Advancing U.S. Agriculture through Global Engagement

National Institute of Food and Agriculture (NIFA) grantees are including international activities as an effective way to help achieve research, education, and extension objectives important to U.S. agriculture. Only U.S. institutions can apply for NIFA grants, and any international activities must advance U.S. agriculture. The NIFA-funded projects described here are examples of how U.S. researchers and faculty through international collaborations and activities are achieving results to help promote U.S. agriculture, advance trade, serve U.S. food security and food safety needs, and address mutual interests in the global agricultural science community.

Improving Economic and Environmental Sustainability in Tree-fruit Production through Changes in Rootstock Use

Researchers from Michigan State University are examining a wide range of new or candidate fruit tree rootstocks possessing varying traits that include vigor control, pest resistance, and modification of reproductive characteristics. They will evaluate the influence of rootstocks on temperate-zone fruit tree characteristics grown under varying environments and training systems using sustainable management practices. Established replicated uniform trials will be maintained, and new trials will be established across North America. A projected outcome is that fruit tree growers will gain access to a wider range of new rootstocks that have advanced genetic traits and have been thoroughly evaluated for successful adoption to regional orchard climatic and soil conditions. Hatch Multistate grant

Tri-Partite Collaborative: Identification of Regulatory Element Variants Impeding Immune Response to Pathogens Causing Bovine Respiratory Disease

This is a tripartite collaborative research project of the University of Missouri with partners from Teagasc in the Republic of Ireland and the Agri-Food and Biosciences Institute in Northern Ireland. The team's goal is to sustainably reduce the prevalence of Bovine Respiratory Disease (BRD) world-wide via the identification of large-effect causal variants underlying risk of BRD and the rapid deployment of assays containing these variants enabling genomic selection in the U.S. and Irish cattle populations. Research to be conducted in the U.S. and Ireland includes identifying the regions of the cattle genome responsible for regulating the expression of the genes involved in the normal immune response to disease causing pathogens. AFRI grant

Receptor –Cry Toxin Interactions and High Throughput DNA-Based Tools to Predict Resistance to Bt Crops in Fall Armyworm

The evolution of resistance to the Cry1Fa Bt toxin by fall armyworm (*Spodoptera frugiperda*) is the most serious threat to the sustainability of transgenic corn and other transgenic crops that produce insecticidal proteins from the bacterium *Bacillus thuringiensis* (Bt). The fall armyworm is a devastating pest that has rapidly developed resistance to the Bt toxin produced by transgenic corn. University of Tennessee researchers are developing sensitive, high throughput, DNA-based methods to screen for resistance. The researchers are using targeted next-generation sequencing to screen for mutations in the SfABCC2 gene in up to 6,000 fall armyworm from locations in the USA, Brazil, Colombia, and Africa. An expected project outcome is the deployment of a highly sensitive system for monitoring the development of fall armyworm resistance to transgenic Bt crops. AFRI grant

Advancing U.S. Agriculture through Global Engagement

Establish Research on Phytochemicals at Delaware State University

Plant species *Emilia coccinea, Momordica charantia, Ocimum grantissimum* and *Prunus africana* contain substantial amounts of flavonoids, alkaloids, steroids and glycosides, and are widely used in Cameroon for their potent analgesic property, thus opening new avenues for investigation of their potential health benefits. Delaware State University (DSU) researchers' objectives are to: identify and quantify phytochemicals from *E. coccinea*, *M. charantia* and *P. africana*; evaluate bioavailability and pharmacokinetics of phytochemicals in animals; evaluate antimicrobial properties of crude extracts from *E. coccinea*, *M. charantia* and *P. africana*; and evaluate chemopreventive action of *P. africana* extract. DSU researchers envisage that the results from these investigations will strengthen capabilities in herbal plant research and help to establish these plants as cultivated crops and improve production practices in Delaware. Evans-Allen grant

The Contribution of the Alternate Host to Virulence and Diversity in Oat Crown Rust

Crown rust disease of oat caused by the fungus *Puccinia coronata f. sp. avenae* (Pca) significantly impacts oat yield and productivity in the U.S. and throughout the world. University of Minnesota researchers will address the contribution of sexual recombination, migration, and mutation to generating virulence diversity in Pca. Researchers are comparing three oat populations: from northern U.S. where common buckthorn (the alternate host of Pca) is present; from southern U.S. where buckthorn is absent; and from Australia where buckthorn is absent. This project addresses the hypothesis that sexual recombination contributes to the extreme variability and rapid virulence evolution in Pca populations and seeks to identify genome sequence variation associated with virulence. The goal is to contribute to the development of disease management strategies to control crown rust epidemics. AFRI grant

Ensemble Prediction for Livestock Disease

Foot and Mouth Disease (FMD) is a viral disease infecting cloven-hooved animals, including cattle, pigs and sheep. Because many countries have invested in FMD mathematical models, there are good models that can be used to develop policy and potentially be used in an active response situation for the United States, which fortunately has not had an FMD outbreak. Colorado State University (CSU) researchers are developing a new methodological tool, called ensemble modeling that can combine predictions of outbreaks from multiple mathematical models to create a single, easy to interpret forecast. CSU researchers will study differences in FMD outbreaks in the United Kingdom, Japan and Argentina, enabling them to understand how outbreaks progress in different countries, and how to improve U.S. preparedness and response plans for potential FMD outbreaks. AFRI grant

Key for NIFA Grant Programs cited:

AFRI grant – Agriculture and Food Research Initiative competitive grants program

Animal Health grant – Animal Health and Disease Research program

BRAG grant - Biotechnology Risk Assessment Research Grants competitive grants program

1890 grant – 1890 Institution Capacity Building Grant competitive grants program

Evans-Allen grant - Evans-Allen capacity grant program

Hatch grant – Hatch Act of 1887

Hatch Multistate grant - Hatch Act of 1887 (Multistate Research Fund)

HSI grant - Hispanic-Serving Institutions Education competitive grants program

NLGCA grant - Capacity Building Grants for Non-Land Grant Colleges of Agriculture competitive grants program

Advancing U.S. Agriculture through Global Engagement

Improving Forage and Bioenergy Crops for Better Adaptation, Resilience, and Flexibility

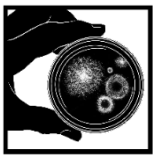
Developing broadly adapted climate-resilient forages for sustainable cropping systems is an objective of this Cornell University project. Researchers will assess the varied profiles and contents of isoflavones in Birdsfoot trefoil (a forage crop) across diverse climates in the northern latitudes of the U.S. and Canada. These isoflavones are bioactive components that control parasitic nematodes that reduce milk production in cows. Researchers will establish a replicated plot trial in New York with several cultivars and elite experimental populations of trefoil. Plots will be assessed for plant development stage and forage yield. Forage also will be sampled from each plot and flash frozen, freeze dried and sent to Nova Scotia, Canada where they will be analyzed for isoflavones. Hatch Multistate grant

Genetic Structure and Mechanisms of Drought Adaptation in *Capsicum*

Using wild and landrace chile pepper (genus *Capsicum*) accessions in germplasm collections, Ohio State University researchers are determining the population genetic structure of chile pepper collections from the center of origin and diversity and its relationship with geographic and environmental factors. The researchers aim to identify traits involved in adaptation, especially to drought. The researchers will identify additional areas of Mexico to collect accessions to expand the range of environmental variation sampled compared to their current samples. The team will locate quantitative trait loci (QTL), or specific regions of the chile pepper genome affecting phenology, physiology, and agronomic performance under drought in the greenhouse. This will enable the researchers to assemble a list of loci associated with varied abiotic conditions and plant performance in the face of drought stress, while better understanding how genetic diversity varies across diverse landscapes where peppers are found. AFRI grant

Tropical Agriculture, Ecology, Environmental and Energy Sustainability Research and Education in Costa Rica

The goal of Alcorn State University's (ASU) project (with Alabama A&M University - AAMU) is to strengthen their capacities and capabilities to develop globally competent students and faculty in tropical agriculture, food systems, natural resources, and environmental and energy sciences. An international summer experiential learning program for ASU and AAMU undergraduates has been developed with Veritas University in Costa Rica. Interaction of these undergraduates with Costa Rican students and faculty, and mentoring by ASU and AAMU faculty will enhance ASU and AAMU faculty's teaching skills and their students' learning experience. 1890 grant



On the Mechanism of Translocation of Effectors into Living Rice Cells by the Blast Fungus *Magnaporthe oryzae*

Many fungi form close relationships with living plant cells by delivering proteins known as effectors inside the plant cells to shut down plant defenses and control other processes. To understand if effector proteins are moved inside rice plant cells by endocytosis Kansas State University (KSU) researchers will perform live cell microscopy to visualize effector dynamics at the fungus-plant cell interface using the rice blast fungus (*Magnaporthe oryzae*), which causes the most serious disease of rice. Effector proteins and plant endocytosis components will be labeled with different fluorescent probes to make them visible during microscopy. KSU will collaborate with a laboratory at the University of Exeter, United Kingdom, which already has early and late endosome fluorescent markers expressed in transgenic rice. Understanding a role for plant endocytosis in delivering blast effectors inside plant cells will lead to novel methods to block rice and wheat blast diseases. AFRI grant

Advancing U.S. Agriculture through Global Engagement

Ecology and Biological Control of Invasive Insects and Weeds in Louisiana

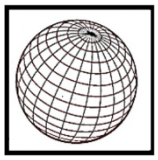
Biological Control of Weeds: Giant salvinia is a free-floating aquatic fern that has invaded waterways of tropical and subtropical regions throughout the world. Native to southeastern Brazil, this weed is a major problem in Louisiana and Texas. The salvinia weevil is a host-specific agent that has been extensively used to manage Giant salvinia. Louisiana State University (LSU) researchers' goal is to improve the establishment of the salvinia weevil and its control of the Giant salvinia weed in central and northern Louisiana. LSU researchers are identifying regions in South America with winter temperatures similar to Louisiana and collecting salvinia weevil populations. A population of salvinia weevil adapted to colder conditions was discovered in Argentina and Uruguay. Having a cold tolerant population of the salvinia weevil will add a tool for controlling Giant salvinia in temperate regions of the southeastern United States. Hatch grant

Development of Novel Vaccine Candidates to Prevent the Re-emergence of Bovine Babesiosis in the U.S.

Cattle fever, Bovine babesiosis, transmitted by cattle fever ticks is an important global disease of cattle causing significant economic loss. *Babesia*-infected cattle fever ticks are prevalent in Mexico. Reports of widespread occurrence of acaricide-resistant cattle fever ticks in Mexico pose a vulnerability to the cattle fever-free status of the United States. The goal of Texas A&M University's research (which includes work with collaborators in Mexico) is to innovate a reverse vaccinology strategy to identify and select candidate antigens, which can be used to make a vaccine that will block tick feeding and prevent transmission of *Babesia* parasites to cattle. Animal Health grant

Establishment of an Efficient Transformation System for Functional Analysis of Cold Tolerance Genes in Rice

Rice yield would be enhanced if growers could plant two weeks earlier in the season to better utilize spring rain and avoid high night-time temperatures of mid-summer which decrease grain yield and quality. Marquette University intends to establish a high-efficiency transformation system of standard and recalcitrant rice cultivars to test probable rice cold-tolerance genes as candidates to enhance chilling tolerance of commercial rice grown in the United States. The objective of this Marquette professor's sabbatical is to receive training in rice transformation of standard and recalcitrant rice cultivars from a collaborator at the Chinese Academy of Sciences in Beijing, China, and to establish an efficient rice transformation system at Marquette. AFRI grant



Understanding the Drivers and Assessing the Impacts of Technology Adoption and Diffusion in the Food and Agribusiness Sector

An objective of this South Dakota State University project is to study the factors influencing agricultural biotechnology regulations and conduct impact analyses of regulatory policy. While regulations are required for technologies such as agricultural biotechnologies, over- or under-regulation could have negative implications on social welfare. Researchers will conduct impact analyses of technology regulations on social welfare. They will compare and contrast the regulatory policy approaches for agricultural biotechnology in the U.S, Europe, and India and analyze welfare implications on various stakeholders. Hatch grant

Advancing U.S. Agriculture through Global Engagement

CRISPR/Cas9 Mutagenesis for Genetic Containment of Forest Trees

Transgenic trees may provide a valuable resource for wood production, biofuels, bioremediation, and many other applications, however commercial uses are severely limited by regulations and associated ecological and legal risks due to transgene dispersal. Researchers at Oregon State University (OSU) will transform wild type Eucalyptus using CRISPR-Cas to target four selected genes. Once transformed the trees will undergo a greenhouse trial at OSU for vegetative phenotype assessment before they are planted in a field trial in Israel where they will be allowed to flower naturally. Trees will be assessed for floral and vegetative morphology in the field, sterility, stability, and any off-target effects. BRAG grant

Advancing Harvest Index in Wheat through Genomic Enabled Physiological Breeding

To increase wheat yields, University of Florida researchers' long-term goal is to develop new wheat ideotypes with a Harvest Index (HI = grain dry matter yield/aboveground dry matter) that is high (≥ 60%) by combining increased spike partitioning, fruiting efficiency, fertile florets per spikelet, and improved spike morphology. A major objective is to develop new breeder-friendly molecular markers for grain partitioning traits that permit photosynthesis products to be consistently translated to grain yield through genome-wide association study using two association panels in high biomass backgrounds. One panel is with U.S. soft wheat at the University of Florida and the other panel is with spring wheat at the CIMMYT (International Maize and Wheat Center) IWYP (International Wheat Yield Partnership) Hub, in Mexico. Increasing HI to 60% would result in a 25% increase in grain yield. AFRI grant

Global AgLeader: Development of Leadership and Global Competency to Enhance Recruitment and Retention of Minority Students in Agriculture

Texas State University's (TSU) project is designed to improve agricultural education for students from underrepresented/minority groups so as to positively influence these students' recruitment and retention at the university and their hiring desirability on the job market. An objective is to develop an innovative international exchange program focusing on collaboration between TSU and CGIAR system institutes. Students will attend a study-abroad program in Bangladesh and visit various agricultural research institutes in Asia, including the International Rice Research Institute (a CGIAR institute) in the Philippines. A Bangladesh Agricultural University professor will visit TSU to offer a course on agricultural development in Asia to prepare the study-abroad students. NLGCA grant

Establishment of Turmeric (*Curcuma longa*) as a High Value Medicinal Crop to Sustain Small Farms in Alabama

Alabama A&M University (and Auburn University) with assistance from an herbal industry specialist, have leveraged their resources to develop turmeric for commercial production in Alabama. Their previous studies showed turmeric is adaptable to Alabama, but there is a need for a high curcumin (the bioactive compound in turmeric) containing variety. This project includes screening several turmeric accessions for growth, development, yield and curcumin levels. Plot experiments in year 1 using 25 elite germplasm lines obtained from two research stations in India will be conducted at Alabama A&M and Auburn. The initial 25 genotypes will be reduced to about 10 in year 2, and 3-5 in year 3. In years, 2 and 3 replicated variety trials will be conducted at university research stations in north, central, and south Alabama. AFRI grant

Advancing U.S. Agriculture through Global Engagement

Tomato Powdery Mildew Effectors Identify New Sources of Disease Resistance

Powdery mildew disease is a growing threat to tomato production worldwide, causing losses in yield and fruit quality. University of California, Berkeley (UCB) researchers are using newly available genome sequence information to identify sources of powdery mildew disease resistance that can be utilized by tomato breeders. The identified sources of resistances will be introduced into susceptible tomato varieties that will be grown under disease pressure conditions to verify the efficacy of the resistances. Transformed tomato lines will be produced in UCB's collaborator's laboratory at the Chinese Academy of Sciences in Beijing, China using methods developed in that laboratory. UCB researchers will travel to China to perform the powdery mildew disease assessments of the transformants, and those transformed tomato lines with resistance will be brought back to UCB and assessed against California strains of the tomato powdery mildew. AFRI grant

NIFA-BARD Collaborative: Exposure Risks of Pathogens and Disinfection Byproducts from On-Site Treated Rainwater and Drainage Water for Irrigation

Community gardens and commercial greenhouses growing vegetables and fruits are being developed in cities throughout the United States. At the same time, soilless substrate-based or hydroponic greenhouses for the production of flowers, fruits, and vegetables have been developed in Israel for years. However, in both countries, these farms face significant challenges including the cost of freshwater used for irrigation. The presence of microbial contaminants in the harvested rainwater (RW) and the drainage water (DW) from soilless farms prevent the use or recycling of these waters to substitute for freshwater. Although disinfection is likely to inactivate plant and human pathogens in these waters, toxic disinfection byproducts (DBPs) may be formed. The extent of human pathogen survival and of formation of DBPs in disinfected RW and DW, as well as the possible residual toxicity of these waters, are not well known. Researchers from the University of Illinois and the Volcani Center of Israel's Agricultural Research Organization are collaborating to 1) characterize the microbial community, including pathogens in RW and DW collected in both Illinois and Israel; and 2) determine the disinfection efficacy and mechanisms of well-characterized strains of rotavirus and coxsackievirus in these water samples by chlorination alone and by chlorination preceded by ozonation or solar irradiation; as well as address other knowledge gaps. This study will determine the relative potential human health impacts of irrigation water used in urban and small farms in both dry climates (Israel and the American South and Southwest) and temperate climates (the American North and Midwest). AFRI grant

Integrating Indigenous and Urban Farming to Incentivize Latino Agricultural Career Choices

San Diego State University's project provides students the opportunity to study abroad in Oaxaca, Mexico where they will work alongside indigenous farmers to document and preserve traditional farming techniques. This interdisciplinary approach entails teaching traditional Mesoamerican farming methods, along with modern methods and techniques from the nutritional sciences, biochemistry and molecular biology. Faculty will develop lecture and laboratory curricula around a traditional Milpa (multispecies inter-planting farm) while introducing students to modern urban agricultural methods and advanced scientific instrumentation. Recognition of the scientific and cultural importance of Milpa is expected to attract Latino students whose backgrounds are situated within traditional farming, and incentivize their career choices in agriculture. HSI grant

All project descriptions in this document are based on the reports from the grantees in the USDA Current Research Information System (CRIS) https://cris.nifa.usda.gov/

Advancing U.S. Agriculture through Global Engagement

3 Steps for Applicants to USDA NIFA programs interested in including international collaborations or activities in their proposals

Step 1: Determine how an international collaboration or activity is important in accomplishing your research, education, or extension objectives

The preceding pages in this brochure give a variety of examples of how international collaboration or activity can serve an important role in accomplishing an objective important to U.S. food and agriculture.

Step 2: See if your interest fits within a NIFA Competitive or Capacity grant program

Competitive

- **Agriculture and Food Research Initiative (AFRI)**, NIFA's flagship and largest competitive grant program has global engagement opportunities. NIFA supports global engagement that advances U.S. agricultural goals. Applicants to AFRI Requests for Application (RFAs) may include collaborations with international partners, but applications may only be submitted by eligible U.S. institutions. Such applications may include subcontracts to international partners or other institutions and must clearly demonstrate benefits to the United States. Additional information is on the AFRI International Partnerships webpage: https://nifa.usda.gov/resource/afri-international-partnerships
- **Other competitive grant programs with opportunities for international activities include**: 1890 Institution Teaching, Research, and Extension Capacity Grants; Higher Education Challenge Grants (HEC); Biotechnology Risk Assessment Grants (BRAG); Breakthrough Ideas to Advance Crop Breeding; Citrus Disease Research and Extension (CDRE); Food and Agricultural Sciences National Needs Fellowships (NNF); Higher Education Multicultural Scholars Program (MSP); Hispanic Serving Institutions Grants (HSI); Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS); Organic Agriculture Research and Extension Initiative (OREI); Secondary, Post-Secondary Education & Ag. in the Classroom (SPECA) Small Business Innovation Research (SBIR); Specialty Crop Research Initiative (SCRI); and Women and Minorities in STEM (WAMS). For details, see https://nifa.usda.gov/opportunities-global-engagement

For Capacity programs (primarily land-grant institutions) check with your State Experiment Station Director, Research Director, Extension Director or Administrator, or Dean as appropriate. Many NIFA awardees have included international collaborations or activities in their capacity grants.

Step 3: Identify potential collaborators, institutions, or locations

You are welcome to identify potential collaborators or foreign locations utilizing your own networks and professional contacts and include in your NIFA proposals as appropriate. You may also want to utilize partnerships NIFA has developed with foreign institutions and international organizations with whom NIFA has identified areas of mutual interest. These partnerships enable NIFA awardees to collaborate with foreign researchers that have funding from their own organizations, or help NIFA awardees identify foreign collaborators they may want to write into their NIFA projects.

For more information on these and other NIFA global partnerships, please visit our website: https://nifa.usda.gov/developing-global-partnerships

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Quick guide to info on USDA NIFA programs and global engagement

NIFA's international partnerships

NIFA's Center for International Programs develops opportunities for U.S. scientists in NIFA-funded programs to link with international partners to achieve greater global impact and advances for U.S. agriculture.

https://nifa.usda.gov/developing-global-partnerships

International Partnership Videos

See researchers who through their NIFA grants are participating in NIFA international partnerships briefly share what they are doing, why it is important, and what international collaboration is enabling them to achieve.

https://nifa.usda.gov/international-partnership-videos

NIFA Competitive Grant RFAs with opportunities for global engagement to advance U.S. agriculture

See listing of NIFA's Requests for Applications (RFAs) and what's in those RFAs relevant to international activity.

https://nifa.usda.gov/opportunities-global-engagement

NIFA Capacity Grants

As noted in the NIFA Policy Guide, "NIFA supports global engagement that advances U.S. agricultural goals." Consult the NIFA Policy Guide on allowable costs related to international activity in Capacity Grants and check with your State Experiment Station Director, Research Director, Extension Director or Administrator, or Dean as appropriate.

https://nifa.usda.gov/resource/nifa-federal-assistance-policy-guide-2018

Learn more about USDA NIFA's Opportunities for Global Engagement to Advance U.S. Agriculture

USDA NIFA's Center for International Programs establishes connections between NIFA and other organizations, such as the U.S. Agency for International Development (USAID), the U.S. Department of State, the Food and Agriculture Organization of the United Nations (FAO), CGIAR system of international agricultural research centers, and other organizations, and with agricultural research agencies of other countries to globally advance the results and experience of NIFA and the institutions it serves, and achieve goals important to U.S. agriculture.

To find out more about NIFA's international collaborations and opportunities in the different NIFA grant programs visit us on the web: https://nifa.usda.gov/program/global-engagement-programs