USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

# ARS
# OFFICE OF INTERNATIONAL RESEARCH ENGAGEMENT AND COOPERATION

## Annual Report for Fiscal Year 2020

# ARS
# Office of International Research Engagement and Cooperation

Annual Report, April 2021

*I hope you find this report informative and that it sheds light on the many ways OIREC can help facilitate ARS international engagement. We look forward to partnering with you!*



## From the Director

The ARS Office of International Research Engagement and Cooperation (OIREC) Annual Report for Fiscal Year (FY) 2020 provides a snapshot of OIREC's efforts and partnerships with ARS researchers, programs, and administrative offices to advance the ARS mission.

2020 was a whirlwind year filled with uncertainty and unprecedented challenges. Looking back, reflecting on all we achieved in just one year—especially during a global pandemic—is quite remarkable. In FY 2020, OIREC celebrated our 20th anniversary and changed our name[1] to better reflect our role within the Agency. We chartered an International Engagement Council to facilitate and support cross-agency coordination and collaboration among ARS scientists and staff on international issues; continued our Inform and Engage International Engagement and Travel Awareness Seminar Series to share best practices for international engagement and travel awareness; and in January 2020, we hosted the first-ever stakeholder meeting for our Overseas Biological Control Laboratories.

We are excited to share more about these and other accomplishments in our report, which highlights the many ways OIREC is cultivating pathways to partnerships that drive ARS science toward global impact.

Bryan Norrington
Director, Office of International Research Engagement and Cooperation

1 The Office of International Research Engagement and Cooperation was previously known as the Office of International Research Programs. The name change was officially announced April 8, 2020.

# Contents

# Introduction

In fiscal year (FY) 2020, international collaboration continued to be a valuable component of the ARS research mission, despite the challenges posed by the COVID-19 pandemic. While ARS is charged with finding solutions to the problems of agricultural producers and consumers in the United States, partnerships with international collaborators help ARS scientists meet their scientific objectives. These collaborations bring fresh perspectives and novel resources to ARS' research projects and help ARS researchers test their ideas and technologies across a wide variety of climates, conditions, and cultural contexts.

The Agriculture Improvement Act of 2018, signed into law on December 20, 2018, underscored the significance of global research partnerships by adding new text that supports "international collaboration that leverages resources and advances priority food and agricultural interests of the United States," including addressing emerging plant and animal diseases; improving crop varieties and animal breeds; and developing safe, efficient, and nutritious food systems. As Federal funding continues to decrease as a share of overall investment in agricultural research and development in the United States, it has become even more important to join forces and share resources with like-minded scientists and research organizations in partner countries.

In FY 2020, ARS researchers reported 1,298 international collaborative activities across all program areas and research locations. These activities demonstrate the broad array of scientific expertise at ARS, from improving food crops so they can grow better in heat and drought conditions, to developing more efficient systems for irrigating agricultural land, to finding new biological control agents for invasive insects and weeds. The ARS Office of International Research Engagement and Cooperation (OIREC) supports these research partnerships by creating and facilitating international scientific networks, managing programs with international scientific collaborators, representing ARS in internationally focused working groups and committees, and providing support as needed when scientists implement their research projects.

This report contains an overview of international projects in FY 2020 for which OIREC provides direct support, binational and international cooperation, interdepartmental cooperation, an update on the overseas biological control laboratories (OBCLs) and their latest research, and achievements toward the OIREC 2020–2025 strategy for enhancing agricultural research.

## OIREC Team Working Virtually In FY 2020

# Abbreviations and Acronyms

| | |
|---|---|
| ABCL | Australian Biological Control Laboratory |
| APHIS | Animal and Plant Health Inspection Service |
| ARS | Agricultural Research Service |
| BARD | U.S.-Israel Binational Agricultural Research Fund |
| BPC | Bovine Pangenome Consortium |
| CGIAR | Consultative Group for International Agricultural Research |
| CIMMYT | International Maize and Wheat Improvement Center |
| CLCuV | Cotton leaf curl virus |
| CPEP | U.S.-Pakistan Cotton Productivity Enhancement Program |
| EBCL | European Biological Control Laboratory |
| ECDC | European Centre for Disease Prevention and Control |
| ECF | East coast fever |
| EFSA | European Food Safety Authority |
| FAS | Foreign Agricultural Service |
| FY | Fiscal year |
| I&E | Inform & Engage webinar |
| ICARDA | International Center for Agriculture Research in the Dry Areas |
| IEC | ARS International Engagement Council |
| IIBBL | Invasive Insect Biocontrol and Behavior Laboratory |
| IICA | Inter-American Institute for Cooperation on Agriculture |
| INIFAP | National Institute of Forestry, Agriculture and Livestock (Mexico) |
| IRD | OBCL International Research Detail |
| NAL | National Agricultural Library |
| NPRA | National Program Retrospective Assessment |
| OBCL | Overseas Biological Control Laboratory |
| ODEO | ARS Office of Outreach, Diversity, and Equal Opportunity |
| OIREC | Office of International Research Engagement and Cooperation |
| ONP | Office of National Programs |
| OSQR | Office of Scientific Quality Review |
| OTT | Office of Technology Transfer |
| PPPR | Project Plan Peer Review |
| RAVL | RDA-ARS Virtual Laboratory |
| RDA | Rural Development Administration (South Korea) |
| RLAC | Research Leaders Advisory Council |
| RNAi | RNA interference (a form of gene silencing) |
| S&T | science and technology |
| Sino-ABCL | Sino-American Biological Control Laboratory |
| STEM | science, technology, engineering, mathematics |
| TCA | tawny crazy ant |
| USAID | U.S. Agency for International Development |
| WPEP | U.S.-Pakistan Wheat Productivity Enhancement Program |

# OIREC Programs and Collaboration

## ARS International Engagement Council

In FY 2020, OIREC established the ARS International Engagement Council (IEC) to facilitate and support cross-agency coordination and collaboration among ARS scientists and units on international issues and to advise the Administrator and associate administrators on priorities and policies affecting ARS international collaborations. Under the leadership of the OIREC Director as chairperson, the IEC functions to:

1. Facilitate analysis, discussion, and coordination of international engagement issues to improve efficiency and effectiveness.

2. Disseminate information, guidelines, and best practices about international collaboration to ARS.

3. Provide feedback on government policies that may affect ARS' international collaborations.

4. Ensure that implementation of new Government policies and regulations affecting international collaboration is responsive to the mission of ARS and the needs of ARS locations.

5. Advise ARS senior leadership about the opportunities and challenges involved in international engagements at the local, regional, and national levels of ARS.

ARS employees can learn more about the ARS IEC and its membership on the OIREC Axon page.

## Champion Scientists' Virtual Mini-Summit on ARS International Engagement

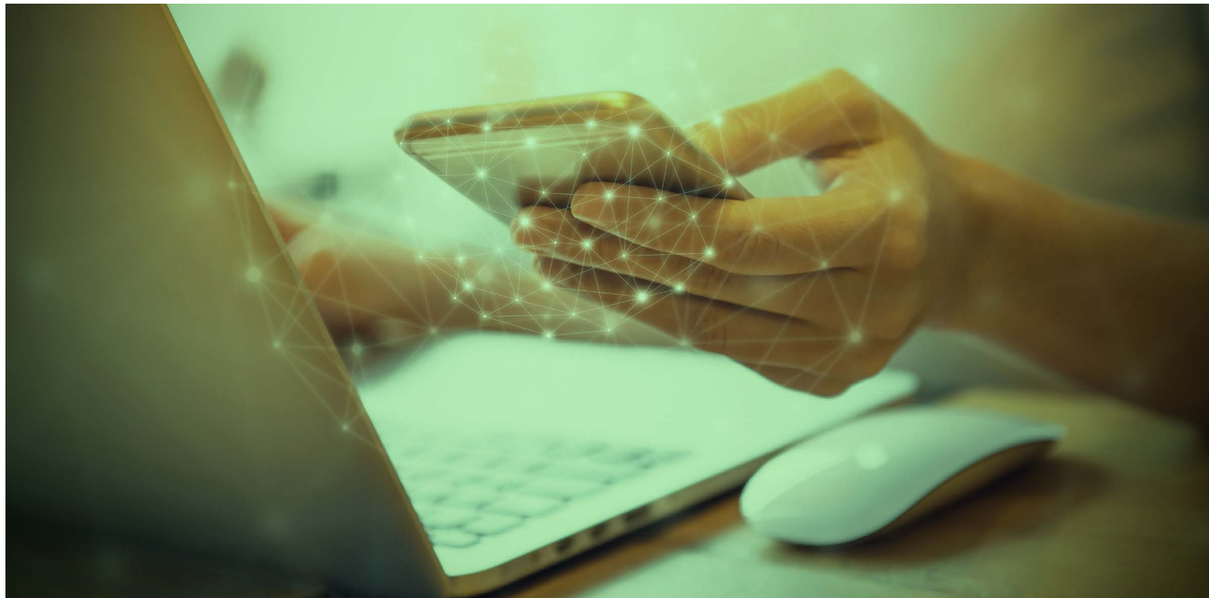
On August 26, 2020, OIREC hosted an "OIREC Champion Scientists' Virtual Mini-Summit on ARS International Engagement." OIREC identified 12 ARS research scientists, with representation from each Area, as our champions because of their continued partnership, advocacy, and help as OIREC developed the recently released OIREC multiyear strategy for FY 2020 through FY 2025. OIREC met with these champions to specify multiyear strategy topics the scientists expressed interest in discussing further, and exciting new ideas proposed by the scientists when they submitted their comments on the proposed strategy. OIREC will leverage the IEC (discussed in the adjacent paragraph) to explore and advance viable recommendations.

## Enhancing Collaboration with USDA Foreign Agricultural Service Foreign Service Officers

The Foreign Agricultural Service links U.S. agriculture to the world to enhance export and global food security. Foreign service officers are posted across the globe, and are the front-line professionals representing USDA as diplomats in 93 U.S. missions covering 171 countries. Foreign service officers are critical to ARS international engagement. Since 2017, OIREC has partnered with the FAS Office of Foreign Affairs to promote awareness of ARS research at FAS and among foreign service officers. This outreach has included providing training seminars for foreign service trainees to speak about ARS and the role that OIREC plays in it. In 2020, OIREC teamed up with the National Agricultural Library (NAL) to organize a virtual presentation for a group of trainees. Members of the group learned about ARS research and resources, about NAL, its database and digital research tools, and ways that ARS and FAS can work together overseas.

## Webinar on Cross-Cultural Communication

OIREC partnered with the ARS Office of Outreach, Diversity, and Equal Opportunity (ODEO) and the ARS Research Leaders Advisory Council (RLAC) to promote awareness of cross-cultural communication and the importance of cultural sensitivity. The result was a webinar on cross-cultural communication conducted as part of the ARS Inform & Engage (I&E) webinar Stay at Home specials. The webinar provided best practices to effectively engage with international colleagues, while focusing on cultural sensitivity.



# OIREC Supported Projects and Activities

## Whitefly Management in Cassava and World Food Crops

The whitefly, *Bemisia tabaci*, impacts food security globally and transmits hundreds of plant viruses to economically important crops, including cassava mosaic disease and cassava brown streak disease, resulting in yield losses across Africa of almost 50 percent, equivalent to more than $1 billion annually, and impacting the livelihoods of hundreds of millions of people. A team of ARS scientists from Salinas, California; Charleston, South Carolina; Fort Pierce, Florida; the Boyce Thompson Institute (Ithaca, New York); and the International Institute for Tropical Agriculture (Dar es Salaam, Tanzania and Nairobi, Kenya); are working together to develop and implement a novel biotechnology approach (RNA interference or RNAi) to control whitefly populations and to reduce virus transmission rates in the field.

Products using this RNAi (gene silencing) technology were developed and a patent application was filed in 2019 for use as a sprayable application or incorporated into transgenic plants. A genetic marker system was completed and published in FY 2020 that reliably distinguishes different cassava-colonizing whitefly populations from one another. This system will assist scientists in monitoring population changes that may influence virus transmission and cassava production. These products and resources will support farmers throughout Africa, the United States, and other parts of the world by reducing whitefly populations and associated spread of whitefly-transmitted viruses on many economically important crops, including cassava and tomato. This will benefit cassava production in Africa, South America, and elsewhere, and production of vegetables and other crops in the United States and globally.

## Desert Locust

Desert locusts are considered the most destructive migratory pests in the world. Hundreds of thousands of hectares, including cropland and pasture, have been affected. This project has been proposed in response to the ongoing desert locust crisis that affected the Greater Horn of Africa earlier in 2020.

ARS scientists were granted $50,000 to develop the first phase of the project "Establishing Critical Genomic Infrastructure to Manage Desert Locust Outbreaks in Africa." The funding comes from an interagency collaboration between the U.S. Agency for International Development (USAID) Africa Bureau and the USDA Foreign Agricultural Service (FAS) Office of Global Programs. The project's main objective is to provide the scientific community with necessary fundamental infrastructure to produce novel solutions for locust control. Phase I aims to sequence the genome and transcriptome (gene atlas) of the desert locust.

## East Coast Fever

East coast fever (ECF), caused by *Theileria parva*, a relative of organisms that cause malaria, is transmitted via ticks, and leads to severe economic hardship for pastoral farmers in East Africa. Economic losses occur primarily from illness and death in cattle. The primary stakeholders for this project are pastoral farmers in East Africa. Partners are the International Livestock Research Institute (Nairobi), the Roslin Institute at the University of Edinburgh, University of Parma, Italy, and medical schools at the universities of Maryland and Washington.

In FY 2020, a bovine herpesvirus-4 construct to immunize cattle containing *T. Parva* 67 was developed to support protection from ECF. A minigene vaccine platform containing *T. parva* antigens p67 and Tp9 was generated, allowing scientists to test many parts from complex pathogens to discover which parts are necessary to stimulate the protective systems of animals and humans. A flow-cytometry assay was developed to predict the vaccine's success more accurately.

These collective accomplishments are leading to a vaccine for the economically devastating ECF, leading to methods to measure vaccine efficacy without the need for lethal challenge, and providing for the desperately needed infectious disease scientists to solve ongoing and new infectious disease challenges to global animal health.

## Goat Improvement

The USDA-USAID Livestock Improvement Project aims to enhance genetic gains made in local goat populations. Project scientists led development of a new model to construct high-quality reference genomes at a fraction of the cost along with enhanced DNA tools, both of which hold promise for American goat producers. The project's DNA sample bank underpins all aspects of goat research, allowing researchers to identify traits deemed desirable, such as increased weight and milk production. American farmers can use that information to design a program that will help them produce resilient and productive goats and improve their economic bottom line. Project researchers also developed software to predict a goat's body weight by analyzing color images of goats taken by cellphone. Animal weight is critical in monitoring animal health and growth and for marketing live animals. In Africa, the project created community-based breeding programs and the African Goat Improvement Network, a collection of nearly 70 representatives from more than 20 countries, to ensure the continual improvement of local goats.



## Bovine Pangenome Consortium

ARS scientists have initiated an international effort to identify all the genes found among cattle breeds currently in existence around the world. The effort, called the Bovine Pangenome Consortium (BPC), is based on recent discoveries that suggest a substantial number of genes or genome segments that exist in cattle may not be present in the current, Hereford breed–based, reference genome assembly. Some of those genes may be important to productivity, longevity, and sustainability of cattle production. The global BPC partnership aims to produce reference-quality genome assemblies of breeds from a broad spectrum of environments as well as breeds specialized for dairy and beef products, with the aim of identifying all genes and breed-specific variants of genes. The data will aid in conservation efforts for rare or endangered cattle breeds that may carry genetic traits that are difficult to replace, help to maintain biodiversity within the species, and shed light on the effects of domestication and selection for specific uses or environments. Ultimately, these research results will translate into functional improvements that can greatly increase the rate of genetic improvement of cattle and ensure that producers remain competitive in a changing global environment.

## U.S.-Pakistan Wheat Productivity Enhancement Program (WPEP)

WPEP was initiated in 2011, and since then, USAID has provided funds to FAS and ARS through which WPEP is able to conduct cooperative U.S.-Pakistan research to identify, adopt, and establish optimal agronomic management techniques for new, high-yielding, and disease-resistant wheat varieties, with particular attention to wheat rusts. OIREC provides programmatic support for WPEP and maintains a cooperative agreement with the International Maize and Wheat Improvement Center (CIMMYT), a CGIAR (Consultative Group for International Agricultural Research) center, to provide scientific expertise and on-the-ground project management in Pakistan. Through WPEP, the wheat breeding and pathology programs in Pakistan have been re-established. In FY 2020, rust surveillance work continued during the wheat growing season, without any detection of Ug99 stem rust. Due to WPEP, wheat breeding efforts have brought together genotypic and phenotypic evaluation of experimental lines and promising varieties, resulting in stopping the eastern spread of Ug99 wheat stem rust to massive wheat growing areas. Through WPEP, 50 new wheat varieties were released for production. These new, high-yielding, disease-resistant varieties will enable the farmers in Pakistan to produce more wheat per acre.

# Bilateral and Multilateral Partnerships

## U.S.-Pakistan Cotton Productivity Enhancement Program (CPEP)

Initiated in 2011, USAID has provided funds to FAS and ARS for the CPEP to conduct collaborative research on cotton leaf curl virus (CLCuV) in Pakistan, with the objective of mitigating the threat that CLCuV poses to international economic and food security. OIREC provides programmatic support for CPEP. ARS researchers from Stoneville, Mississippi, have partnered with the International Center for Agriculture Research in the Dry Areas (ICARDA), which is administered by CGIAR, to work with scientists, farmers, government agencies, and other stakeholders in Pakistan on this initiative, which has successfully contained CLCuV in Pakistan. New resistant cotton lines have been developed and should be available for farmers in 2021. In addition, CPEP expanded the Farmer Field School program and worked with local organizations to establish separate schools for women and ensure they are sustainable. ARS also developed a new cooperative seed-exchange project with Embrapa (Brazil), and Embrapa scientists are working with colleagues in the United States and Pakistan to develop CLCuV-resistant lines using a second source of resistance that originally comes from Brazil.

## U.S.-Israel Binational Agricultural Research Fund (BARD)

The primary mission of BARD is to bring together U.S. and Israeli scientists to jointly address key agricultural challenges that concern both countries. Most BARD-funded research projects focus on increasing agricultural productivity, particularly in hot and arid climates, and emphasizing plant and animal health, food quality and safety, and environmental issues.

As a member of the BARD Board of Directors, ARS Administrator Dr. Chavonda Jacobs-Young participates each summer in the board's annual meeting. Her role is supported by the OIREC Director, who also participates in the annual meetings. These meetings serve as the third and final round of evaluations for that year's BARD proposals when finalists are chosen for funding and to determine the priority areas of collaboration for the next year's funding cycle. The board met (virtually) in June 2020 and reviewed preliminary findings for BARD's 40-year review, discussed strengthening BARD's impact by partnering with other U.S.-Israel funding programs, and planned fellowships and workshops for FY 2021.

At the culmination of 40 years of activity, the BARD Board of Directors appointed a committee to oversee an external review that would assess past and present impacts on binational American-Israeli agricultural research. To date, the 1,330 awards funded by BARD have generated more than 5,600 published manuscripts. These were an outcome of approximately 925 projects, which yielded an average of 6.1 publications per project. Thirteen percent of projects funded by BARD over this time had an ARS scientist who served as principal investigator.

## Rural Development Administration/RAVL

The Rural Development Administration (RDA) and ARS signed a memorandum of understanding in 2009 establishing the RDA-ARS Virtual Laboratory (RAVL) that has since been managed by OIREC. RAVL has promoted several joint research programs and facilitated the exchange of South Korean and U.S. scientists. In 2020, ARS and the RDA had seven active research RAVL collaborations in the areas of food safety, crop protection using biological control, integrated pest management, crop and vegetable production, molecular biology, animal health and animal production, and genomes.

In February 2020, RDA visiting scientist Dr. Bongnam Chung completed her 2-year program coordinator term with OIREC and returned to South Korea. RDA research scientist Dr. Sukyoung Hong was appointed to serve as the RDA RAVL coordinator for 2020–2022 to help facilitate ongoing and novel ARS-RDA research collaborations with OIREC. In addition to her role as coordinator, Dr. Hong will also conduct her own collaborative research, "A Study on Digital Agriculture for Sustainable Agricultural Systems." Due to the onset of the coronavirus pandemic, Dr. Hong was unable to travel to the United States this year but has been successful in filling the coordinator position remotely from Korea. Dr. Hong is expected to join OIREC in person in 2021.

## Procinorte

### Board of Directors Meeting

OIREC supported the participation of ARS Associate Administrator for Research Programs Dr. Steven Kappes in the 21st Procinorte Board of Directors meeting, hosted by the Inter-American Institute for Cooperation on Agriculture (IICA) in San José, Costa Rica. Procinorte is a trilateral (Canada, Mexico, United States) arrangement hosted by IICA that coordinates a joint research agenda in plant health, animal health, genetic resources, and fruit quality. Each year the board of directors reviews the progress of the task forces and agrees upon actions for the coming year.

ARS has been the U.S. representative to Procinorte since 2008 alongside Federal counterparts National Institute of Forestry, Agriculture and Livestock (INIFAP) in Mexico, and the Agriculture and Agri-Food Canada-Science and Technology Branch, with an executive secretariat provided by IICA. In addition to research cooperation with our border-sharing neighbors, the trilateral relationship has fostered interinstitutional relationships that would not be possible if we did not have a forum through which to meet.

### Fruit Quality Task Force

The fruit quality task force concluded its long-term project that resulted in the Mexican Haas avocado industry moving to a new maturity standard based upon research conducted by the members that used a commercially available sensor that was modified to produce rapid, reliable, repeatable measurements to inform harvest rather than traditional standards that relied upon slow, destructive, laboratory-based procedures.

### Plant Health Task Force

In FY 20, through the plant health task force, ARS led a one-day international webinar on a tomato virus that affects production and trade in all three countries. The webinar was attended by more than 350 people from 23 different countries.

## Embrapa/LABEX

Building on the original ideals of leading-edge collaboration topics under Labex, our researchers are considering future research agendas in digital transformation in agriculture, from big data to precision agriculture and advanced biology. After 22 years, the ARS-Labex relationship has evolved from one of purely research collaboration to a point at which we can now share insight on management of large science agencies. Given the similarities in size and budget between ARS and Embrapa, and our roles as public sector agricultural research agencies, we have identified additional opportunities to learn from each other in areas such as strategic planning, priority setting, and scientific communication. Labex is in the process of transitioning from a long period in-residence model in which Embrapa researchers might work 2 to 4 years inside an ARS research unit, to a more flexible model in which paired researchers meet once or twice a year for a few weeks or months to develop, plan, review progress, and conduct field work, then return home to collaborate remotely, or continue to work onsite for longer periods similar to a traditional Labex project.

# Overseas Biological Control Laboratories (OBCLs)

ARS owns and operates a research laboratory in France, with a satellite location in Greece, and also has close overseas cooperative research collaborations with scientists in Argentina, Australia, and China. The main focus of these four collaborations has historically been on biological control of invasive weed and insect pests. The European Biological Control Laboratory (EBCL) near Montpellier, France, is the largest overseas facility and is the only research facility constructed and owned by the U.S. Government. Overseas labs are strategically placed in regions of the world that contain the native host range of the most damaging pests to U.S. agriculture. The labs provide a continuous research infrastructure, regional experts, and research sites where scientists can identify and work with native predators, herbivores, or pathogens which can be used for biological control of the invasive pests without risking introduction to the United States.

## OBCL Stakeholder Meeting

OIREC, in coordination with the ARS Office of National Programs (ONP), held the first OBCL stakeholder workshop in Beltsville, Maryland, on January 14, 2020. Nearly 50 people attended, and represented were Federal agencies, State departments of agriculture, universities, conservancy groups, private industries, and private citizens. The overall workshop goal was to prioritize research needs and raise stakeholder awareness of the expertise and services the OBCLs can provide. Each overseas laboratory director made a presentation on their facilities and projects, and stateside collaborators discussed the value the laboratories lend to their research programs. Due to stagnant budgets, inflation, currency exchange fluctuations, and rising salaries, the purchasing power of the laboratories is decreasing. Therefore, to maintain desired services, functions, and collaborations, a comprehensive strategy is needed to best take advantage of these valuable facilities and opportunities.

## Office of Scientific Quality Review (OSQR) Peer Review for OBCLs

In FY 2020, OIREC partnered with the Office of Scientific Quality Review (OSQR) and national program leaders in ONP to facilitate and oversee successful administration of the OBCL project plan peer review process. All OBCL locations submitted project plans that were peer reviewed, ensuring that ARS research conducted through these OBCL partnerships meets the same level of scientific rigor as the work performed in ARS locations in the United States. OIREC, ONP, and OSQR agreed on a process for incorporating the three overseas locations (Argentina, Australia, and China) managed through cooperative agreements in the OSQR peer review process in FY 2019.

## About OSQR

OSQR is a congressionally mandated entity, independent and objective within ARS, tasked with ensuring the highest scientific quality for the agency's people, projects, and programs. To this end, OSQR administers three different programs with scope ranging from ensuring accurate classification of ARS scientific positions through the Research Position Evaluation System, to overseeing the external review of all ARS-funded scientific project plans via Project Plan Peer Review (PPPR), and coordinating the retrospective evaluation of all ARS national programs using the National Program Retrospective Assessment (NPRA). To fulfill its mission, OSQR enlists the expertise of the global scientific community. Internationally recognized scientists from various research areas are invited to participate in the PPPR and the NPRA processes as external reviewers to ensure that OSQR offers diversity and perspective in the overall evaluation of scientific quality within the agency.



*During FY 2019–2020, 45 international individuals have participated in the review of ARS projects and programs by serving on review panels for PPPR and NPRA.*

## OBCL International Research Detail Opportunity

OIREC planned to implement a new pilot program in FY 2020, the OBCL International Research Detail (IRD), which would allow OBCL scientists to visit an ARS location for 2 to 4 weeks and partner with ARS host scientists to establish or advance a new or ongoing project that is relevant to both the OBCL and the ARS host scientist's main project plan. The IRD pilot program is currently on hold due to the pandemic.




# European Biological Control Laboratory (EBCL)

## EBCL Director Transition

Dr. Mike Grodowitz began his term as EBCL Director in August 2020. Before that, Dr. Grodowitz served as the Supervisory Entomologist/Research Leader of the ARS Biological Control of Pests Research Unit in Stoneville, Mississippi. The previous EBCL Director, Dr. Dawn Gundersen-Rindal, returned to her position as research leader of the ARS Invasive Insect Biocontrol and Behavior Laboratory (IIBBL) in Beltsville, Maryland. Dr. Gundersen-Rindal's 2-year tenure at EBCL yielded the development and initiation of seven new collaborative projects in FY 2020 between EBCL and IIBBL related to solving both agricultural and biting arthropod pest problems of significance to the United States.

## EBCL Sabbatical Program

The EBCL Sabbatical Program allows highly qualified ARS scientists to conduct research at either the Montpellier, France, or Thessaloniki, Greece, location for 3 to 12 months to conduct and advance research relevant to both EBCL and the applicant's main project plan. Dr. Michelle Heck, Research Molecular Biologist with the ARS Emerging Pests and Pathogens Research Unit in Ithaca, New York, was selected for a sabbatical at the EBCL in 2020. Her research plan was to focus on insect-vectored plant prokaryotes and RNAi. Unfortunately, Dr. Heck's sabbatical was postponed due to international travel restrictions and other COVID-19 precautions.

## Headquarters Early Career Research Scientist of the Year

In April 2020, Dr. Alexandra Chaskopoulou was recognized as the ARS Headquarters Early Career Research Scientist of the Year. Based at the EBCL satellite location in Thessaloniki, Greece, she was recognized as a worldwide expert on arthropod vector control, disease prevention, and integrated pest management. During 5 years of research for USDA in the management of insect vectors and disease prevention, Dr. Chaskopoulou has developed and been recognized for novel research on vector surveillance and vector management with major impact on science and technology. Her research has resulted in the development of useful tools that have been applied well beyond the laboratory bench and have provided solutions to specific significant problems in public health. A key example of this is her work on management of West Nile virus, an important mosquito-borne disease. Dr. Chaskopoulou's research resulted in both the registration of a novel product for the management of West Nile virus vectors in Greece and the United States, and the development of an early warning surveillance system for detection of the virus at the early stage of circulation.

## Research Accomplishments

Notable research accomplishments by the EBCL in FY 2020 include the following:

- Olive fruit fly: In 2019–2020, a study was conducted to investigate the effects of mass rearing on the host specificity and efficiency of the parasitoid *Psyttalia ponerophaga*, a prospective biological control agent of the olive fruit fly *Bactrocera oleae*. This parasitoid has been reared for a number of years (>75 generations) at EBCL on an alternative host, the medfly *Ceratitis capitata*, which could have potentially impacted its biology and behavior. Results showed that field-caught and laboratory-reared parasitoids had the same level of specificity when presented with nontarget fly species and that the wild *P. ponerophaga* population was only slightly more efficient at attacking *B. oleae* in olives. These results validate the rearing method used at EBCL to rear olive fruit fly parasitoids.

- EBCL and the VectorNet Consortium: VectorNet, a European consortium of experts in medical and veterinary entomology, is a joint initiative of the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC), which started in May 2014, and is now in its second iteration (2019–2023). VectorNet provides scientific support to ECDC and EFSA for their assessments on vectors and vector-borne disease risk, prevention, and control. The EBCL entered into an agreement with the VectorNet consortium to perform a comprehensive literature review on vector control practices and strategies against West Nile virus vectors. Under the umbrella of VectorNet a comprehensive technical report on vector control strategies for West Nile virus has been produced by Dr. Alexandra Chaskopoulou (EBCL) in collaboration with VectorNet coordinators Dr. Marietta Braks and Dr. Wim van Bortel and under the technical guidance of ECDC and EFSA.

The report collated information on West Nile virus vector management experiences across the world under specific operational contexts and identified gaps in knowledge and capacities relating to effective West Nile virus vector management practices. Information produced by this report will be of use to European Union and U.S. public health/vector control authorities and operators. The report was published in November 2020 and is available online at https://www.ecdc.europa.eu/en/publications-data/vector-control-practices-and-strategies-against-west-nile-virus

- Bagrada bug *(Bagrada hilaris)*: The parasitism behavior of an egg parasitoid *(Gryon gonikopalense)* has been elucidated, showing a highly adapted foraging to belowground Bagrada eggs, opening possibilities for a future agent to control this invasive stinkbug that negatively impacts many Brassica vegetable crops (cabbage, cauliflower, broccoli, etc.) in the United States.

- New research plans: The EBCL has produced two new research plans emphasizing environmentally friendly management of invasive weeds and arthropod pests for which classical biological control and vector control as regards to blood feeding arthropods are two major components. Research involves identifying insects or mites that attack the target pest or weed in its land of origin. Prospective agents will be characterized morphologically, genetically, and biologically, and their degree of specificity toward the target pest or weed will be assessed before shipment to U.S. cooperators. Research proposed in these two research plans includes new priority targets such as the tree of heaven *(Ailanthus)*, Sahara mustard grass, and the spotted lanternfly, and incorporates the most advanced tools in chemical ecology, microbiomics, and genomics that shall improve the predictability and safety of the agent. These two new research plans are very well regarded by the reviewers and established the road map for the next 5 years of research and service at EBCL.



# Sino-American Biological Control Laboratory (Sino-ABCL)

The Sino-ABCL, a cooperative agreement between ARS and the Chinese Academy of Agricultural Sciences, is based in the Institute of Plant Protection in Beijing. The objective of the laboratory is to search for, identify, and evaluate the potential of natural enemies of pest insects, weeds, and plant diseases that affect U.S. agriculture. High-priority pests being studied include Roseau cane scale, citrus psyllid, and brown marmorated stink bug. These pests currently are major concerns to U.S. agriculture and the environment and have resulted in billions of dollars of loss.

## Research Accomplishments

Notable research accomplishments by the Sino-ABCL in FY 2020 include the following:

- Determining the distribution and natural enemy complex of the Roseau cane scale in China. Heavy populations of Roseau cane scale led to widespread dieback and thinning of the stands of Roseau cane in the lower Mississippi River Delta in recent years. In 2020, Sino-ABCL researchers continued to determine the distribution and natural enemy complex of the Roseau cane scale in China, and found four parasitoid species in Beijing, Guangzhou, and Yunnan. One of the parasitoid species that has been recovered has tentatively been identified as *Platencyrtus parkeri* (a wasp in the Encyrtidae family). To date, this parasitoid species has only been found in China, where it is highly abundant in Beijing.

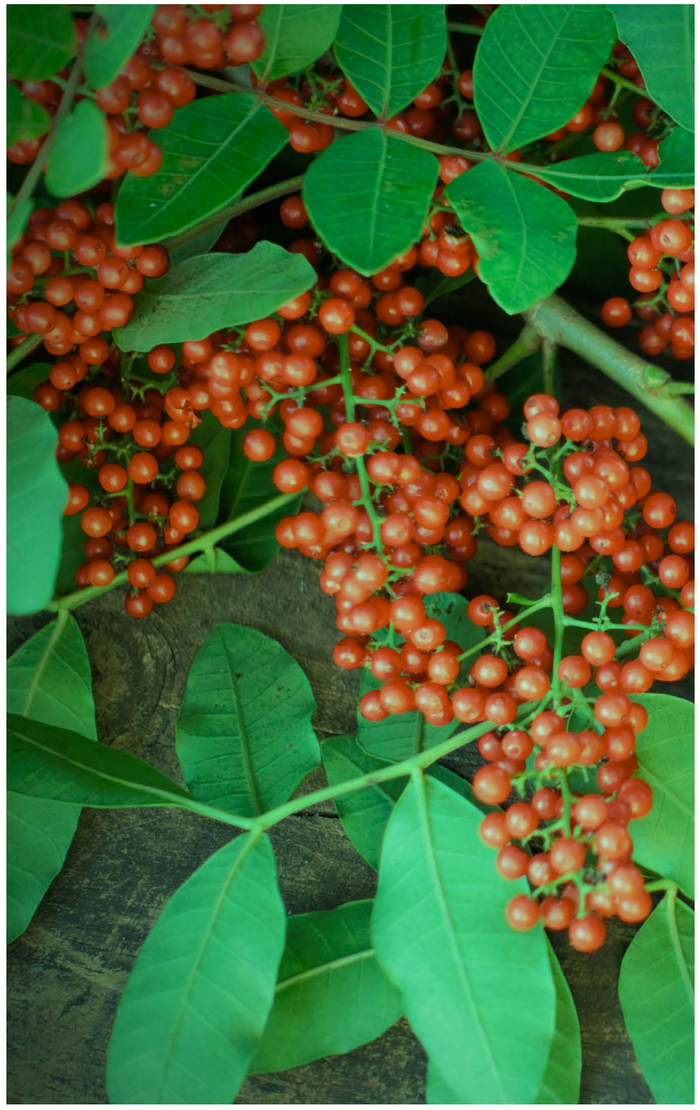
- Sino-ABCL scientists identified citrus insect biodiversity by DNA metabarcoding and combining it with two cloud-based data storage and analysis platforms, BOLD and mBRAVE. The scientists found more than 1,300 bins that correspond to insects at the species level. In addition, some insect species, which were not reported before in citrus planting areas in China, have been identified by DNA metabarcoding in the current study.

- Predatory and herbivorous stink bugs share an ancestral phospholipase C gene of bacterial origin. Salivary gland secretome analysis reveals a novel mechanism of horizontal gene transfer in a predatory bug *(Arma chinensis)* and an herbivorous stink bug *(Halyomorpha halys)*. From the salivary gland secretome of these two bugs, scientists identified phospholipase C genes with bacterial homology, possibly gained by the insect through horizontal gene transfer.

# Foundation for the Study of Invasive Species (FuEDEI)

In Argentina, ARS partners with FuEDEI, which was established in 2012 with the support of the Ministry of Agriculture, Livestock, and Fisheries of Argentina. FuEDEI replaced the South American Biological Control Laboratory, which had 50 years of experience in classical biological control. FuEDEI carries out entomological, botanical, ecological, taxonomic, and genetic studies in order to develop classical biological control strategies that are sustainable and beneficial to agriculture and to the environment. FuEDEI has extensive and well-equipped facilities, and fully equipped vehicles for field trips. FuEDEI maintains a collection of 6,000 insects and 2,300 plants on site.

High-priority invasive weeds being studied include water hyacinth, Brazilian peppertree, water primrose, and giant Salvinia, among others. High-priority pests include imported fire ants, little fire ant, tawny crazy ant, cactus moth, and cactus mealybug.



## Research Accomplishments

Notable research accomplishments by FuEDEI in FY 2020 included the following

- Brazilian pepper tree *(Schinus terebinthifolia)*: Brazilian pepper tree is a highly invasive woody weed that displaces native vegetation and can form dense thickets. It is primarily in Florida, but has spread to Hawaii, Texas, California, and other states. A new species of sawfly, named *Heteroperreya kava*, was discovered in Brazil by ARS and FuEDEI scientists. A close species studied previously, H. hubrichi, has a restricted host range, but was discarded for fear that it might be toxic to predators. Yet, recent studies revealed that the cytotoxic peptides occurred at lower concentrations compared with purportedly toxic species of the family, so this species is being reconsidered as a biological control agent for *S. terebinthifolia*.

- Harrisia cactus mealybug *(Hypogeococcus pungens complex)*: Laboratory host specificity tests were performed with parasitoids *Anagyrus cachamai* and *A. lapachosus* on five populations of mealybugs of the same genus. Two species of mealybugs from other genera were included in the test. Results indicated that both parasitoid species are restricted to the cacti pest genus, *Hypogeococcus*. This suggests that the parasitoids, which have already been introduced in quarantine in Puerto Rico, could be safe for release on the island.

- Giant Salvinia *(Salvinia molesta)*: The aquatic weevil *Cyrtobagous salviniae* (Coleoptera: Curculionidae) is an effective natural enemy of *Salvinia*. However, the plant is invading more temperate areas with harsher winters in the United States where the weevil introduced in the United States cannot overwinter. The weevil *Tanysphiroideus parvulus* was found in temperate, southern populations of *Salvinia* in Argentina, opening possibilities to find a new, cold-resistant biocontrol agent to control this invasive weed that produces dense mats over still waters.

- Tawny crazy ant (TCA; *Nylanderia fulva*): Extensive nest sampling throughout Argentina, followed by molecular analyses, indicate the existence of at least three different *Nylanderia* species, suggesting TCA comprises a putative species complex. Within the TCA group, one lineage is closely related to the invasive populations established in the United States, and one to two other lineages are clearly distinct haplotypes. These three TCA groups do not differ in nesting type, behavior, or morphology. Studies will be extended to the decapitating flies that attack this species complex, to determine whether only one or more species infect all TCA groups.

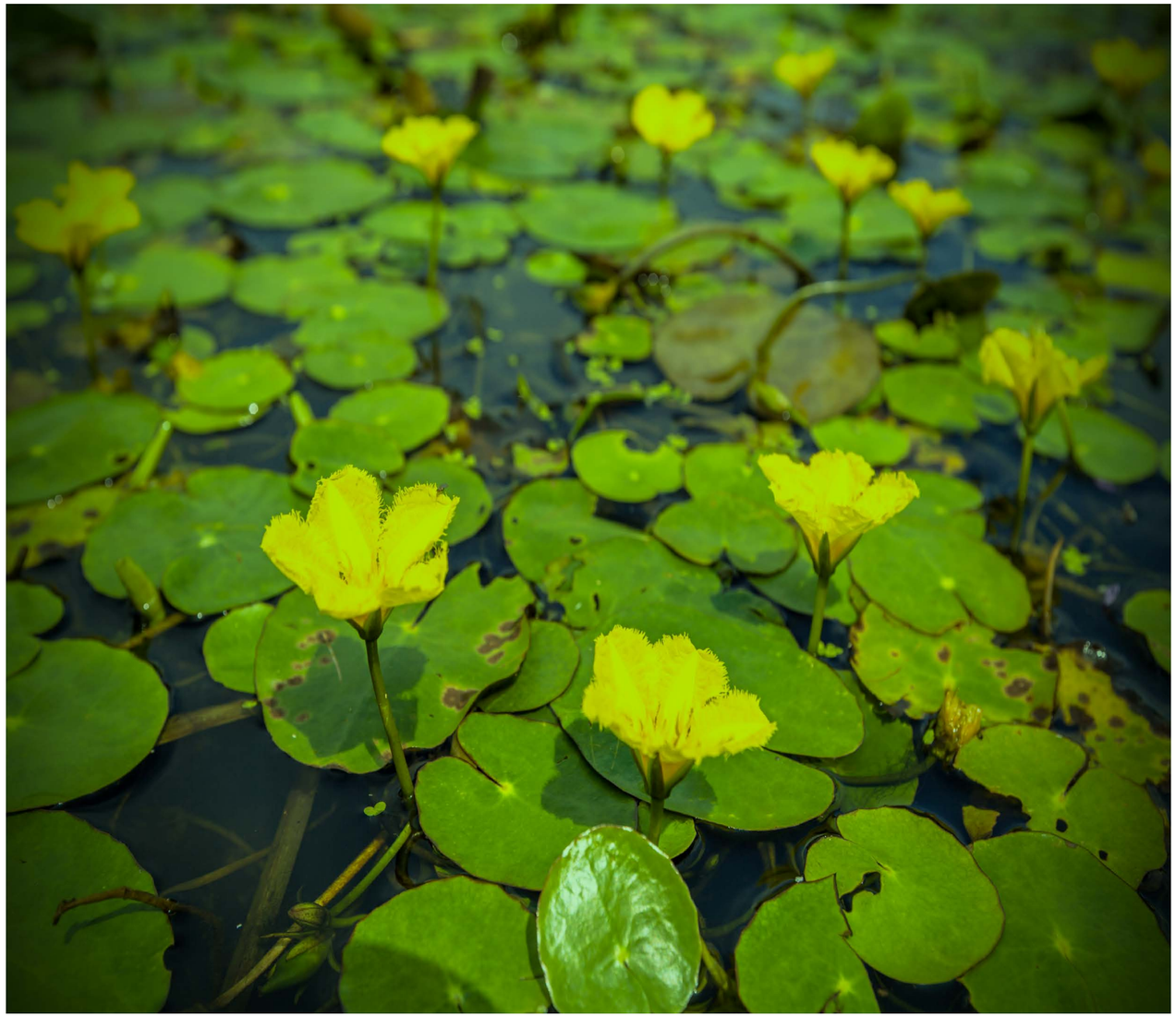
- Water primrose *(Ludwigia hexapetala)*: Studies on a very damaging flea beetle *(Lysathia sp.)* are devoted to clarifying the identity of the species. This beetle had been discarded in the past because it had been reported to attack both water primrose and parrot feather. New morphological and molecular evidence suggest that there is more than one species involved, suggesting it could be a suitable biocontrol agent for the temperate climates of California and Europe.

- Cactus moth *(Cactoblastis cactorum)*: A native parasitoid, *Goniozus legneri*, is being evaluated in laboratory and semi-field experiments. This parasitoid is used in inundative biocontrol programs against pome fruit pests in Argentina. *G. legneri* showed a combined effect on the host moth larvae, mainly by killing them through paralysis and feeding on their lymph, as well as parasitizing them. Both effects markedly decreased the feeding activity of *C. cactorum* larvae, indicating this parasitoid could serve as a control method through inundative releases.

## Australian Biological Control Laboratory (ABCL)

ARS has partnered with the Commonwealth Scientific and Industrial Research Organisation in Australia for more than 30 years. The aim of ABCL is to explore Australia and Asia for natural enemies, including microorganisms, of invasive weeds and arthropods, by performing collections; imports and exports in compliance with local and international regulations; taxonomic and phylogenetic studies; and identifying the biological and physical parameters that affect the efficacy and safety of potential agents (climatic conditions, host specificity, effective rearing conditions, biogeography).

High-priority weeds include a climbing fern *(Lygodium microphyllum)* and ear leaf acacia *(Acacia auriculiformis)*, and the aquatic weeds Hydrilla *(Hydrilla verticillate)*, yellow floating heart *(Nymphoides peltata)*, crested floating heart *(Nymphoides cristata)*, mosquito fern *(Azolla pinnata)*, and water strangler *(Rotala rotundifolia)*. Many of these plants are becoming invasive weeds in Florida and other parts of the United States.



### Research Accomplishments

Notable research accomplishments by the ABCL in FY 2020 include the following:

- Climbing fern *(Lygodium microphyllum)*: Climbing fern is highly invasive, particularly in Florida where it covers and smothers native vegetation, reduces biodiversity, promotes wildfires, and destroys wildlife habitat. Biological control agents discovered by ABCL, a defoliating moth, *Neomusotima conspurcatalis* and a gall forming mite, *Floracarus perrepae*, are affecting this invasive fern but further control is required. Promising agents discovered by ABCL staff and under evaluation in Florida quarantine include the defoliating moths *Lygomusotima stria*, from Singapore and Thailand; and *Callopistria exotica* from Hong Kong; as well as a defoliating sawfly, Neostrombocerus albicomus, recollected in Thailand in December 2019.

- Earleaf Acacia *(Acacia auriculiformis)*: Biological control agents are urgently needed to control this ornamental shade tree that is invading natural areas in Florida. The tree is native to Australia and parts of southeast Asia, and intensive surveys in Queensland

and the Northern Territory discovered several promising insects that may serve as biological control agents. Testing of the herbivorous beetle *Calomela intemerata* is nearing completion in Florida quarantine, whereas a gall-forming wasp, *Trichilogaster* sp. nov., is proving to be host specific and highly damaging to earleaf Acacia in testing after being colonized at the ABCL in Brisbane.

- Mosquito fern *(Azolla pinnata)*: Mosquito fern is a serious floating aquatic weed in Florida. Surveys were conducted over a 3,000-km range in Australia from north Queensland to southern Victoria. The weevil, *Bagous clarenciensis*, completely destroys *A. pinnata* at field sites and this beetle was evaluated by ABCL for use as a biological control agent. Its narrow field and laboratory host range is being assessed; more specifically its performance on *A. filiculoides*, an American native close relative of *A. pinnata*.

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