17-inch copy.

All three products also are available to Forest Service and the Department of the Interior, Bureau of Land Management employees at the at the [Dam Safety Web page](#) (1473-2W03-MTDC).

Missoula Technology and Development Center (MTDC), Scott Groenier, Missoula, MT, 406-329-3900

Does a shaded PV parking structure make sense for your facility?

Sustainability and climate change are in the news. The Forest Service looks for ways to address the concerns of a changing world. Considering solar energy production and making informed decisions will align the agency with current Executive Orders, rules, and regulations to protect the environment and save money.

Project leaders Kathie Marks and Keith Windell conducted an extensive literature and market search to help Forest Service employees determine whether solar energy is a feasible option for their work locations. Their report for the National Technology and Development Program provides information to use during the planning and design process, when integrating green technology, and while maintaining new or existing facilities. The report “Does a Shaded PV Parking Structure Make Sense for Your Facility?” is now available online at the Missoula Technology and Development Center Web site.

http://fswweb.mtdc.wo.fs.fed.us/php/library_card.php?p_num=1473%202823

Missoula Technology and Development Center, Keith Windell, 406-329-3900

A Guide to Maintaining the Historic Character of Your Forest Service Recreation Residence

Ever wonder why so many historic recreation residences within national forests still look much the same as when first built? It’s because recreation residence owners must meet the complex and hard-to-understand requirements of historic preservation laws. This guide explains how to meet regulatory requirements while accommodating changing needs and keeping recreation residences in good condition. The guide explains strategies for maintaining historic integrity, including detailed drawings and example photos.

If you own a recreation residence, the information in the guide can help you navigate the review and approval process for any needed changes more quickly. It can help you maintain the historic character and property value of your recreation residence. Doing so will benefit everyone because the best ways to preserve the significant historic features of a recreation residence are continued use, careful preservation or rehabilitation, and appropriate regular maintenance. View 300 dpi PDF (30.48 MB)

http://fswweb.mtdc.wo.fs.fed.us/php/library_card.php?p_num=1423%202815P

Missoula Technology and Development Center, Kathleen Snodgrass, 406-329-3900

Avoiding wildlife—vehicle collisions

Project leader Lisa Outka-Perkins worked with wildlife experts to produce a DVD safety training program (1367–2D02–MTDC). The 25–minute, closed–captioned program explains some of the most important aspects of safe driving in wildlife habitat, including the perception differences between motorists and deer. This insight may help you reduce your chances of having a vehicle collision with a deer.

A recent study in the United States estimates more than one million collisions occur between vehicles and large animals annually. These collisions result in an average of 200 human fatalities and 26,000 injuries per year. Most of the collisions that result in property damage or human injury are with white-tailed deer or mule deer. The most dangerous roads for animal-vehicle collisions are two-lane rural highways with posted speed limits of 55 miles per hour, the roads Forest Service employees drive the most.

This DVD is available to order from MTDC’s Web site, by calling 406–329–3978, or by emailing wo_mtdc_pubs. It can also be found on YouTube at

<https://www.youtube.com/watch?v=eJsCfadbl4M&feature=youtu.be>

Missoula Technology and Development Center, Lisa Outka-Perkins, 406-329-3900

Cleaning and maintaining chain saws for safety and performance

Proper cleaning and maintenance enable chain saws to work efficiently. Well–maintained saws require less effort for users, resulting in safer operation. Because every chain saw is exposed to dusty and dirty working conditions, and because chain saw operation requires gas and oil, cleaning a chain saw is an important aspect of routine maintenance. This report provides sawyers with some basic tools for cleaning and maintaining chain saws. It also explores alternative solvents and degreasers that reduce health and safety hazards to employees and the environment. View low resolution PDF (12.50 MB)

Missoula Technology and Development Center, Godot Apuzzo, Robert Wetherell, 406-329-3900

Basic roadside safety

Forest Service employees can be injured or killed by moving vehicles during work activities or emergency operations. It is important to understand what you can do to be safe. This web-based training program (1351–2F01–MTDC) has three parts: Roadside Work, Roadside Hazards, and Mitigating Roadside Hazards. It provides

basic safety practices for all employees, such as construction and maintenance workers, incident personnel, and traffic control workers, whose duties place them on foot next to moving traffic.

The practices shown also can apply when you are driving—either for work or as a member of the public. You don't know when you'll need to stop and get out along the roadside.

The presentation is available in HTML media format. If you are unable to view it online, a DVD (1351-2D01-MTDC) can be ordered by calling 406-329-3978 or emailing wo_mtdc_pubs. [View HTML](#)
Missoula Technology and Development Center, Lisa Outka-Perkins, 406-329-3900



WASHINGTON OFFICE

Journals Seek to Educate Students about Natural Resources and Ecology

Forest Service Research and Development (FS R&D) creates and publishes resources that constitute a focused national effort to educate students about the scientific study of natural resources and ecology. *Natural Inquirer* and *Investi-gator* are publications that emulate real scientific journals and are published for middle and elementary level students, respectively. These journals are based directly on peer-reviewed scientific papers written by FS scientists. The journals are extremely popular with science teachers, with close to 100,000 journals distributed annually. A Website provides additional educational resources to help educators use the journals in their classrooms and to enable users to order or download (<http://www.naturalinquirer.org>). In fiscal year 2014, the *Natural Inquirer* Website posted 110,994 visits, an increase of 39.66% from the previous year. The journals are produced in partnership with the Cradle of Forestry in America Interpretive Association (CFAIA) and the State and Private Forestry (S&PF) Conservation Education staff. Each journal also enjoys the partnership of other internal FS partners and external partners.

WO R&D KMC, Barbara McDonald, Ph.D., Education Program Manager, 706-559-4224

Celebrate Wilderness' 50th with Two New Natural Inquirers

Just in time for students to celebrate the 50th anniversary of the Wilderness Act, the *Natural Inquirer* Team has produced two wilderness monographs. "Wilderness 2.0" presents a case study of how wilderness participants use online blogs to share their wilderness experiences. This case study explores the blog account of a 16 year old boy in the Uncompahgre Wilderness. Daniel Williams, Rocky Mountain Research Station, and his colleague Joseph Camp, Colorado State University, are the scientists.

"Pack to Back" presents trends in backcountry and wilderness participation from 2008 to 2060. Specifically, the research highlights trends in challenge activities, horseback riding on trails, hiking, and visiting primitive areas, and compares trends with and without considering climate change. Ken Cordell and Mike Bowker, Southern Research Station, are the scientists.

Both monographs include a wilderness timeline that highlights major actors on the wilderness stage, as well as activities that bring wilderness research to life for students. To view or order free copies, which help students learn about and celebrate 50 years of Wilderness protection, visit <http://www.naturalinquirer.org>.
WO R&D KMC, Barbara McDonald, Ph.D., Education Program Manager, 706-559-4224

Scientific Modeling in Adaptive Management Edition Now Available

In partnership with USGS and Washington Office R&D, the *Natural Inquirer* Team has created the Scientific Models in Adaptive Management *Natural Inquirer* edition. This edition has been popular with educators faced with teaching scientific modeling according to the new Next Generation Science Standards. The edition contains four articles, two from USGS and two from the Forest Service. Forest Service scientists include David D'Amore, Paul Hennon, Trista Patterson, Dustin Wittwer (all of the Pacific Northwest Research Station), and Paul Schaberg of the Northern Research Station. This edition may be viewed or downloaded, or ordered for free from <http://www.naturalinquirer.org>.

WO R&D KMC, Barbara McDonald, Ph.D., Education Program Manager, 706-559-4224

Beginning Readers Learn About Forest Service Scientists

The *Natural Inquirer* Team has introduced a new product, targeted at beginning readers (K-2). The *Natural Inquirer* Readers Series now includes five Readers, each focusing on the research of one Southern Research Station scientist. Scientists include Ge Sun, Stephanie Laseter, Qinfeng Guo, Evan Mercer, and Scott Goodrick. This series was created to complement the Climate Change *Natural IQ*, a journal supporting the Cradle of Forestry's new climate change exhibit at the Cradle of Forestry historic site in North Carolina. The *Natural Inquirer* Team has plans to continue this series by including scientists from other research stations. The Readers are free to download or order in hardcopy. Check out the Readers at <http://www.naturalinquirer.org>, "Educational Resources," "Pre-K-5th."

WO R&D KMC, Barbara McDonald, Ph.D., Education Program Manager, 706-559-4224

Forest Service Research Data Archive

FY 2014 marked the fifth year of operation for the Forest Service Research Data Archive (<http://www.fs.usda.gov/rds/archive>). It added 34 research data sets to its catalog in FY 2014, and now offers 137 research data sets to the public and global science community. The catalog is also searchable via science.gov (using its new 'Data' tab). Twelve of the new data sets resulted from the archive's service agreement with the Joint Fire Science Program (<http://www.fire-science.gov>). Over 1,680 people downloaded a published data set in FY 2014 (> 50 percent increase relative to FY 2013); 70 percent of the data sets have been downloaded by a customer at least once. The archive expects to begin tracking citations of its published data sets in FY 2015 using the digital object identifiers (DOIs) it assigns to each data set.

National Research Data Archivist, David J. Rugg, FS R&D, 608-231-9234

Forest Service eResearch - Advertising Forest Service R&D among Other Federal Research Agencies

Forest Service R&D, through efforts spearheaded by USDA, has joined with other research agencies in USDA and other Federal Government research organizations to improve the transparency of their activities and demonstrate the impact of federal science investments on the economy and society. Three new systems show the results of those collaborations, all based on data research stations already report.

- 1) [VIVO](#) is a web tool for sharing information about researchers and institutions to support collaboration and discovery. Search USDA's version of this NIH-funded tool to find researchers, publications, and problem areas from the Agricultural Research Service, Economic Research Service, National Agricultural Statistics Service, and the National Institute of Food and Agriculture as well as the Forest Service. Some really cool visualization tools come with the package.
- 2) [STAR METRICS](#) (Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science) attempts to document the outcomes of science investments. This solution displays R&D's problem areas and funding among current studies funded by

NSF, EPA, NIH, ARS and NIFA. Powerful query and visualization tools let you slice and dice federal research like you've not seen before.

- 3) [PatentsView](#) is a visualization tool for patent information that now includes all the patents issued to USDA inventors including those in the Forest Service. Find the innovative ideas Forest Service research has made available to create jobs and launch businesses.

In addition, Research and Development websites delivered to the public, abstracts of its scholarly papers over three quarters of a million times in FY2014, describing some forty two thousand full text publications freely offered online.

National eResearch Program Manager, John Pye, jpye@fs.fed.us, 919- 549-4013

National Urban Forest Technology & Science Delivery Team

The Forest Service has a long history - well over three decades - of delivering urban forestry research, technology, and information to a broad set of partners, stakeholders, and customers. Sharing Forest Service knowledge and tools is essential to improving the management and long-term sustainability of urban ecosystems. In FY2014, in recognition of growing demand for science information on urban natural resources stewardship, the Forest Service established the *National Urban Forest Technology and Science Delivery Team*. The team represents a shared commitment across Forest Service mission areas to deliver quality urban natural resources science, technology, and information to improve urban forests and advance urban sustainability and community resilience. The team meets regularly to implement a “start-up” action plan to ensure that the Forest Service is timely, relevant, and coordinated in sharing urban forestry science and program information with stakeholders and the broader American public. The action plan serves as an internal road-map, setting forth a suite of near-term actions to reshape and redefine current Forest Service communication efforts and to create a clear, comprehensive, contemporary information delivery system for urban forestry research and technology into the future. Two important products of this team include:

- (1) *Urban Forest Connections webinar series*: Launched in September 2014, this monthly seminar series brings urban environmental experts together across sectors and institutions to discuss the latest science, practice, and policy on urban forestry and the environment. The webinar series creates a forum for sharing the latest knowledge, ideas, and tools among a growing community of academics, practitioners, and decision-makers. [www.fs.fed.us/research/urban-webinars]
- (2) *Focused science synthesis and delivery*: The team is embarking on a series of urban forestry “deep dives” that will serve as rapid, state-of-the-science activities to inform key partners, shape new directions in research and decision-making, coordinate Forest Service messages, and increase visibility of the Forest Service’s emphasis on urban natural resources stewardship.

Urban Research, Elizabeth Larry, eblarry@fs.fed.us, 202-213-5107

Joint-Invention Exclusively-Licensed to Purdue University

A Forest Service patent application titled “Cellulose Nanocrystal Additive for Improved Performance in Cementitious Systems” (PCT Patent Application Ser. No. PCT/US14/37576) was filed on May 9, 2014. This is the third nanocellulose invention that the USDA Forest Service, Forest Products Laboratory, has jointly invented with and licensed exclusively to Purdue University.

This is the first study of its kind to add cellulose nanocrystals (CNCs) into cement composites that resulted in a mechanical performance improvement as compared to more traditional cellulose-based particles (wood flake, pulp fibers, etc). The CNC-reinforced cementitious material has a unique set of characteristics, such as enhanced mechanical properties, low defects, higher surface area to volume ratio, and engineered surface chemistries. Additionally, CNCs are extracted from renewable and sustainable sources, which have low environmental-health-safety risks, and have the potential to be processed at industrial scale quantities and at low costs.

Patent Program, Janet Stockhausen, Patent Advisor, jstockhausen@fs.fed.us, 608-231-9502

Patent Licensed to Mississippi State University

Lignin is a by-product from current pulping and bio-ethanol processes, making it the second most abundant biopolymer next to cellulose in the world. There is a need to develop an innovative method to further utilize lignin, a low cost and renewable carbon source, for the production of high value carbon-based nanomaterials, particularly graphene nanosheets.

An exclusive patent license between USDA Forest Service and Mississippi State University, titled “Methods of Synthesizing Graphene from a Lignin Source” (U.S. Patent Application Ser. No. 14/297,275), was filed on June 5, 2014. This is a method to convert lignin, using a simple, cost effective thermal treatment process, in the presence of a catalyst, to synthesize graphene nanosheets. The graphene nanosheets have many potential beneficial applications, such as uses in nanoelectronic devices, energy storage, chemical probes, biosensors, biomedical and biological sensing materials. As lignin is a low-cost raw material, this invention can significantly reduce production costs of graphene nanosheets. Licensees to commercialize this technology are being sought. *Patent Program, Janet Stockhausen, Patent Advisor, jstockhausen@fs.fed.us, 608-231-9502*

Issued Patent Titled “Methods for Integrated Conversion of Lignocellulosic Material to Sugars or Biofuels and Nano-cellulose”

Bioconversion of biomass to biofuel and bioproducts has great potential to transform the current petroleum based economy to a more sustainable biobased economy. Scientists of the USDA Forest Service have invented a novel method for producing both sugars (for fuels or chemicals) and recalcitrant cellulose (for use in producing micro- and/or nano-cellulose) in a single process using lignocellulosic materials such as plant biomass.

This particular method uses an environmentally friendly enzyme treatment of lignocellulosic material to synthesize sugars and recalcitrant cellulose. The method is also highly efficient as it is a single process, compared to multiple stages in traditional methods, thus significantly reducing the production cost of biofuels and nano-cellulose. A patent covering this method was issued on September 16, 2014 (U.S. Patent No. 8,835,141) and licensing will be aimed toward the manufacturing and fuel industries.

Patent Program, Janet Stockhausen, Patent Advisor, jstockhausen@fs.fed.us, 608-231-9502

Forest Service Biofuel Patent Issues

The USDA Forest Service, with the University of Wisconsin-Madison, have jointly developed a method and composition for biofuel processing that results in improved efficiency, and can save energy and costs during biofuel production. The patent entitled “Metal Compounds to Eliminate Nonproductive Enzyme Adsorption and Enhanced Enzymatic Saccharification of Lignocellulose” was issued on August 26, 2014 (U.S. Patent No. 8,815,561) and is exclusively licensed to Wisconsin Alumni Research Foundation.

Lignocellulose is the most abundant plant material resource for the production of biofuel. Generally, cellulose is isolated from the lignocellulose for enzymatic saccharification and fermenting into biofuel. However, the unbound lignin in lignocellulose is a nonproductive enzyme adsorption medium that reduces the efficiency of cellulose hydrolysis.

Traditionally, an initial washing and separation step is needed to remove or at least reduced the lignin, leading to significant amounts of water and energy consumption, which increases costs and presents a serious environmental concern. This novel method utilizes a divalent metal, such as calcium or magnesium, can reduce lignin’s inhibitory effect in cellulose hydrolysis, and eliminate the need of a washing step, thus saving energy and cost. This metal also stimulates the enzyme activity of cellulose hydrolysis and enhances the production of fermentable sugars that would be used to produce biofuels.

Patent Program, Janet Stockhausen, Patent Advisor, jstockhausen@fs.fed.us, 608-231-9502

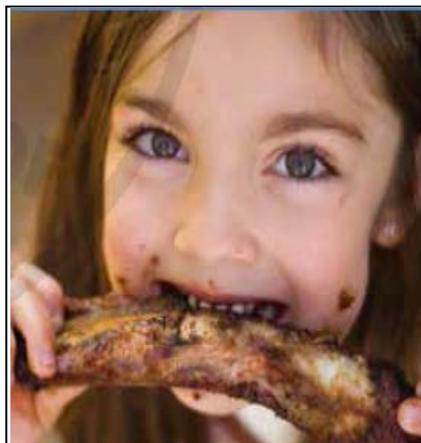
FS Patent for Higher Yield of Structural Nanocellulose Materials from Natural Sources of Cellulose

Nanocellulose materials, particularly the cellulose nanocrystals (“CNC”) and cellulose nanofibrils (“CNF”), are high-quality, durable, light weight, and cost-effective structural building blocks for a variety of applications. Researchers at the USDA Forest Service have developed a novel method allowing concurrent production of CNC

and CNF under a milder acid hydrolysis condition, while being able to maintain substantial yields for both CNC and CNF with this method. This improved process can achieve a near zero cellulose loss (due to degradation into soluble sugars), and thus provide a higher total cellulosic solid yield to form CNF than traditional methods.

A patent covering this method was issued on April 29, 2014 (U.S. Patent No. 8,710,213), with the title “Methods for Integrating the Production of Cellulose Nanofibrils with the Production of Cellulose Nanocrystals”. Target markets for this technology are the manufacturing and fuel industries.

Patent Program, Janet Stockhausen, Patent Advisor, jstockhausen@fs.fed.us, 608-231-9502



FSIS is responsible for the safety of meat, poultry and egg products.

FSIS food safety outreach transfer of food safety knowledge to consumers using fact sheets, videos, blogs, brochures, and refrigerator magnets

FSIS laboratories apply research advances to efficiently monitor potential chemical and microbiological hazards in meat, poultry and egg products.

7.0. Food Safety & Inspection Service

<http://www.fsis.usda.gov>

7.1. Mission Statement

The Food Safety and Inspection Service (FSIS) is the public health agency in the U.S. Department of Agriculture responsible for ensuring that the nation's commercial supply of meat, poultry, and egg products is safe, wholesome, and correctly labeled and packaged.

7.2. Nature and Structure of the Program

FSIS applies the latest advances in food safety technologies to reduce foodborne diseases and monitors chemical and microbial hazards in meat, poultry, and egg products. FSIS also facilitates the application of food safety technologies to food production. In addition, the agency conducts outreach to consumers with food safety messages throughout the year.

The FSIS Research Priorities Review Panel routinely identifies and prioritizes research that assists the agency in its mission to protect public health. The list of current FSIS research priorities include developing analytical methods to increase the efficiency of laboratory analyses, identifying and understanding emerging chemical and microbial hazards, identifying and evaluating hazard mitigation techniques (e.g. pathogen interventions) for food processing establishments, and improving the transfer of food safety knowledge to consumers.

Although not a research agency, FSIS addresses its scientific information and data needs through partnerships with a wide variety of federal agencies, universities and private research entities. The agency prioritizes and communicates needs to our partners and stakeholders during meetings with agency leadership and scientists, seminars at universities and scientific conferences, and postings on the FSIS website. During FY 2014, FSIS published 15 scientific articles in peer reviewed journals and delivered multiple presentations at scientific conferences. The FSIS Research Priorities website was accessed on nearly 5,000 occasions. Additionally, about

30% of users navigated to associated pages for additional information on the FSIS Research Priorities and associated studies.

7.3. Activities in FY2014

FSIS Uses Science-Based Food Safety Information to Educate Consumers

FSIS plans, coordinates, conducts, and updates consumer food safety education campaigns and related outreach activities. FSIS is the originator of the *Food Safe Families* campaign, an advertising, partnerships, public relations, digital and social media campaign based on the latest food safety research with consumers. FSIS used the results of the International Food Information Council's Food and Health Survey and an observational study conducted by Kansas State University to formulate messaging and establish communications priorities for this campaign.

FSIS collaborates with the Centers for Disease Control and Prevention, the Food and Drug Administration, and the Ad Council to develop Public Service Announcements (PSAs) for the advertising portion of this campaign. The *Food Safe Families* campaign features PSAs that promote four safe food handling behaviors to consumers: *Clean/Separate/Cook/Chill*. The PSAs inform consumers about simple steps to protect their families from foodborne illness. *Food Safe Families* PSAs were facilitated by the receipt of more than \$100 million in complimentary advertising from the National Ad Council resulting in roughly 6.8 billion views.

FSIS prepared fact sheets, brochures, video news releases, webcasts, public service announcements, press releases, blogs and other documents in support of agency programs and initiatives. These resources were designed to engage stakeholders, including the media and organizations that serve individuals at a greater risk of food poisoning (i.e., older adults, pregnant women, children under five years, and those with a compromised immune system).

Key components of FSIS' consumer educational program operation include the USDA Meat and Poultry Hotline, the USDA Food Safety Discovery Zone traveling exhibit, and the FSIS web-based virtual representative initiative "Ask Karen." The USDA Meat and Poultry Hotline operated throughout the year, including the hotline's busiest time of year, the November–December holiday season. The Hotline operated from 8:00 am until 2:00 pm on Thanksgiving Day answering consumer food safety questions, which focused on turkey preparation, storage, and handling. The Hotline responded to over 77,000 inquiries (calls, webmail, and chats) in 2014 and received 1,234,217 views of *Ask Karen* questions. During FY2014, the USDA Food Safety Discovery Zone attended 9 outreach events in 6 states, reaching approximately 1,715,845 consumers with food safety messages. FSIS also developed consumer food safety content for the mobile "Ask Karen" application supported by iPhone and Android systems.

Social media also is an integral part of the agency's educational outreach. The Agency uses YouTube, Twitter, and Facebook, to communicate to customers, stakeholders and consumers throughout the year.

The @USDAFoodSafety Twitter account saw significant growth this year due to a new effort to communicate on non-traditional topics. FSIS amplified our food safety message using pop culture events like the premier of *Sharknado 2* and National Cheeseburger Day to engage audiences in discussion about those topics. One message posted during the premier of *Sharknado 2* received almost 250 retweets and more than 100 favorites, a record for the @USDAFoodSafety twitter handle. The Hollywood Report highlighted FSIS for its effective use of the *Sharknado 2* meme to engage with the public. Since this effort began, we have seen higher than average engagement on routine messages like recalls and food safety content. This work allowed FSIS to reach 593,607 total followers on Twitter by the end of the fiscal year.

The FoodSafety.gov Facebook account also experienced a surge in growth this year through the complimentary advertising donated by the Ad Council. Because of this campaign, the account gained 80,000

more ‘likes’, and the page reached more than 6 million views this year. FSIS also advises the Under Secretary for Food Safety, the FSIS Administrator, and other key officials on food safety strategies and initiates contacts with, and responds to inquiries from the media, consumer groups, industry officials and organizations, and various other constituents regarding food safety education.

Transferring Analytical Methods Development Research and New Technologies to FSIS Laboratories for Monitoring Hazards in Meat, Poultry, Catfish and Egg Products

FSIS laboratories deploy new technologies to better monitor hazards in meat, poultry, and egg products and minimize human exposure to foodborne hazards. In FY2014, FSIS validated and adopted four new analytical chemistry and five new microbiology laboratory methods. These methods improve the agency’s ability to monitor potentially hazardous concentrations of chemicals (e.g., antibiotics, pesticides, environmental contaminants, growth promoters) and microbial pathogens in food. These new FSIS methods include:

- An improved method to detect pesticides in FSIS regulated products increases the efficiency of analysis to assure that FSIS regulated products do not contain unsafe levels of pesticides. The new method was developed by the USDA Agricultural Research Service (ARS) and successfully validated and implemented in FSIS laboratories. It also provides data that are useful for FSIS and U.S. Environmental Protection Agency consumer pesticide exposure and risk assessments.
- An improved multi-residue method (MRM) to detect veterinary drug residues increases the efficiency of analysis to assure that FSIS regulated products do not contain unsafe levels of veterinary drugs. This MRM was also developed by USDA ARS and successfully validated and implemented by FSIS laboratories. The U.S. Food and Drug Administration will use the data generated by this method to ensure that veterinary drugs are being properly used in food animals and that the levels of these drugs in foods do not present a public health concern to consumers.
- An improved method for identifying nitrofurans metabolites in poultry combines aspects of FSIS and Canadian Food Inspection Agency methods. This new method supports U.S. poultry trade and improves the accuracy of identifying poultry that had been treated with banned nitrofurans antimicrobial veterinary drugs. This method assists the agency in assuring both a safe food supply and reduction in poultry improperly rejected for nitrofurans contamination.
- Improved methods to detect *Salmonella*, Shiga Toxin producing *E. coli*, and *Campylobacter*. These new methods generally apply molecular genetic advances to the high-throughput screening of meat, poultry, and eggs.
- Improved guidance to industry was afforded by FSIS web site posting of successfully validated analytical chemistry or microbiology methods on the agency’s website. These methods provide a “gold standard” for the development of test-kits by industry. FSIS guidance for the development of such test kits is communicated to stakeholders via documents that are posted on the FSIS websites: 1) FSIS Guidance for Test Kit Manufacturers, Laboratories: Evaluating the Performance of Pathogen Test Kit Methods and 2) Foodborne Pathogen Test Kits Validated by Independent Organizations. Additionally, USDA-ARS is currently comparing the results of several industry developed test-kits with the official FSIS method for detection of adulterant Shiga toxin producing *E. coli* (STEC) in beef. Identification of commercial test methods that are equivalent to FSIS methods assists industry in the production of safe meat, thereby minimizing consumer exposure to pathogens and the need to recall products.

Adoption of Whole Genome Sequencing Techniques

In 2014, FSIS Eastern Laboratory collaborated with the Centers for Disease Control and Prevention, the U.S. Food and Drug Administration, the National Institutes of Health, and the Agricultural Research Service to use whole genome sequencing to better identify and respond to foodborne illnesses. FSIS plans to use this technology to provide information regarding serotype, virulence factors, lineage, antimicrobial resistance genes and inferred phylogeny. This technology may also help identify strain evolution in processing environments (harborage).

Facilitating the Application of New Food Safety Technologies to Food Production

FSIS evaluated new technologies aimed at enhancing food safety, including new commercial pathogen interventions, process innovations, and new ingredient usages proposed by industry. If the evaluation indicates that the agency has no safety concerns with the proposal, the agency issues a “no objection” letter, which facilitates the adoption of new technologies for production of FSIS regulated products with enhanced safety. In FY2014, FSIS issued 65 “no objection” letters in response to new technology requests by industry, which led to the adoption of food ingredients to enhance safety, initiatives to reduce *Salmonella* in foods and approvals to increase the safety of egg products. FSIS encourages continued improvement and innovation in food safety technologies.

Facilitating the Application of Food Safety Research Findings to Produce Safe Food and Compliance with FSIS Guidance and Regulations

In FY 14, FSIS released 8 guidance documents to assist industry with identifying and applying relevant scientific findings to produce safe meat, poultry, and egg products. Examples include: 1) Pre-Harvest Management Controls and Intervention Options for Reducing Shiga Toxin-Producing *Escherichia coli* Shedding in Cattle: An Overview of Current Research and 2) Compliance Guideline for Establishments Sampling Beef Trimmings for Shiga Toxin-Producing *Escherichia coli* (STEC) Organisms or Virulence Markers.

8.0. Grain Inspection, Packers and Stockyards Administration (GIPSA)

<http://www.gipsa.usda.gov/>

8.1. Mission Statement

To facilitate the marketing of livestock, poultry, meat, cereals, oilseeds, and related agricultural products, and promote fair and competitive trading practices for the overall benefit of consumers and American agriculture.

8.2. Strategic Plan

GIPSA's Strategic Plan serves to ensure fair and transparent markets free from deceptive and fraudulent practices, combined with recognized and reliable descriptors of crop quality and value, to promote economic health and prosperity in American agriculture. U.S. farmers produce a wide variety of agricultural products, and the vast American infrastructure permits these products to be processed and distributed throughout the United States and international markets effectively and efficiently. The markets serviced by GIPSA represent a total economic value of approximately \$170 billion annually with exports contributing over \$28.7 billion to the U.S. economy.

8.3. Nature and Structure of Research Programs

GIPSA maintains a strong presence, domestically and internationally, in the development, evaluation, and implementation of practical grain quality assessment and inspection methods. Our laboratories work with the latest technologies, and through these technologies and our ongoing efforts, we're helping improve the quality of U.S. grain available to the global market. But to enhance the marketing and facilitation of grain into the future, we're also conducting internal research and participating in development and collaborative efforts with other governmental entities, laboratories, and private business. The research and analysis we conduct is in response to clear and widespread market needs. In general, GIPSA research is highly "applied" in that GIPSA's successful projects result in direct and immediate use in the US grain industry. GIPSA also develops written information for customers and stakeholders, including scientific publications, publications in trade journals, and reports to stakeholders.

As agricultural crops evolve and varieties with enhanced traits are developed, reliable tests must be developed to detect and quantify the quality traits important to the market. GIPSA conducts a research program to assess the performance of rapid test kits that are designed for detecting and/or quantifying the presence of mycotoxins in grain or for detecting the presence of specific biotechnology-derived traits in grain to allow test kit manufacturers to make verified claims regarding their products. GIPSA research results in new applications of existing technologies (such as near-infrared spectroscopy and nuclear magnetic resonance) and improvements in those technologies to meet identified market needs for grain quality assessments. The accurate prediction of end-use quality of wheat has become a major objective in recent years. Millers, bakers, and grain processors are looking to rapid industry-applicable testing methods to replace or supplement current chemical and rheological tests. With the development of such new testing procedures, reference methods are needed to validate and improve their accuracy.

8.4. Current Technology Transfer Goals, Objectives, and Measures of Success (Metrics)

8.4.1. Current Technology Transfer Initiatives

Moisture measurement remains one of the most important official and commercial grain inspection activities because of moisture content's impact on end-use value (dry matter content) and storability.

GIPSA research (in collaboration with ARS) has resulted in the Very High Frequency (VHF) Unified Grain Moisture Algorithm (UGMA)—an approach to grain moisture measurement that should improve grain moisture measurement by (1) yielding improved accuracy, (2) permitting multiple manufacturers to design moisture meters

that can use common calibrations and give equivalent results, and (3) reducing the cost of on-going calibration maintenance. GIPSA has worked closely with manufacturers for approximately 10 years to develop instruments that could use GIPSA's UGMA technology successfully. GIPSA made the UGMA freely available as a public algorithm to facilitate adoption by multiple manufacturers.

Two manufacturers have developed and commercialized UGMA-compatible instruments and other manufacturers have expressed interest in developing such instruments. GIPSA's Grain Inspection Advisory Committee (consisting of U.S. producers, exporters, USDA Cooperator organizations, academicians, and other U.S. stakeholders) encouraged the agency to proceed to implement the new moisture measurement technology beginning in September 2012 to better serve the Agency's stakeholders. The UGMA technology was implemented for corn, soybeans, sunflower, and sorghum on September 10, 2012, and for all 60 other grains and commodities under GIPSA's jurisdiction on May 1, 2013. The impact of this research project is very high, with the potential to improve the accuracy of grain moisture measurements for the entire U.S. grain industry and, eventually, for the global grain industry.

The inspection of rice is primarily performed using visual inspection by trained personnel. In FY 2013, GIPSA began the development of an objective test method using a flatbed scanner system and a program to determine the percent broken kernels in rice samples. Depending on how the project progresses, a goal may include freely distributable software, the USDA Rice Studio, that is compatible with a wide range of inexpensive commercially available scanners and to develop mathematical algorithms that are specifically applicable to all U.S. rice types and varieties for assessing the percentage of broken rice kernels. The USDA Rice Studio is being tested by official system users in four of the six major rice producing states.

GIPSA has completed a cooperative research program with ARS, two land-grant universities, and a private company to develop a relevant and practical method for assessing the gluten strength of wheat. Guidance provided to GIPSA by our major stakeholders indicated that gluten strength is probably the best definition of wheat end-use quality. GIPSA contributed to the project by acquiring and preparing representative samples, testing prototype instruments, contributing to algorithm refinement, and providing overall project coordination. Although studies showed that the test could successfully discriminate gluten strength among key samples representing hard wheat classes, it showed poor correlation with the current standard for determining gluten strength; the Farinograph method. GIPSA has handed off leadership of this project to the manufacturer, Perten Instruments, who is still engaged in efforts to commercialize the instrument for unofficial use.

8.4.2. CRADA Activities

When it would contribute to a project's success, GIPSA works through ARS to establish Cooperative Research and Development Agreements (CRADAs) with land-grant universities or private industry; however, most of GIPSA's research projects do not involve CRADAs. GIPSA does not have any active CRADAs at the present time.

8.4.3. Measures of Success

One measure of our success is through feedback expressed by our Grain Inspection Advisory Committee members. Another metric is the number of quality and weight complaints we receive from our customers each fiscal year. A critical measure of success of GIPSA's research is the commercialization and adoption of the methods that GIPSA has developed.

8.5. Downstream Outcomes

- **Harmonizing Biotech Reference Methods.** There is a need for highly specific and accurate tests for the various genetically-engineered (GE) crops grown in the United States. GIPSA has developed intra-laboratory validated real-time polymerase chain reaction methods and has evaluated the accuracy,

reliability, and proficiency of publicly available methods used to detect and identify GE grains and oilseeds. GIPSA participated on a scientific panel of experts engaging U.S. stakeholders and influencing outcomes on issues related to testing of GE traits in grains with the goal of developing global scientific consensus regarding the analysis of transgenic events. GIPSA continues to collaborate with international organizations such as Codex Alimentarius, International Organization for Standardization, American Association of Cereal Chemists, American Oil Chemists' Society, Institute for Reference Materials and Measurements, and the Canadian Grain Commission to harmonize testing technologies for GE grains and oilseeds.

- **Export Wheat and Corn Quality Surveys.** GIPSA coordinates with representatives of U.S. Wheat Associates and the U.S. Grains Council to conduct export wheat and corn surveys. GIPSA assisted with the wheat survey by collecting samples, providing inspection results, and performing additional tests for pesticide residues and heavy metals. GIPSA has assisted with the wheat survey for over 30 years, and 2012 was the first year of the corn survey. The two market development organizations use the data to advise importers worldwide on what is available for sale, the cost, and the advantages that U.S. wheat and corn have over the competition.

8.6. Outreach Activities

8.6.1. Domestic Outreach

- GIPSA scientists presented at a variety of conferences to detail the USDA Rice Studio Program to discuss the technology and software which will be utilized for determining rice brokens. Symposia included:
 - Rice Outlook Conference, St. Louis, MO
 - US Rice Producers Association Meeting, Houston, TX
 - Rice Breeders Meeting, Stuttgart, AR
 - USDA Science/USA Rice, Washington, DC
 - California Warehouse Association Annual Rice Meeting, Scottsdale, AZ
- A GIPSA scientist provided technical assistance and troubleshooting for Nuclear Magnetic Resonance (NMR)-based detection of sunflower oil at Kanas Grain Inspection and North Dakota Grain Inspection in Colby, KS and Enderlin, ND respectively.

8.6.2. International Outreach

- A GIPSA scientist attended the International Food Safety Training Laboratory, which is a part of the Joint Institute for Food Safety and Applied Nutrition (JIFSAN). JIFSAN is a joint collaboration between the U.S. Food and Drug Administration and the University of Maryland and helps provide the scientific basis for ensuring a safe, wholesome food supply as well as provide the infrastructure for contributions to food safety programs and international food standards. The purpose of the training was to educate international scientists involved in food safety on mycotoxin testing methods in food.
- A GIPSA scientist served as a member (alternate delegate) of the U.S. delegation to the Codex Committee on Methods of Analysis and Sampling meeting held in Budapest, Hungary. The U.S. delegation actively participates in continuing discussions on uncertainty of sampling, conformity assessment, and processes for resolution of disputes.
- **Technical Assistance.** In FY 2014, GIPSA responded to customers' needs for technical assistance in foreign markets. Exporters, importers, and end-users of U.S. grains and oilseeds, as well as other USDA agencies, USDA cooperator organizations, and other governments, occasionally ask for our personnel to

provide expertise. These activities include representing the Agency at grain marketing and grain grading seminars, meeting with foreign governments and grain industry representatives to resolve grain quality and weight discrepancies, helping other countries develop domestic grain and commodity standards and marketing infrastructures, assisting importers with quality specifications, and training local inspectors in U.S. inspection methods and procedures. Such activities typically have been funded through various programs administered by FAS, Farm Service Agency, or directly by GIPSA. These types of outreach activities serve to strengthen the U.S. reputation for being a reliable supplier of high-quality grain, to reinforce the integrity of GIPSA as an independent quality inspection authority, and to minimize discrepancies in inspection results between GIPSA and the importer.

- GIPSA personnel frequently meet with delegations visiting from other countries to brief them on the U.S. grain marketing system, our national inspection and weighing system, U.S. grain standards, and our mission. Many of these delegations are sponsored by USDA Cooperator organizations like U.S. Wheat Associates and U.S. Grains Council, which arrange visits to grain production areas, GIPSA field offices, onsite laboratories at export grain elevators, and our National Grain Center in Kansas City, Missouri. At the National Grain Center, delegations sometimes receive technical training on analytical testing procedures and grain inspection methods and procedures.
- Briefings are tailored to address each group's interests and concerns. Presentations include explanations of the various services available from GIPSA, our use of the latest technology to provide grain traders with accurate and reliable inspection and weighing information and, for importers or potential importers new to the U.S. grain market, information on contracting for the quality they desire. These briefings foster a better understanding of the entire U.S. grain marketing system and serve to enhance purchasers' confidence in U.S. grain. Ultimately, these efforts help move our nation's harvest to end-users around the globe.

8.7. Publications

8.7.1. Book Chapters

None

8.7.2. Peer reviewed-publications

None

8.7.3. Internet Publications

- On November 23, 2014, GIPSA implemented a new process for posting instructions for mycotoxin test kits that have been certified as meeting GIPSA's performance criteria. In January 2014, GIPSA began requiring manufacturers who seek certification to submit test kit instructions that conform to GIPSA's requirements for use within the Official system. The November 23, 2014 update included all test kits certified since January 2014. If the test kit is certified by GIPSA, the instructions for the test kit will now be posted at the same time as the certification. This change will enable test kit users to more effectively evaluate and use the test kit in accordance with Official procedures.
- The GIPSA Performance Verified Mycotoxin Test Kits matrix is located at the link below. The Matrix is normally updated on a monthly basis.

9.0. National Institute of Food and Agriculture (NIFA)

<http://www.nifa.usda.gov/>

9.1. Mission Statement

NIFA's mission is "Leading food and agricultural sciences to create a better future for the nation and the world." NIFA advances knowledge for agriculture, the environment, human health and well-being, and communities by providing leadership and grant funding to help support research, education, and extension programs in the Land-Grant University System and other partner organizations.

9.2. Nature and Structure of Research Program

NIFA's two key mechanisms for accomplishing its mission are:

- National program leadership. NIFA helps states identify and meet research, extension, and education priorities in areas of public concern that affect agricultural producers, small business owners, youth and families, and others.
- Federal assistance. NIFA provides annual capacity grants to land-grant universities and competitively granted funds to researchers in land-grant universities, other universities, and other partner organizations.

NIFA collaborates or has formal working partnerships with many institutions and individuals. Our key partners are the institutions of higher learning making up the Land-Grant University System. However, we also partner with other federal agencies, within and beyond USDA; non-profit associations; professional societies; commodity groups and grower associations; multistate research committees; private industry; citizen groups; foundations; regional centers; the military; task forces; and other groups.

NIFA and its partners focus on critical issues affecting people's daily lives and the nation's future. The advanced research and educational technologies NIFA supports empower people and communities to solve problems and improve their lives on the local level.

Among the many programs NIFA leads, many are currently focusing efforts on the following societal challenges:

- Advance our ability to provide global food security and fight hunger
- Create a resilient and environmentally sustainable agricultural system responsive to climate change
- Enable U.S. energy independence through the development of sustainable bioenergy feedstocks and value-added bio-based industrial products
- Combat childhood obesity by ensuring the availability of affordable, nutritious food and providing individuals and families science-based nutritional guidance
- Reduce the incidence of food-borne illness and provide a safer food supply

NIFA does this not only through their research and higher education programs, but also through an extensive network of state, regional, and county extension offices in every U.S. state and territory. These offices have educators and other staff who respond to public inquiries and conduct informal, noncredit workshops and other educational events. Extension education for all citizens is also provided nationally online through eXtension.org.

Moreover, with support from more than 500,000 volunteers, 4-H - USDA's 111-year-old youth development program administered through NIFA - engages more than 6 million young people every year and teaches them life skills through hands-on learning and leadership activities.

9.3. Current Technology Transfer Goals, Objectives, and Measures of Success (Metrics)

Applicants or recipients of NIFA grants that support basic research and integrated projects are encouraged to explore potential commercialization through the Small Business Innovation Research (SBIR) program.

Conversely, small business owners or other grant recipients are encouraged to use NIFA-funded basic research programs to enhance innovation and competitiveness in their commercial operations. Each land-grant university funded by NIFA has a university technology transfer office to promote, support and improve technology transfer from academic and nonprofit institutions. They often manage and license innovations derived from research at their universities (including research funded by NIFA) and are a good source to link small businesses with university faculty. Moreover, the Cooperative Extension System Offices are a nationwide, non-credit educational network. These offices are staffed by one or more experts who provide useful, practical, and research-based information to agricultural producers, small business owners, youth, consumers, and others in rural areas and communities of all sizes.

9.4. Strengthening Current Activities and New Initiatives

NIFA plans to promote SBIR funding opportunities to USDA intramural research CRADA partners through a partnership between NIFA's SBIR national program leaders and the Agricultural Research Service (ARS) Office of Technology Transfer (OTT).

Through a partnership with ARS, NIFA informs those who have applied to the NIFA SBIR program of potential partnership possibilities and benefits with ARS scientists. Notification to the SBIR applicant are made after NIFA SBIR program managers have completed disposition of SBIR applications.

- Joint intellectual property potential (ARS can file patent applications for CRADA partners and only charges the partner for filing fees, patent application and prosecution completed by registered USDA patent agents provided free of charge saving small businesses substantial costs)
- CRADA partners can work with ARS to utilize the benefits of the ATIP Foundation

Partner with ARS for their joint ARS / ATIP "Forum" series

- NIFA's relationship with the Cooperative Extension System and the Regional Rural Development Centers enables improved coordination and partnership with ARS intramural research to improve technology transfer that is relevant to stakeholders. This increases the likelihood of success of technology transfer by the agricultural sector partners of USDA.
- Partner with ARS on forums on bioenergy feed stock development
- Partner with ARS, Rural Development, and ATIP Foundation to coordinate economic development funding from public and private sources. In FY 2014 the ARS OTT held a series of listening sessions in cooperation with USDA RD and in those sessions the SBIR program was one program within USDA that was highlighted. In FY 2015 the ARS OTT will hold joint forums with USDA RD and the SBIR program and these forums will be focused on rural states that are a priority for both USDA RD and SBIR.

9.5. Response to Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses

USDA 27: New Metrics (beginning FY 2014) on NIFA outcomes:

Efforts to develop procedures for requesting information from NIFA awardees are in progress. Information will be collected on: 1) number of new jobs created by a small business as the result of receiving SBIR grant funds; 2) increase in sales of technology or services developed by a small business as the result of receiving SBIR grant funds; and 3) sale to other businesses of licenses to technology developed by a small business as the result of receiving SBIR grant funds.

The data on the patents issued based upon Competitive NIFA Funding has been collected for FY2014 and is now being reported (see Table 1).

Annual Reporting on Technology Transfer in USDA, FY 2014

Table 1. Patents Issued in FY2014 based upon Competitive NIFA Funding.

Institution Name	Award Number	Patent Number	Issue Date	Invention Description
University of California	97-35304-4657, 98-35100-6150	8,704,044	4/22/2014	Nucleic Acids that Encode ERS1 from Maize and Their Uses
Louisiana State University	2007-35204-05420, 2009-35204-05200	8,877,211	11/4/2014	Bovine Herpes Virus Vaccine with Multiple Mutations
University of Missouri-Columbia	2006-34113-17139	8,692,064	4/8/2014	Quantitative Trait Loci Associated with Soybean Cyst Nematode Resistance and Methods of Their Use
University of Missouri-Columbia	2006-34113-17139	8,771,934	7/8/2014	Inorganic Pyrophosphate and Uses
University of Wisconsin-Madison	2001-35204-10184	8,535,685	9/17/2013	H3 Equine Influenza A Virus
University of Wisconsin-Madison	2001-35204-10184	8,697,089	4/15/2014	H3 Equine Influenza A Virus
University of Wisconsin-Madison	2001-35204-10184	8,784,838	7/22/2014	H3 Equine Influenza A Virus
University of Wisconsin-Madison	04-CRHF-0-6055, 2004-35204-14209, 2004-35605-14243	8,758,773	6/24/2014	Vaccine Candidates Against Johne's Disease
University of Wisconsin-Madison	05-CRHF-0-6055	8,569,574	10/29/2013	Mutations in the STAT5A Gene are Associated with Embryo Survival and Milk Composition in Cattle
University of Wisconsin-Madison	2006-35503-16998	8,734,878	5/27/2014	Method to Separate Lipids From Cheese Whey and Fat-Free Whey Protein Product Formed
University of Wisconsin-Madison	2006-35503-16998	8,771,772	7/8/2014	Method to Separate Lipids From Cheese Whey and Fat-Free Whey Protein Product Formed
University of Wisconsin-Madison	05-CRHF-0-6055	8,802,420	8/12/2014	Construction of Quadruple Enterotoxin-Deficient Mutant of Bacillus Thuringiensis
University of Wisconsin-Madison	09-CRHF-0-6055	8,871,494	10/28/2014	Over-Production of Secondary Metabolites by Over-Expression of The VEA Gene
University of Wisconsin-Madison	12-CRHF-0-6055	8,647,819	2/11/2014	Association of the Progesterone Receptor with Fertility
University of	09-CRHF-0-6055	8,790,875	7/29/2014	Methods and Compositions for

Annual Reporting on Technology Transfer in USDA, FY 2014

Wisconsin-Madison				Improved Federalization of Embryonic Survival
University of Wisconsin-Madison	11-CRHF-0-6055	8,834,704	9/16/2014	Electrochemical Detection of Beta-Lactoblobulin
University of Massachusetts	2005-35503-12296, 2005-35503-16164	8,603,566	12/10/2013	Enzymatically cross-linked biopolymer interfacial complexes for improved lipid particle stability

USDA 28: Partner with ARS and the Animal and Plant Health Inspection Service (APHIS) at USDA on the National Plant Diagnostic Network, and the National Animal Health Laboratory Network. There are two goals for NIFA in this area.

- 3) Develop competitive funding opportunities to include ARS scientists in the development of diagnostic assays and validation protocols that are needed to support APHIS regulatory surveillance efforts for foreign and emerging plant and animal diseases. In FY 2015 the Food Security RFA will promote this objective.
- 4) Coordinate APHIS regulatory and ARS research efforts with relevant components of the Cooperative Extension Service in order to better identify producer needs and the transfer of relevant technology. Plans for FY 2015 are still being developed.

9.6. Downstream Outcomes

Eldertide is located in Maine and has received support from the SBIR program. Eldertide is involved in the development of elderberries as a new crop that can be profitably grown by farmers in Maine and elsewhere. Most elderberry-based products in this country have utilized the European elderberry, *Sambucus nigra*, but in this project the work has focused on the American elderberry, *Sambucus canadensis*. Foods that are high in antioxidants are frequently associated with promoting human health and well-being. Antioxidants help neutralize free radicals and prevent oxidative stress. The Oxygen Radical Absorbing Capacity (ORAC) has become the industry standard for assessing the antioxidant strength of foods. Many fruits have high ORAC levels with values ranging from wild blueberries - 13427, cranberries - 9584, cultivated blueberries - 6552 and raspberries - 4882. Elderberries have ORAC values of 14697 and thus are one of the best antioxidant fruits that is being farmed. In addition to working out procedures for growing the American elderberry they have helped an additional 10 farmers start growing elderberries. The first product they have commercialized is Anthoimmune, an organic elderberry syrup sold as a nutraceutical product to boost ones immune system. This product is based on a combination of certain European and American cultivars. It is being sold in all New England Whole Foods stores and has been very well received with sales for the year projected to exceed \$200,000.

Aquaculture Systems Technologies is located in New Orleans, LA and has received several different SBIR awards. The focus of this company is on the development of bead filter technology for use in recirculating aquaculture facilities. Traditionally most aquaculture has been done in ponds, raceways with flow through water, or in cages or net pens in the shallow marine waters. In such systems water quality and waste disposal are usually not major issues because there is an excess of water. Finding appropriate natural resources to allow this type of aquaculture is becoming increasingly difficult. Consequently, in recent years there has been a real push to develop intensive recirculating systems where the reuse percentage for the water often exceeds 90%. Such systems require far less space and far less water but developing appropriate ways to dispose of the fish wastes so as to maintain adequate water quality at an affordable cost is a real challenge. A scientist from Louisiana State University developed and patented the concept of bead filters where a large number of small spherical beads provide filtration and also a large surface area on which a biofilm of bacteria forms. This biofilm consists of the

heterotrophic and nitrifying bacteria and is where the biological wastes are broken down into inorganic compounds. This bead filter system has been commercialized and widely adopted in aquaculture facilities and commercial aquaria. Sales have reached several million per year and this is now one of the dominant technologies being used in recirculating aquaculture facilities.

University of Kentucky researchers were awarded funding from Hatch/NRI with the long term goal of reducing sulfur containing odorants from isolated soy proteins to improve flavor and promote consumption of soy based products. Research determined that free sulfites formed during the final stages of soy protein (ISP) manufacturing react with a naturally occurring chemical in soybeans, and oxygen to degrade the primary odorant in soy protein products. Subsequent research conducted found that the addition of potassium iodate during soybean processing inhibited the chemical reaction that encourages the off-flavor to below detectable levels. Potassium iodate is a GRAS compound and its addition during soy protein processing is both commercially practical and economical. This patented technology was transferred to a large US soy protein processor and incorporated into a successful plant trial.

Washington State University (WSU) researchers have developed an innovative, pilot-scale microwave assisted pasteurization system (MAPS) to rapidly and evenly heat packaged food products. The prototype is a 915 MHz microwave that processes foods that are both safe and of high quality. Initial results show that the quality of microwave-pasteurized foods, such as mussels, shrimp, and tofu, is better than using conventional thermal processing methods. An additional benefit to this technology is that microwave heating time is shorter than conventional thermal processing, and the shorter time means producing higher food quality at lower energy output and cost. Food companies can now use MAPS to test a wide range of food products and adapt the technology to suit their needs. WSU anticipates licensing this technology to a start-up company, Food Chain Safety, for commercialization in the coming months.

University of Wisconsin-Madison (UW-Madison) researchers, through a multi-disciplinary approach involving food scientists, sensory scientists, nutritionists, speech pathologists and clinical doctors, have developed an improved understanding of what attributes of fluids are important for developing a series of thickened fluids for dysphagia patients, or individuals with swallowing disorders (over 18 million adults and millions more children). This has led to a patent application detailing the required flow properties of these thickened fluids. This provisional patent application has been licensed by a company to produce these scientifically-designed fluids. Once this company has successfully completed final development plans, new scientifically-based products that provide improved options for dysphagia sufferers will be available on the market. Results from this work are now used as a lab module in a senior-level Food Functionality course at UW-Madison, and the lab describes aspects of dysphagia and through the context of thickened fluid rheology, ties back to the hydrocolloid section of the course.

University of Maryland Eastern Shore researchers with support from an 1890 Capacity Building Grant have studied the prevalence, growth, survival, and control of *Listeria monocytogenes* in blue crab meat. The results of this project indicate that raw live crabs and associated surfaces are potentially important initial sources of *L. monocytogenes* contamination in blue crab meat and crab processing plants. These findings assist the crab processing plants to develop sanitation protocols that better target sources of *L. monocytogenes*. Comparison of rapid and traditional methods for detection of *L. monocytogenes* in blue crab meat and crab processing plants allows the seafood industry and regulatory agencies to refine their methods for rapid detection of this bacterium in crab meat and crab processing environments. The predictive model will assist the seafood industry and regulatory agencies in designing and implementing food safety plans which minimize the risk associated with this pathogen in crab meat.

Northeastern Regional Aquaculture Center (NRAC) researchers have initiated a Shellfish STEM-GIS (SHELLGIS) project for improved siting and farm management. The project conducted workshops in the New England region and delivered several presentations to share information on decision-making tools to identify the best areas to place new aquaculture farms given scientific data, modelling and public opinions and the second to use the tool to illustrate how differing public or scientific opinions can affect the decision making process. The

project also developed and delivered 20 minute outreach presentations for both scientific and trade meetings. The project has hosted a focus group meeting with key industry and resource management officials to conduct beta-testing of the model. A technology transfer workshop for the Northeast Aquaculture Extension Network feature a training workshop on the GIS at the NACE meeting. NRAC fact sheet on the use of ShellGIS is available through NRAC. An article for publication in World Aquaculture on the SHELLGIS program is in press. A final workshop on the project is in the planning process.

Center for Tropical and Subtropical Aquaculture researchers have focused on the expansion of aquaculture and aquaponics in Hawaii and the U.S. Pacific Islands. The specific goals were to assist in the start-up of commercial aquaponics farms for the purpose of economic development, sustainability, and food self-sufficiency. Aquaculture production in the region is small and a majority of the farmers are over the age of 50. Aquaponics is environmentally friendly (green) and takes waste products from fish culture, to grow healthful vegetables for people to eat. Aquaponics enhances food security and provides a sustainable supply of food for local consumption. The technology also generates local employment opportunities, as well as revenue streams. The research group participated in several regional workshops, webinars, and other events. A forthcoming how-to manual will provide farmers with information to solve technical issues on their farms, and will also describe step-by-step instructions to construct a system. Significant on-farm outreach was also conducted, resulting in the establishment of new commercial aquaponics farms and a new rooftop garden at a rehabilitative shelter in Hawaii. The extension support provided under the auspices of this project has helped commercial farms in their startup and day-to-day production efforts. These farms produce 30,000 - 83,000 kg of produce a year and sell at “food safe” or preferably “organic” prices. One farmer is looking to franchise his gourmet watercress operation, and another now sells approx. \$300 of produce weekly from the aquaponics part of his farm.

North Carolina State University scientists with support from the Biotech Risk Assessment Grants program have examined the use of transgenic plants for insect control. The use of transgenic plants in crop production for insect control is increasing and the number of different insect toxins being used for control in these plants is expanding. It is essential to accurately discriminate this transgenic produce from non-transgenic produce in the environment and in commerce. In addition, methods are needed to effectively diagnose insect resistance to the many different transgenic crops being developed. The purpose of this project was to develop user friendly, inexpensive assays for monitoring for insect resistant transgenic crops and for insect resistance to these crops. The detection of insect resistance is critical to the early detection and monitoring of the evolution of resistance and the preservation of this crop technology for the farmer. In addition, it is critical to environmental monitoring that methods are available to detect the insect resistant toxins and crops as they are transported to the field and market. Researchers at NCSU developed a field assay kit to detect insect-resistance to transgenic plants for a variety of insect species and plant materials. Fortuitously, they discovered two behavioral mechanisms by which caterpillars may become resistant and likely cross resistant to almost any plant engineered for insect control. If correct, the use of transgenic plant technology will not only produce resistant insects but insects that will have an increased feeding rate. This work was picked up by the US Navy and projects completed to develop similar technology of monitoring mosquito resistance. The work was also applied to the development of nucleic acid-based insect control and work on new insect diets; this resulted in the filing of a US patent.

University of California, Riverside scientists with support from AFRI have undertaken a functional analysis of the potato aphid transcriptome. Plant resistance is the paramount method for controlling pests and pathogens as pesticides are harmful to the environment. It is clear that gene-mediated defenses in plants profoundly affect microbial pathogen survival and alter feeding behavior and survival of piercing-sucking insects. However, the precise effects of plant defenses on these microbes and insect pests are not well understood. UC Riverside researchers achieved several impacts: 1) Developed potato aphid transcript sequence resources which are now accessible to the scientific community at public universities and in private industry. In addition, they produced de novo assembly programs to assemble the transcriptomes of several insects including the potato aphid, a devastating pest of potato and tomato. This program is now being utilized by researchers to assemble the transcriptome of any organism. In addition, they produced a high-throughput gene silencing approach for piercing-sucking insects to understand the functions of specific genes. As a result a powerful tool has greatly

impacted the research community (in universities and private industry) and has established the foundation for novel technologies to engineer novel plant defense genes into crops.

University of Florida scientists with support from a Specialty Crops Research Initiative grant have developed the Strawberry Advisory System (SAS) for informing farmers when to spray their strawberry plants. Traditionally, Florida strawberry farmers spray crops once each week from November to March to prevent attacks of botrytis and anthracnose, the two most deadly fruit rot diseases for strawberry. The SAS system communicates with farmers through their computers and mobile technology to alert them of an adverse disease index; meaning that the combination of leaf wetness, air temperature, and other factors have combined to create a perfect environment for disease. Once alerted, farmers can spray their crops and then log the information onto a website where each spray is tracked, the indexes are logged, and spray advisories given.

North Carolina A&T University scientists have discovered a way to remove up to 98 percent of the allergens from peanuts. Peanuts are the 12th most valuable cash crop in the United States. Allergies to peanuts are among the most severe of all food allergies, affecting some 2.8 million people in the United States, including 400,000 school-aged children. Researchers found that by soaking roasted peanuts that have been shelled and skinned in a solution containing food-grade enzymes, they can virtually reduce or eliminate two key allergens. The process does not affect flavor, and treated peanuts can be eaten whole, in pieces, or as flour in various products. The process has been validated at the University of North Carolina at Chapel Hill through human clinical trials using skin prick tests. Because of this work hypoallergenic peanut products are expected to hit store shelves soon.

The Southern IPM Work Group was funded by the Southern IPM Center to develop new technologies to benefit nursery crop growers. The work group collaboratively wrote a 300-page e-book on deciduous tree production. During one year, 388 separate users downloaded the e-book. Based on user evaluations, each download led to increased savings or earnings of the grower by an average of \$3,313 through reduced pesticide use or more refined pesticide applications, for a total savings of \$1,285,444 per year. The Work Group also developed a mobile app called IPMPro for the nursery crop growers. The first of its kind for the green industry, IPMPro uses text notifications to alert growers when key insects, mites and diseases of woody plants are emerging and to encourage the grower to begin scouting. Reminders for scouting and plant care have saved growers an average of \$3,367 per user, resulting in a total impact of \$1,356,901 based on 403 downloads.

National 4-H staff was active on the White House Maker initiative and fostering making and inventing in 4-H. Several states have been piloting maker experiences in 4-H clubs, afterschool programs and camps, including military 4-H partnership programs. About 90 4-H professionals attended a workshop presented by 4-H STEM NPL on Mentors as Makers in January 2014. With assistance from 4-H Headquarters, National 4-H Council hosted a National Youth Maker Summit in November 2014. The 4-H staff coordinated National 4-H GIS/GPS Leadership team composed of teens and adults. The team is developing several online GIS maps, including a 4-H history map where local clubs can map their 4-H historic places of interest. The 4-H staff presented geospatial workshop to 15 teachers at the Next Steps Institute in September. Briefings by delegates to the 2014 National 4-H Conference about Youth as Makers and Digital Gaming for Education were organized by 4-H National Headquarters staff. The 4-H teen delegates researched, prepared and presented their briefings to White House Office of Science and Technology Policy staff in April, 2014.

University of Idaho Federally-Recognized Tribes Extension Program at Fort Hall program concentrates on improving profitability on Fort Hall reservation ranches and farms. It will provide one-on-one support as well as workshops and training. The goal of the project is to improve the genetic quality of beef cattle, reduce the incidence of cattle dystocia on reservation ranches by half and control trichomoniasis. The project director will teach financial management classes to increase ranch profitability, and work with the ranching community to rehabilitate 25,000 acres of fire damaged rangeland. The project director will also work with the farming community to reduce noxious weeds by 25 percent and teach hands on horticultural programming. In addition, a youth outreach effort will provide programs on agriculture, science, nutrition and life skills.

University of Missouri researchers received support from the Farm Business Management and Benchmarking Competitive Grant program to improve farm management knowledge and skills of agricultural producers and establish and maintain a national, publicly available farm financial management database. The cooperation and sharing of ideas have been key to the collaborative efforts within this grant. Continual communication including an online meeting and a face-to-face dialogue were completed to aid in the collaborative process. The concerted effort to increase the size of the database has been through a variety of promotional and recruitment methods to farm producers. Methods have included displays at farm shows, informative pamphlets, community seminars, commodity workshops, and comprehensive training of new FINPACK analysts. Consequently, seven collaborators reported an increase in producers within the national database (although not all collaborators reported as records were still in process). Over 60 new farms have been added to the program which provides more data to the FINBIN. This increase in producers includes younger individuals and producers in geographical areas and production sectors that were not previously included. The expansion of collaborators within more states has allowed for 10 states to submit data to FINBIN thus increasing the scope of the potential analysis.

Wheat and Barley (Triticeae) Coordinated Agricultural Project (TCAP) is playing a major role in technology transfer to the wheat and barley industries to: (1) discover and deploy beneficial alleles from diverse wheat and barley germplasm; (2) accelerate breeding through marker-assisted selection and genomic selection; (3) implement sequence-based genotyping methodologies to discover new allelic diversity in wheat and barley; (4) implement web-based tools to integrate marker-assisted selection and genomic selection strategies into breeding programs; and (5) develop and implement a Plant Breeding Education Network. In Summary, TCAP researchers have phenotyped and genotyped large collections of wheat and barley germplasm and association mapping panels. Genome Wide Association Studies have revealed multiple beneficial alleles for disease resistance, water use efficiency and nitrogen use efficiency. These alleles are being deployed into commercial varieties. High-throughput marker-based breeding approaches are being implemented nation-wide and commercial varieties and improved germplasm using Marker Assisted Selection (MAS) are being released. MAS and genomic selection (GS) strategies are accelerating breeding cycles helping breeders to ameliorate the negative impacts of climate change. Nation-wide MAS approaches have been implemented for both wheat and barley, which together with GS are accelerating the release of improved varieties. Genotype By Sequencing (GBS) and gene capture technologies have yielded millions of polymorphic markers. An expanded T3 database is integrating all the genotypic and phenotypic data from the project and is improving the tools to retrieve and analyze this information. This database will serve current and future generations of barley and wheat breeders. The Plant Breeding Training Network (PBTN) is functioning well as a central hub for the education activities and is helping faculty to attract new students into plant breeding. The high level of integration generated among research and breeding programs, genotyping laboratories, germplasm collections and disease laboratories would not have been possible without TCAP. TCAP has also had a very positive impact in fostering international collaborations, a contribution that was recognized in 2014 by the NIFA “Partnership Award for Program Improvement through Global Engagement”.

Penn State University scientists received support from the AFRI Sustainable Bioenergy Research Program to create a binder that holds together waste anthracite fines so as to replace coke in iron foundries. This will save money, energy, and greenhouse gas emissions while increasing the competitiveness of both foundries and biofuel production facilities. In coke production, bituminous coals are pyrolyzed at 900 degrees (C) for a day. This allows the coke to burn rapidly. However, coking consumes 25% of the raw coal's energy. In contrast, our co-product-bindered bricks can be made at near-ambient temperature and thus can diminish carbon dioxide release by 1-3 million tons / year. By bindering waste anthracite fines with a composite binder of biomass co-products, our preliminary results show that the project director (PD) can make a brick with the same toughness, thermal resiliency, high surface area, fast burning rate, and high energy content as coke. Currently, PD will expand the fundamental thermo-chemistry of these hybrid binders, so as to enhance the co-products' value to foundries. The project team has investigated the thermal production of biomass byproducts at temperatures from ambient to 1600C; they have studied the conversion of products into silicon carbide nanowires which impart strength; and have investigated the fuel potential, chemistry, and strengths of the fuel bricks. The bricks have already been

demonstrated at partnering foundries, using 8 Tons of bricks. The demonstrations were highly successful. The project team is trying to optimize the bricks to support further development. There are current interests in the industry for this technology.

Colorado State University scientists received funding from the National Integrated Water Quality Program to address agricultural water security in the Colorado River Basin (CRB). Farmers across the CRB are feeling uncertain about the security of their agricultural water supply and its future—especially where production conditions make it more difficult to raise crops profitably and in areas where proximity to urban areas inflates land and water values. In areas with year round production of high value crops there is less pressure to sell land and water for urban uses and more young people are staying in farming. Agricultural water users want to safeguard irrigated agriculture and remind the public of the many contributions of irrigated agriculture, which include: secure food supply, local and regional economic strength, open spaces and wildlife habitat, and cultural heritage. Pressures that agricultural water users and managers are experiencing include: drought—reliability of Colorado River water supplies; urban—expansion onto agricultural lands, water removed from agriculture for transfer to cities; environmental/recreational/regulatory requirements —instream flows, endangered habitat protection, and water quality, obstacles to additional storage; groundwater availability and groundwater/surface water conflicts; tribal rights; fragmentation of agricultural lands— smaller parcels, new owners with limited knowledge of agriculture water management; and increasing age of farmers/high capital costs for new generations to enter farming. Responding to pressures is taking many forms, some proactive, some reactive, some even with later regret; agricultural producers and water managers are experimenting, trying to take actions that are the most likely to leave future options open. Reported responses from studying what pressures on agricultural water in your area exist; what are farmers doing about those pressures; what other ideas do they have for actions that could be taken; and how can land-grant universities help? Included in the responses were unique and innovative activities: 1. overcoming obstacles to complete storage projects, in some cases including hydroelectric generation; 2. using federal and state funds to make ag delivery system improvements for increased yield while reducing salinity in the Colorado River and improving fish habitat; 3. taking advantage of proceeds from ag/urban transfer agreements to implement on-farm irrigation efficiency improvements; 4. selling water from the least productive lands to concentrate on more productive plots; 5. negotiating temporary water sharing agreements during drought, including tribal participation, not certain whether they will last without formal adjudication; 6. signing ten year leases to cities, with option to renew; entering into contracts with neighboring cities after identifying a pool of water available from shareholders not using their water; and experimenting with informal water banking arrangements between local users. Most of those we interviewed and surveyed expressed at least a cautious optimism for the future.

Purdue University is the lead institution of a \$5 million NIFA grant called Useful to Useable, or U2U at www.agclimate4U.org. They format extensive climate data in a useful way for crop farmers in the Midwest to make better management decisions on crops based on Growing Degree Days (GDD), labor scheduling with weather patterns and field conditions, fertilizer management to maximize yield and reduce pollutant runoff, and better understanding of long term weather patterns. It is formatted in a user friendly way for farmers, certified crop advisors, and agency staff to transfer the latest technology in easy to use methods based on an extensive survey across the Midwest.

Penn State University scientists have been determining the roles and limiting factors facing native pollinators in assuring quality apple production. Meeting the demand for pollination services in the U.S. is getting more difficult with a decreasing supply of honey bees. The cost of renting honey bees is rising, with a 3 fold increase in rental costs, driving up production costs. 3,500 non-Apis bee species are found in the US. The sub-group of pollen bees has been conservatively estimated to have a value of \$3 billion annually for pollination services. There is a lack of long-term population data of most bee species and knowledge of basic taxonomy is incomplete. Wild and managed species of pollen bees in many cases can supplement honey bees for pollination, and, in some situations, replace them. This project addresses this demand for pollination services and the knowledge gap of U.S. bee populations. The team has developed an improved way to trap bees, which is 10 times more effective

than traditional methods, to measure their diversity and has developed an ELISA method to mark bees to improve the measuring of forage ranges. With the updated knowledge on bee activity, the team has created educational you tube videos and online publications in addition to traditional field days and workshops. In addition, guideline documents, such as the Pennsylvania Tree Fruit Production Guide, the NorthEast IPM guide and the NRCS practice specifications for developing pollinator hedgerows of woody perennials , have been updated with new information on bee genera, life history, and pesticide safety to protects bees.

Cornell University scientists have been working to help develop a broccoli industry in the Eastern U.S. Broccoli has recently become a major specialty crop worth nearly a billion dollars a year. Despite high consumption in the East, little is produced in this region. Both high transportation costs and interest in locally-grown food has created demand for eastern broccoli production, but current cultivars do not produce a consistently marketable product under eastern growing conditions. The goal of this project is to develop a broccoli industry in the Eastern US that can deliver high quality, eastern-grown broccoli to eastern consumers year-round, by developing broccoli varieties suited to stressful growing conditions and providing production and marketing support for eastern broccoli growers. The project team to date has developed seed for inbred lines, testcrosses and regional trial entries and has worked closely with commercial seed companies, which have successfully created seed available for growers. The team has also reached out to eastern growers through grower production meetings, updated variety lists, web resources, field days and direct conversations and has reached the public through articles mentioning the project in Business Insider, Scientific American Online, and the New York Times. This project is increasing access to eastern markets for locally produced broccoli. The 2012 Census of Agriculture showed a 3000 acre increase in eastern broccoli production; that increase has a market value of \$10 to \$20 million at the farm gate.

9.7. Outreach Activities

- In FY 2015 the SBIR program will participate in several ARS / ATIP Agricultural & Business Innovation Forums in selected rural states providing information on the SBIR program to potential ARS commercial partners.
- A number of NIFA's National Program Leaders attended National SBIR Conferences in Washington, DC and Austin, TX, with formal presentations on the USDA SBIR program and met one-on-one with 25 or more small business entrepreneurs at each conference. In addition, the USDA SBIR program participated in webinars with Arkansas, Michigan and Wisconsin and state SBIR meetings in Alaska, Alabama, Kentucky, Maine, Mississippi and Tennessee. In each case a presentation was made on the USDA SBIR program. One-on-one meetings were held with small business owners at each of these meetings. In FY 2015 the USDA SBIR program will participate in a National SBIR Conference in Washington DC and in several State SBIR meetings in rural states.