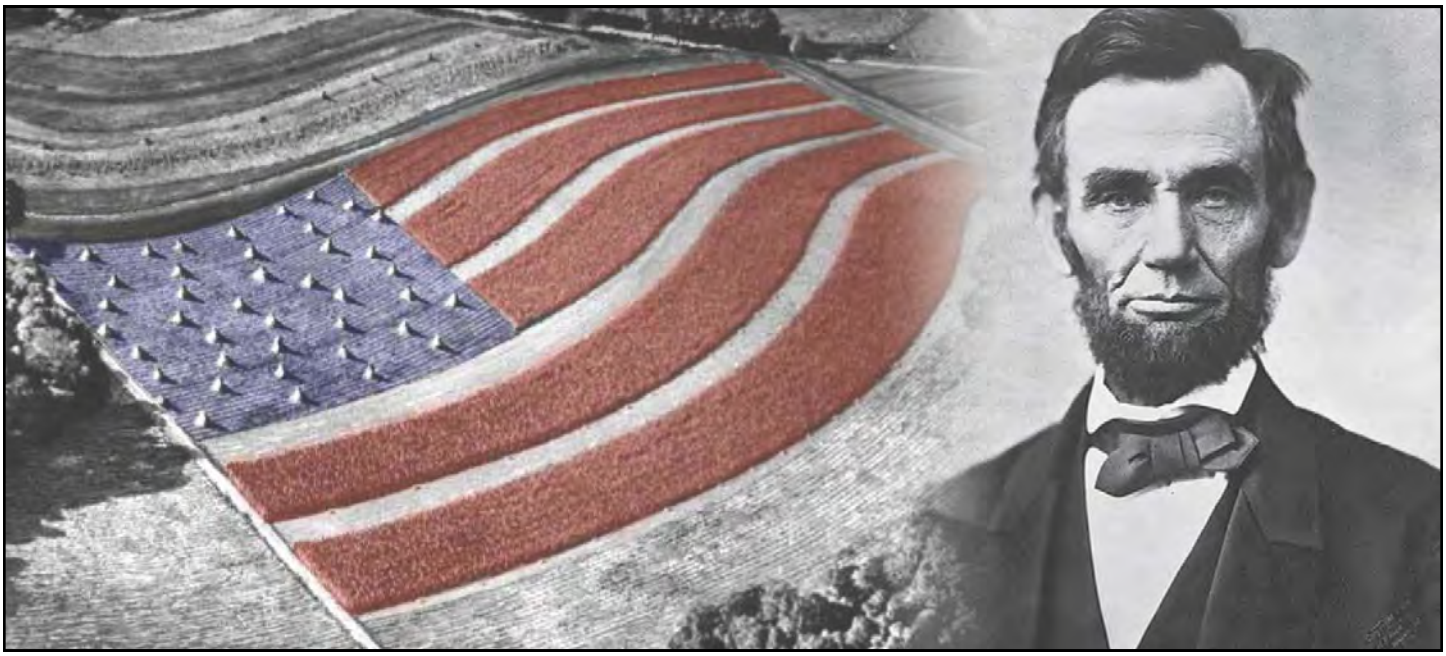
FY2014 U.S. Department of Agriculture Annual Report on Technology Transfer: Agricultural Research Service Section



Celebrating over 150 years of research for a growing world.

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, ≥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 he 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 deliver electronically from manufacturers via the GS1 data stream to the National Nutrient Database. Five manufacturers are participating in his 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 the 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 tactically 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 additional 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 assists 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 county. 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 MTRAs[2]	ND	ND	12	100	188
Newly executed MTRAs	ND	ND	12	86	105
Total number of active other agreements[3]	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 Agreemensts 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 disclosures[1]	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 filed[2]	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 licenses[1]	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 Licenses[2]	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]	NP[3]	NP[3]	NP[3]	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 E 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**
- **Plant Biological and Molecular Processes, NP 302**
- **Methyl Bromide Alternatives, NP 308**

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 piroplasmosis, has been eradicated from the United States, although in 2009, an outbreak of the disease occurred in Texas. Until recently, horses diagnosed with piroplasmosis 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).

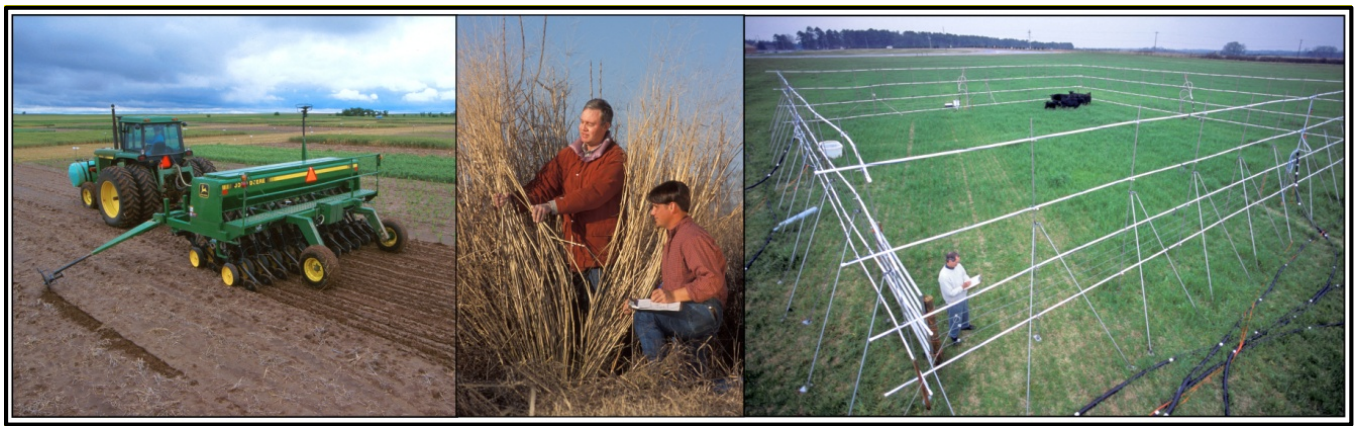
How house fly maggots live in bacteria rich media

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, which 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).



ENVIORNMENTAL 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. 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 N_2O. 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 form 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 it 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.
- 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 the 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 NCARLS'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.

Knipling-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 ant 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 (Cheyanne, 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-toxigenic 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.

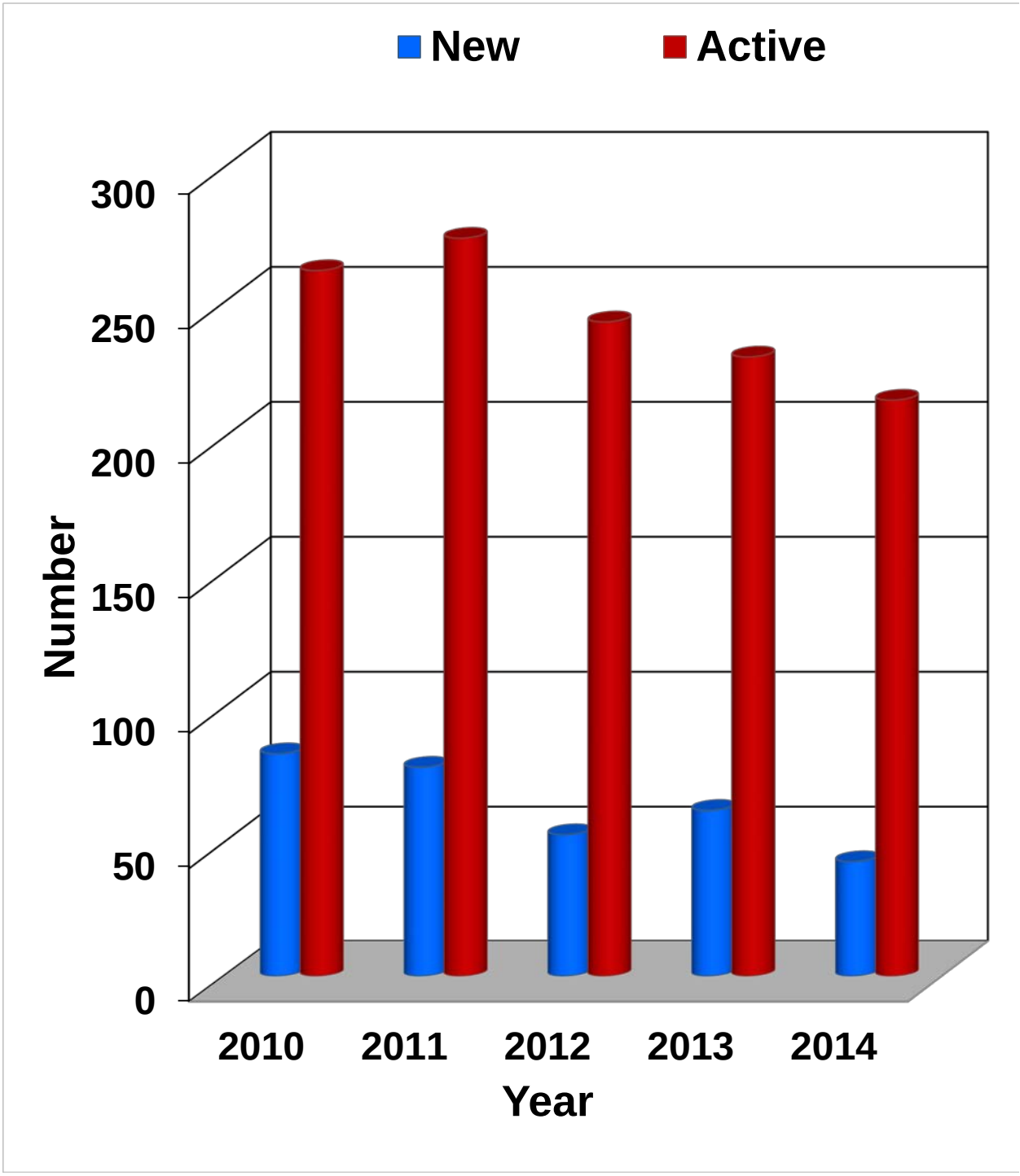


Figure 2. Number of collaborative research agreements by type in FY 2014.

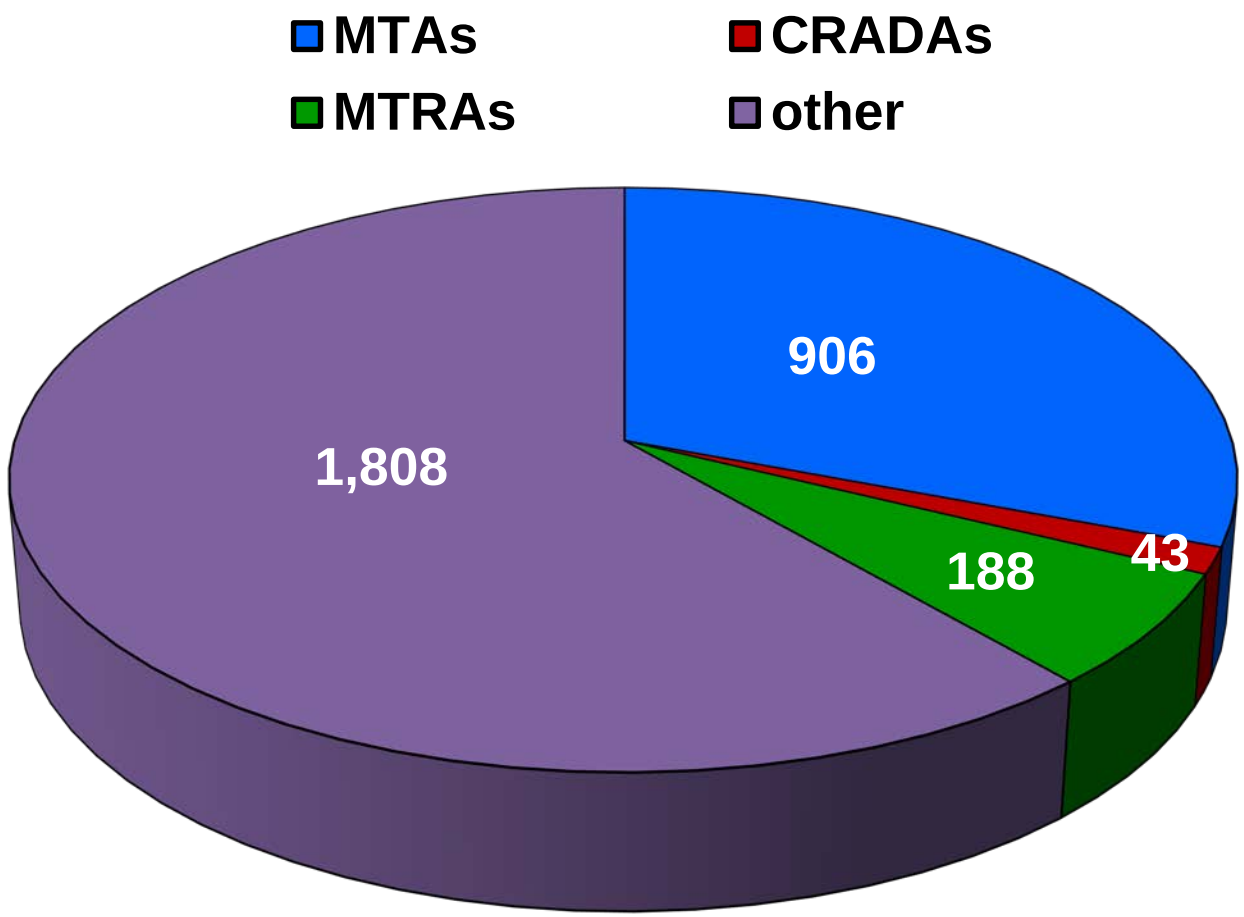


Figure 3. Number of new and active Trust Fund Cooperative Agreements, Reimbursable Agreements, Specific Cooperative Agreements and Non-Funded Cooperative Agreements.

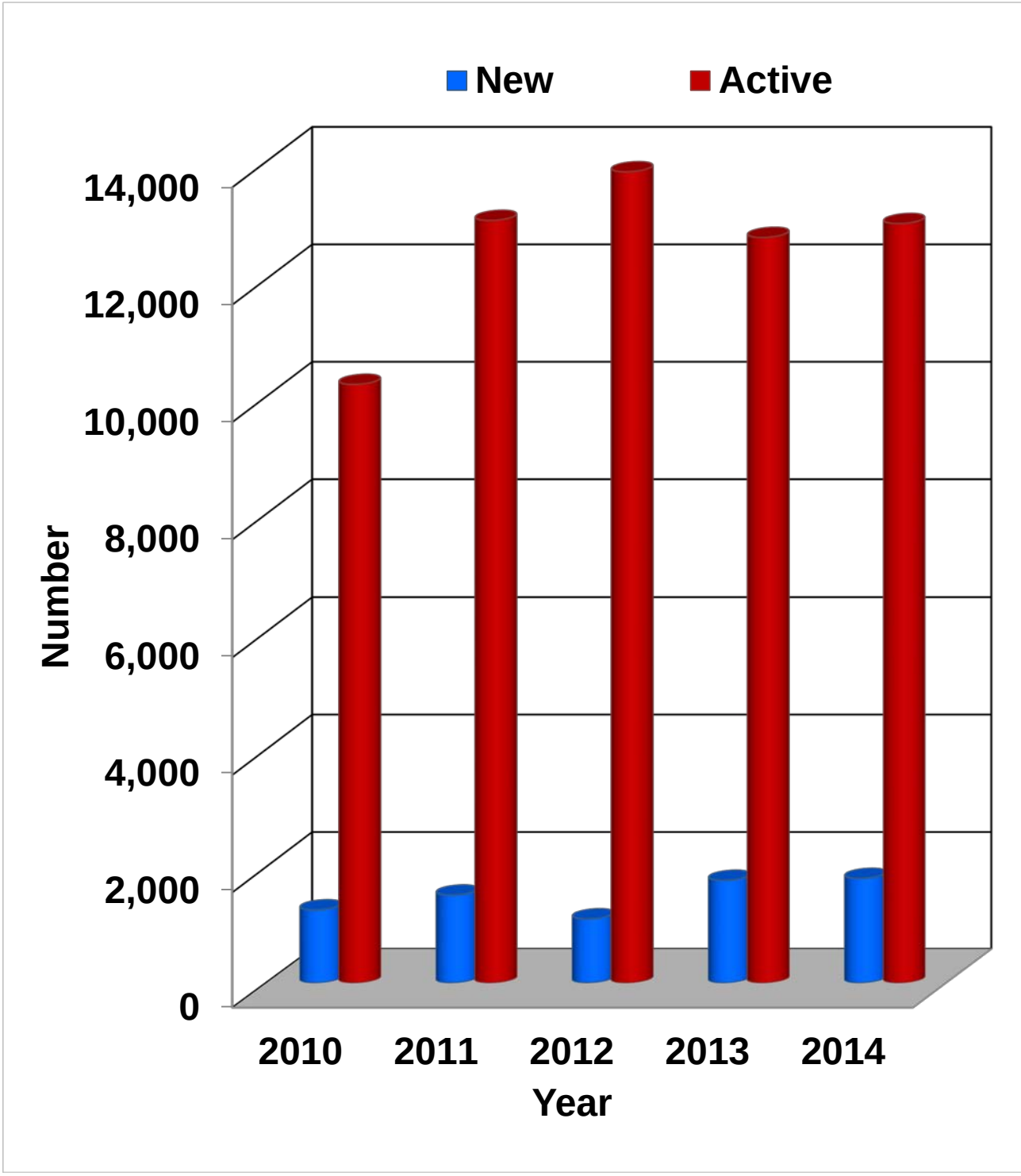


Figure 4. Number of invention disclosures, patent applications filed and patents issued. The year in which a patent issues is the not year in which the patent is filed.

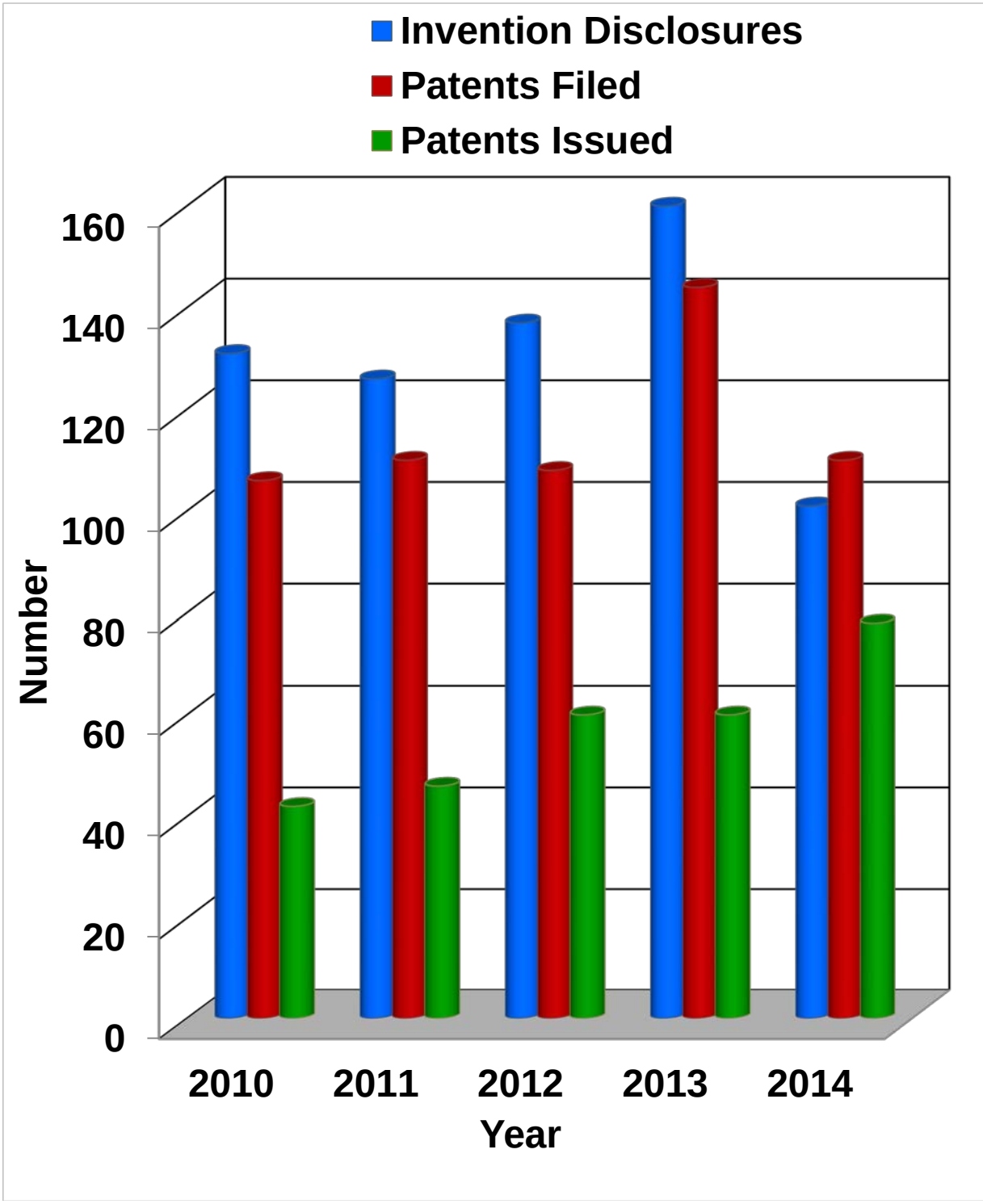


Figure 5. The ratio of patent applications over patents issued per year. While the year in which a patent issues is the not the year in which the patent is filed, the ratio does represent a trend. The current goal is "judicious" patenting to increase the percentage of patents that are issued.

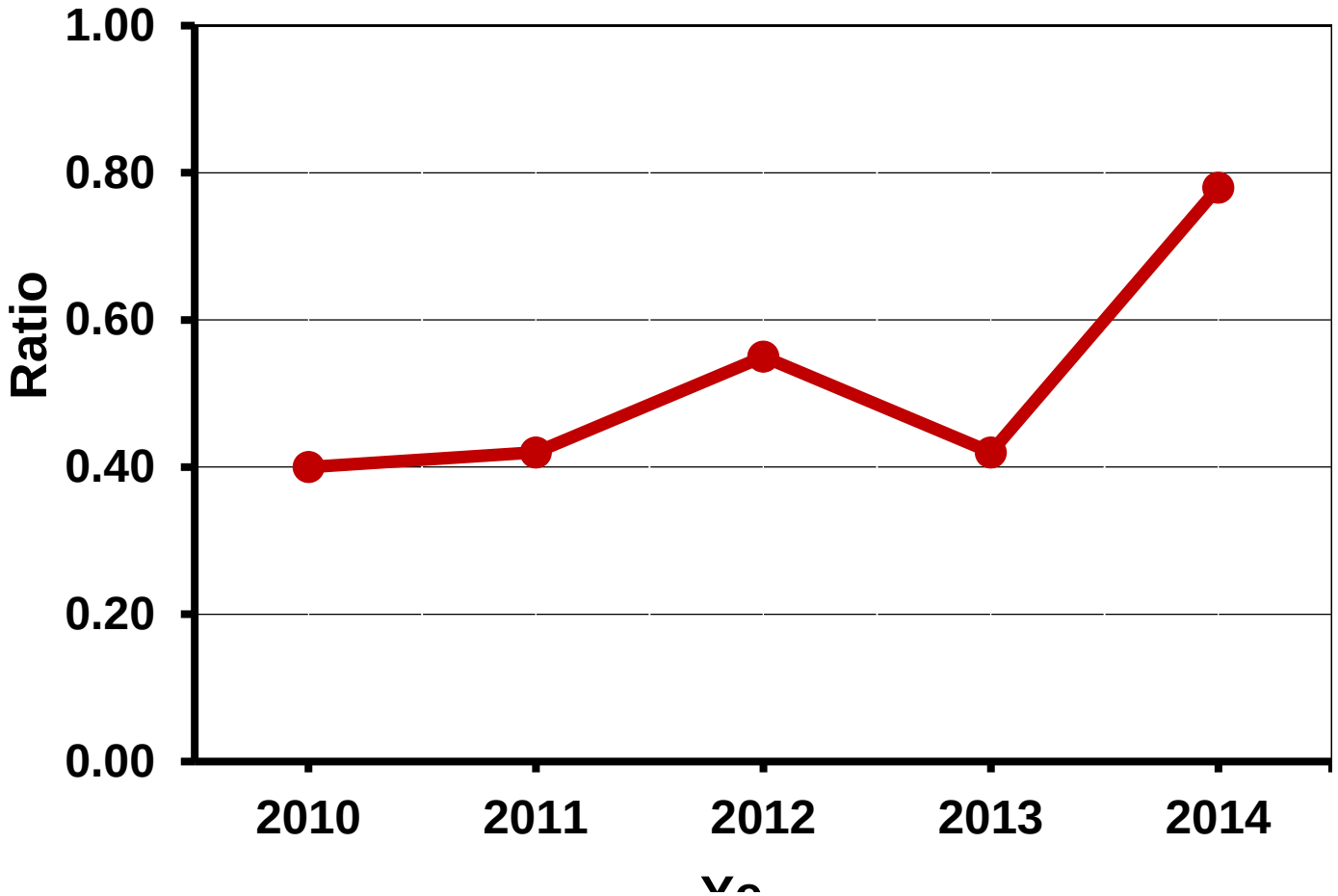


Figure 6. Number of patents issued in FY 2014 by scientific discipline.

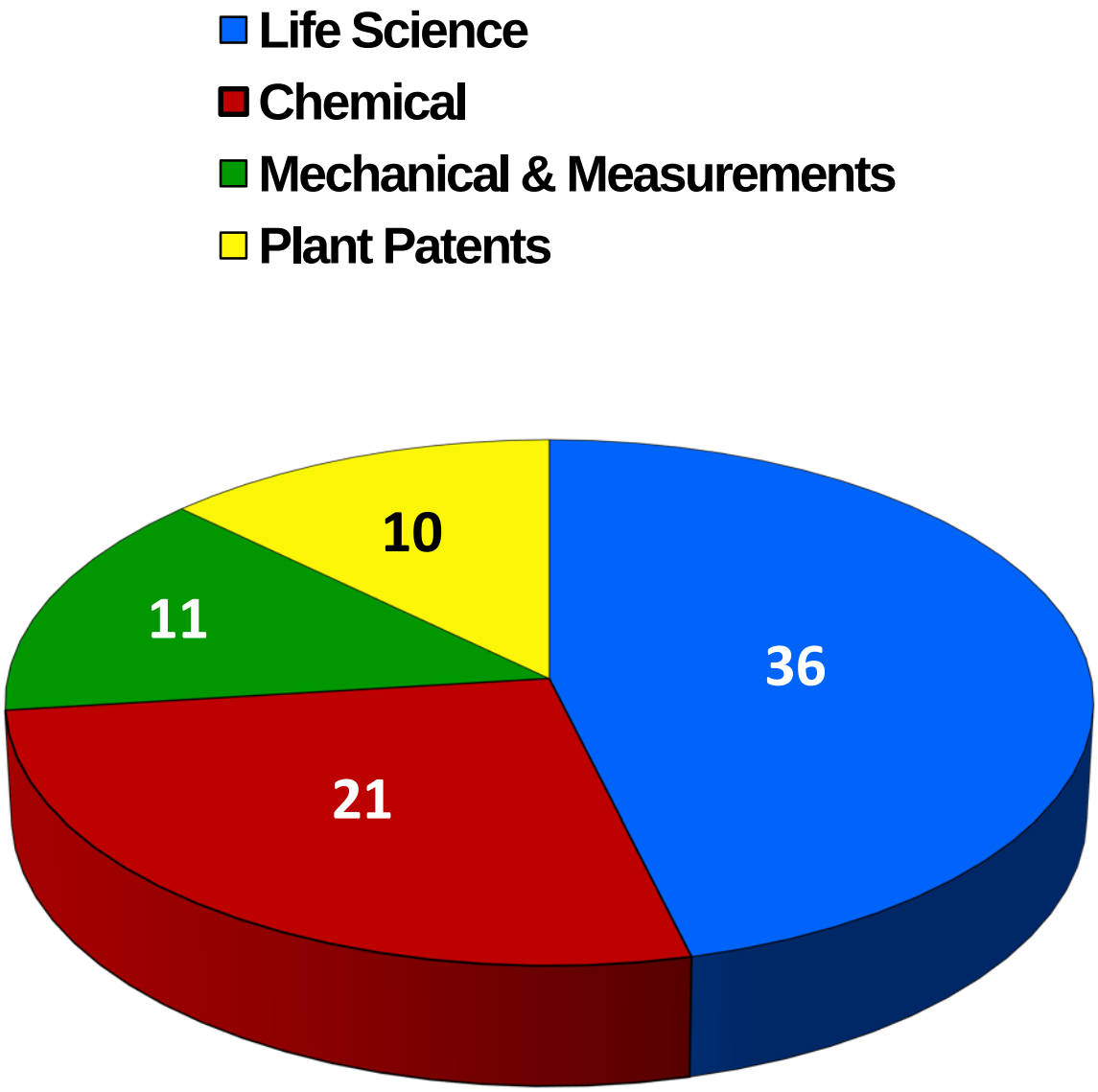


Figure 7. Number of license types per year.

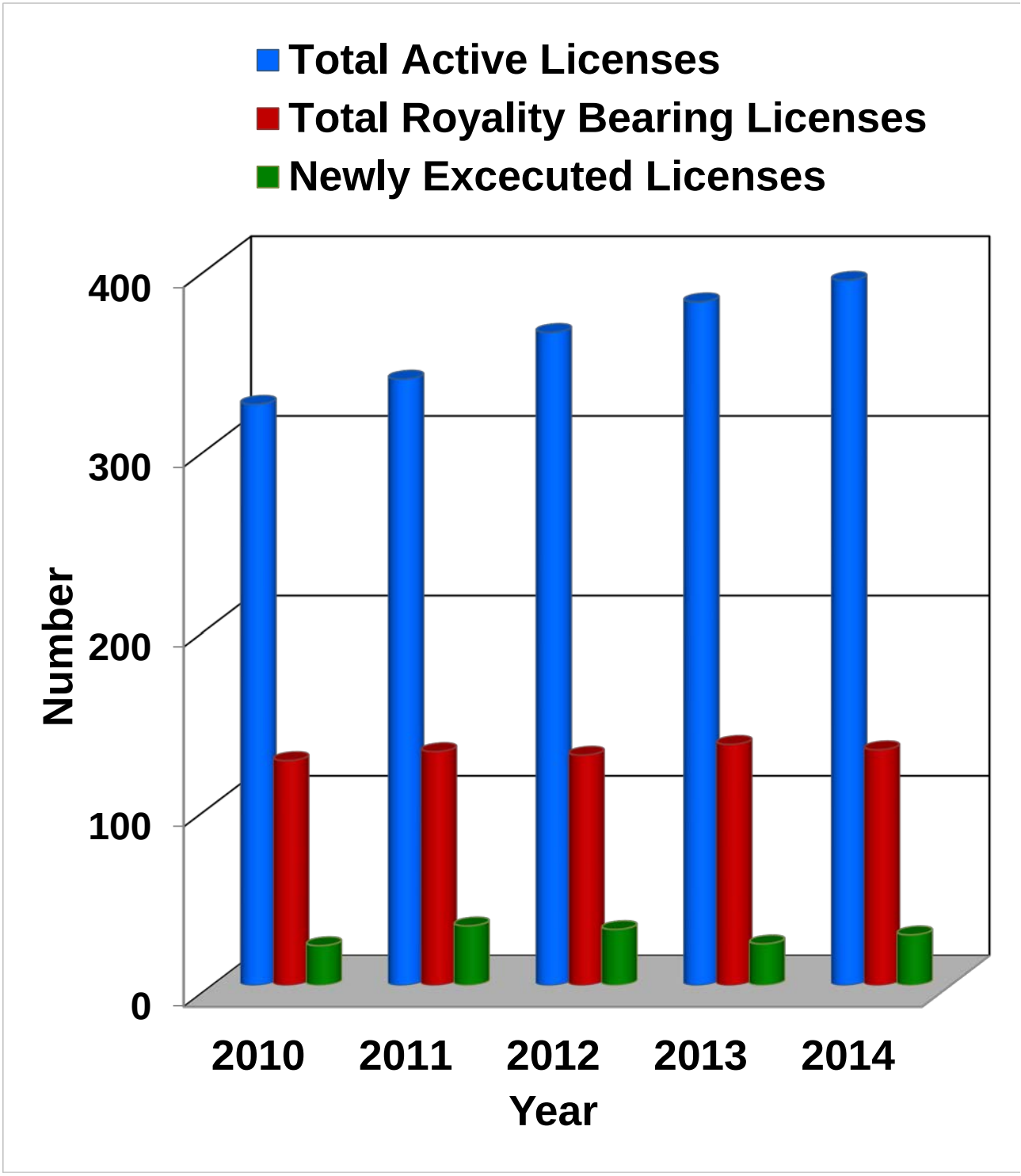


Figure 8. Earned license royalty income (ERI) over time.

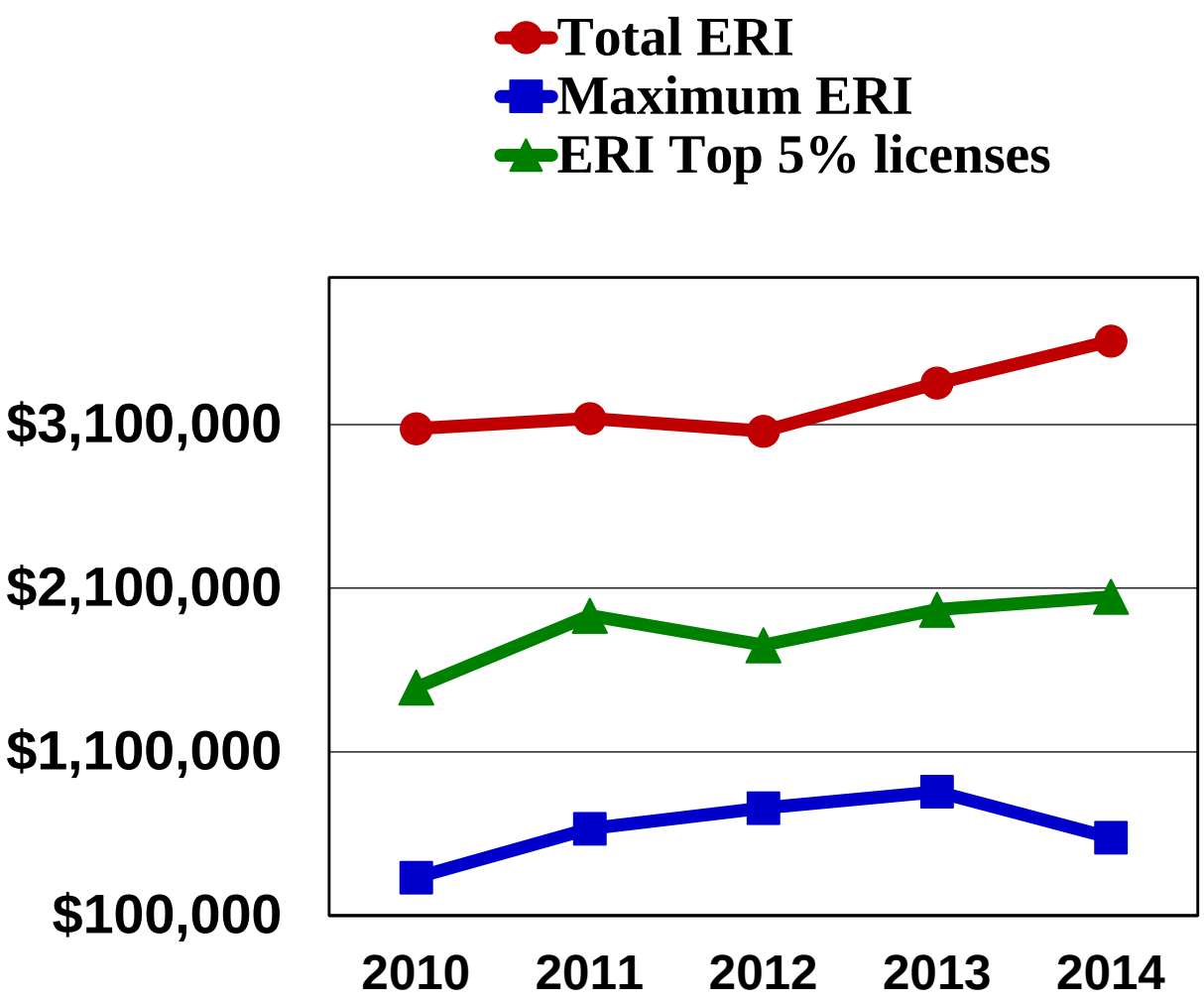


Figure 9. The number of new licenses executed in FY 2014 by business type.

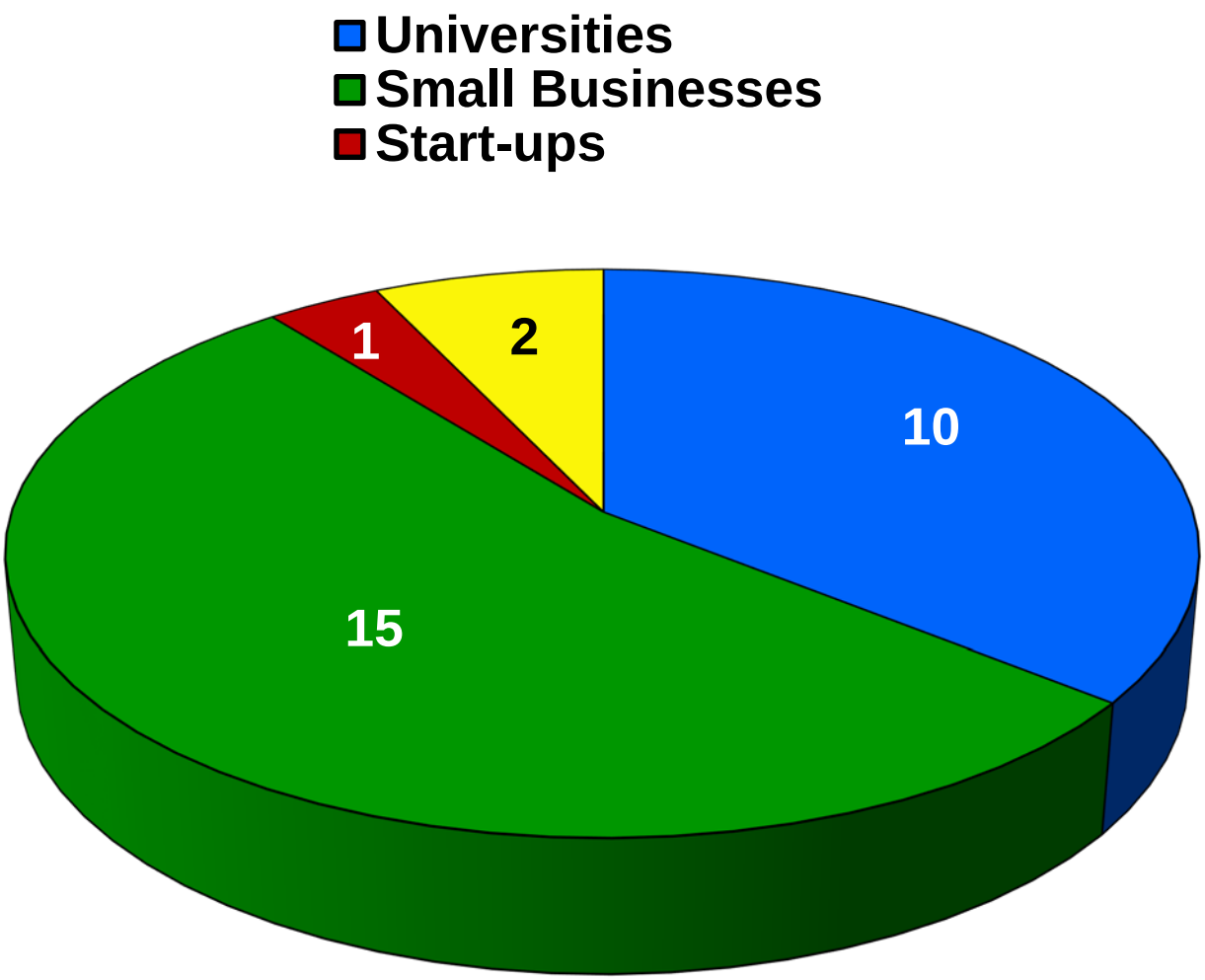
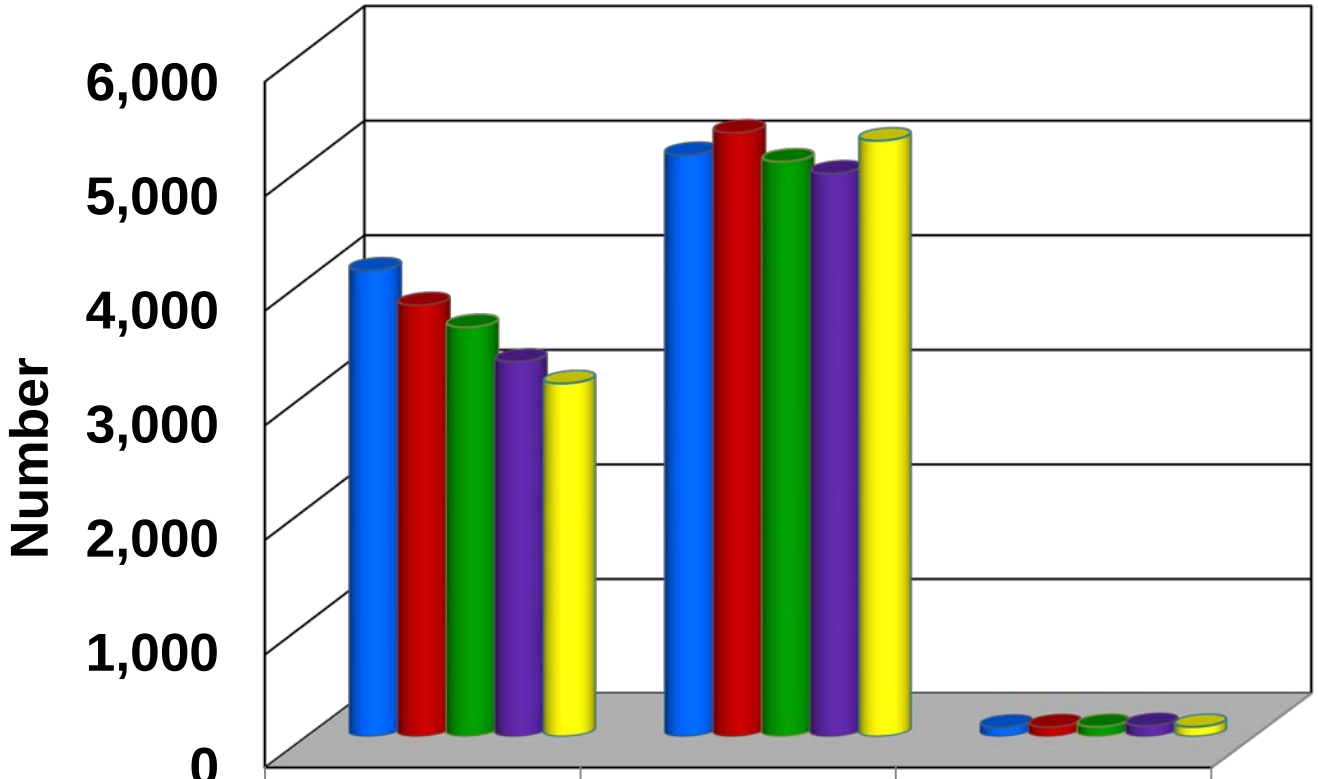


Figure 10. Number of ARS-approved publications per year.



	Abstracts	Peer Reviewed Publications	Trade Journal Articles
2010	4,076	5,083	79
2011	3,773	5,279	83
2012	3,582	5,027	86
2013	3,280	4,922	93
2014	3,091	5,209	85