USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

DISCOVERIES 2023

The Impact of Agricultural Research Service


BIOGAS

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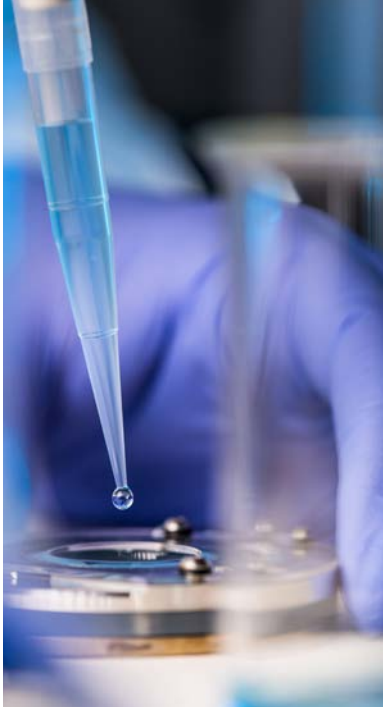
MISSION
ARS delivers scientific solutions to national and global agricultural challenges.

CONTENTS

VISION
Global leadership in agricultural discoveries through scientific excellence.



Steven Kappes
Associate Administrator

Joon Park
Acting Associate Administrator

INTRODUCTION

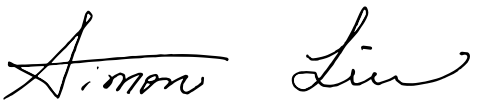
Simon Y. Liu
Administrator
Agricultural Research Service

Welcome to *Scientific Discoveries 2023.* I am proud and excited to share some of our most impactful research – technological advances and groundbreaking science that touch everyone, whether you are a farmer, rancher, supplier, or consumer. Our research delivers innovative solutions to agriculture's greatest challenges. The stories you will read here are truly remarkable.

For example, we are using the power of sound to improve biogas production while also helping the environment. We found that a popular lawn grass also provides food for our important pollinators. We are studying deadly diseases like Japanese encephalitis virus and Highly Pathogenic Avian Influenza. And we discovered a simple method for detecting the metal mercury in food.

You will also want to read about how we are protecting cattle from ticks that spread deadly diseases. In this edition of *Scientific Discoveries,* we unveil new varieties of wheat, cotton, and peas that may soon show up in your local market. We also had a breakthrough in our fight against one of U.S. agriculture's greatest enemies, the spotted wing drosophila. Find out how inside.

I hope you take a few minutes to browse our ARS Awards section, where we feature some of our esteemed researchers who have achieved high honors in agricultural science. This section is just a snapshot of the accolades we received this past year, and it underscores our role as the world leader in innovative agricultural research. I want to thank our scientists, post-docs, and support staff for their tireless dedication in providing the United States and the world with scientific excellence in agriculture. From farm to table, our research makes a difference in the life of every family.



Simon Liu
Administrator, Agricultural Research Service

ARS BY THE NUMBERS

FUNDING

110
PROJECTS
$310
MILLION
Animal production and protection

287
PROJECTS
$618
MILLION
Crop production and protection

143
PROJECTS
$378
MILLION
Nutrition, food safety and quality

123
PROJECTS
$328
MILLION
Natural resources and sustainable agricultural systems

ARS STUDENT REACH

Students Participating in ARS Outreach Events

33,879
School and community presentations

4,190
ARS location visits

16,412
Science fairs

3,756
Courses and demos

ARS NUMBERS AT A GLANCE

90+
ARS locations

8,000
ARS employees

650+
Research projects

15
National programs

32
Number of new licenses

31
Number of new patents issued

3,524
Published peer-reviewed journal articles

TOTAL

ARS Trainees

1,138
Students and interns

221
Postdocs

59,596
Total number of students reached

NATIONAL PROGRAM AREAS

Jeffrey Silverstein
Deputy Administrator,
Animal Production
& Protection

ARS's **Animal Production and Protection (APP)** program aims to improve the health, well-being, and efficiency of livestock, poultry, and aquatic food animals to ensure a productive and safe food supply. Emphasis is placed on germplasm characterization, improvement, and conservation; understanding the mechanisms of disease resistance; and the development of vaccines and tools to prevent, control, or eradicate diseases that threaten our food supply or public health.

Pamela Starke-Reed
Deputy Administrator,
Nutrition, Food Safety
& Quality

ARS's **Nutrition, Food Safety, and Quality (NFSQ)** program coordinates and leads ARS research to define the role of food and its components in optimizing health for all Americans. The NFSQ supports researchers who develop tests and processes that keep the food supply safe, reduce and control pathogens and toxins in agricultural products, and improve the economic viability and competitiveness of American agriculture.

Nora Lapitan
Deputy Administrator,
Crop Production
& Protection

ARS's **Crop Production and Protection (CPP)** program helps ensure that Americans continue to enjoy the most abundant, affordable, safe, and nutritious food supply in history. The research done within CPP delivers science-based information, genetic resources, and technologies for increased crop productivity, economically and environmentally sustainable methods of crop production, and protection from plant diseases and pests.

Marlen Eve
Deputy Administrator,
Natural Resources &
Sustainable Agricultural
Systems

Ingrid Watson
Acting Director,
Office of International
Research Engagement
and Cooperation

ARS's **Natural Resources and Sustainable Agricultural Systems (NRSAS)** program provides innovative solutions that ensure sustainable food production while also protecting our natural resources, leading to agricultural production systems that adapt to changing climate and are sustainable for future generations. NRSAS supports researchers in developing the technologies and strategies needed to help farmers, ranchers, and other natural resource managers effectively steward the diverse agricultural ecosystems across the nation.

The **Office of International Reseach Engagement and Cooperation (OIREC)** coordinates ARS's international relationships and helps empower ARS researchers to develop new ideas, approaches, expertise, and resources beyond U.S. borders. OIREC leverages its extensive international network of experts in science, agriculture, politics, diplomacy, and security to help ARS scientists identify emerging ideas and solutions, increase the impact of research and development spending, and deliver new knowledge and technologies.

GEOGRAPHIC RESEARCH AREAS

Tara McHugh
Director,
Pacific West Area

ARS's **Pacific West Area** delivers innovative research-based solutions to solve problems of importance to U.S. agriculture. Our programs ensure high agricultural productivity, good nutrition, and healthy agroecosystems. The Area is composed of 49 research units at 21 locations in 8 states.

Our diverse research portfolio includes ecologically friendly bioproducts, food processing, crop health and productivity, natural resources conservation, rangeland health, crop germplasm preservation, animal health, and human nutrition programs. Our relationships with stakeholders ensure the benefits of our research are realized by all Americans.

Laurence Chandler
Director,
Plains Area

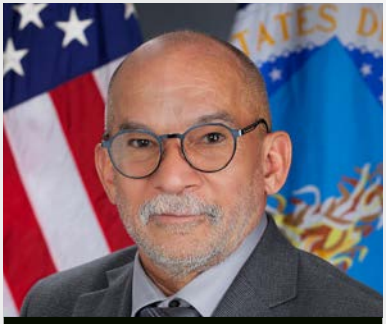
ARS's **Plains Area** develops technologies that solve problems faced by farmers, ranchers, and producers across agriculture. The Area utilizes key resources, including nearly 300,000 acres of rangeland and farmland across the Great Plains and the soon-to-be-completed, state-of-the-art biological containment lab at the National Bio- and Agro-Defense Facility. The Plains Area provides unique opportunities for cooperative research to address key needs of producers across the United States and internationally. The Area addresses national needs through a network of 22 research locations across 10 states.

Archie Tucker
Director,
Southeast Area

ARS's **Southeast Area** delivers innovative, scientific solutions to national and global agricultural challenges. The Area supports ARS National Programs covering animal production and protection; nutrition, food quality and safety; natural resources and sustainable agricultural systems; and crop production and protection. Research programs in the Southeast Area are carried out in 66 research units at 27 locations in 9 states and Puerto Rico.

Thomas Shanower
Director,
Northeast Area

ARS's **Northeast Area** conducts innovative, fundamental, and applied scientific research to develop and transfer solutions that address agricultural and human health problems of high national priority. The Area focuses on maintaining and improving an abundant supply of healthy and safe food, fiber, bioenergy, and agriculture-derived value-added products to all Americans. The Northeast Area encompasses 24 research locations in 11 states and the District of Columbia.



Alberto Pantoja
Director,
Midwest Area

ARS's **Midwest Area** conducts research to develop economically and environmentally sustainable agricultural systems that enhance the yield and quality of crops and livestock, improve human health, create crop-based alternatives to petroleum-derived fuels and products, and protect the environment. The Midwest Area is home to 13 research locations and laboratories in 9 states.

Getting More Out of Green Power

Let's Hear It for Biogas!

ARS scientists are sounding out a new way to improve biogas production and help the environment. Researchers in Bowling Green, KY, placed waterproof speakers into air-free wastewater treatment facilities to study how sonic vibration affects the anaerobic digestion of waste. The sonification (the sound supplied by these speakers) vibrated gas bubbles and sped up the breakdown of wastewater. This produced 27% more biogas during summer months and increased production 74-fold during winter months, allowing for some continued energy production during the winter, when many unheated anaerobic digesters stop producing biogas.

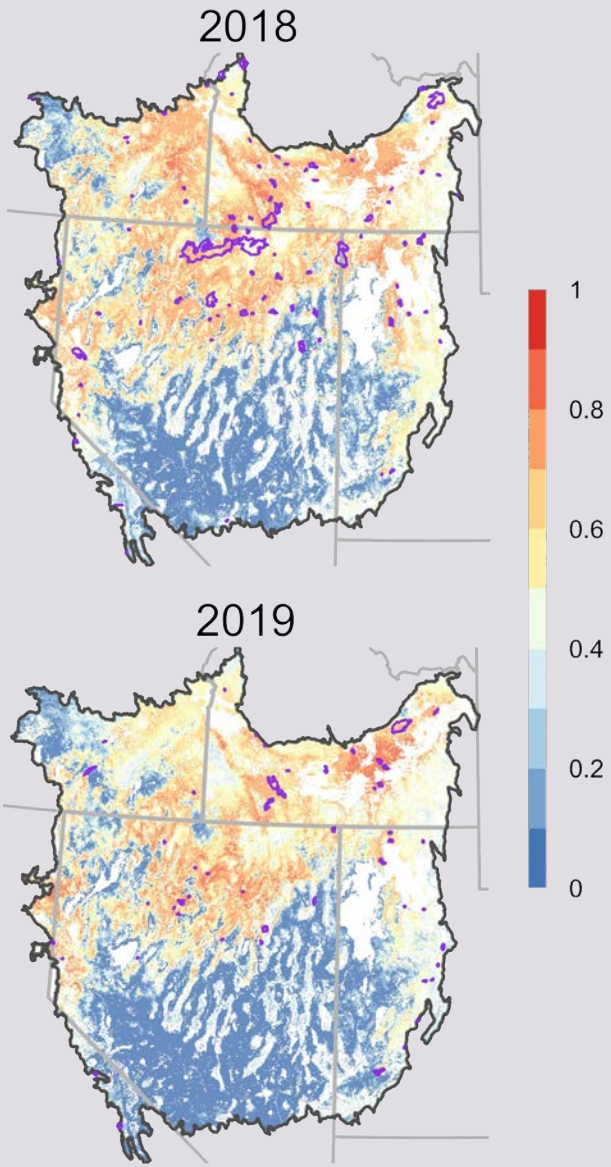
This extra "sonic biogas" can heat farm and livestock facilities and power equipment, improve the quantity and quality of biogas, and even help to recover ammonia nitrogen as a potential fertilizer product. Biogas is a proven source of energy used in the United States and around the world. USDA estimates that biogas systems could produce enough energy to power more than 3 million American homes and reduce methane emissions equivalent to 4 to 54 million metric tons of greenhouse gas emissions in 2030.

Green Jet Fuel Takes Off

U.S. airlines have committed to reducing carbon dioxide emissions by 50 percent in 2050. This has generated significant demand for renewable jet fuel that can be used to replace the 23 billion gallons of fossil fuel currently supplying the jet fuel market. ARS scientists at the National Center for Agricultural Utilization Research in Peoria, IL, assembled a collection of yeasts that convert agricultural waste into bio-oil, which is then easily converted into biodiesel or renewable jet fuel.

One of these yeasts *(Rhorosporidium toruloides)* was used in a pilot demonstration at a commercial development center to convert sugarcane waste into bio-oil. The yeast produced 18 grams of bio-oil/100 grams of agricultural waste, demonstrating that it is robust enough to produce bio-oil in a commercial, large-scale operation. This accomplishment will help reduce fossil fuel consumption and convert underutilized agricultural residues into value-added, green biofuels that support rural economies.

Advancing Strategies for Wildfire Containment



Predicting High-Risk Areas for Wildfires

Wildfires destroy millions of acres of U.S. land every year and cause millions of dollars in damage to forests, residential homes, and the agriculture industry. Like lightning strikes, wildfires can be unpredictable and quickly escalate, especially in the Great Basin region. ARS researchers with the Range and Meadow Forage Management Research Unit in Burns, OR, collaborated with partners at the University of Montana to develop a forecast tool to determine which areas have the highest probability of a large rangeland fire.

The forecast tool combines measures of accumulated annual and perennial grass vegetation that is potential fire fuel with recent weather and climate data. When integrated, this information can be translated into maps showing the likelihood of a large wildfire—greater than 1,000 acres—across the Great Basin. These forecasts also can be scaled down to predict fire risk for counties or even single pastures. Land managers can use this forecasting tool to institute wildfire prevention and suppression practices in notable high-risk areas.

Protecting Our Ecosystems

Targeting Taste Buds, Targeting Grazing

Scientists at the ARS Range Sheep Production Efficiency Research Unit in Dubois, ID, are taking grazing to a new level by developing sheep that prefer or tolerate the bitter taste of plants. Here in the Intermountain West, land managers are looking for ways to use livestock to protect and improve the sagebrush ecosystem, which is a necessary resource for wildlife, rural communities, and ranchers. Sagebrush is a shrub that can have a bitter taste for grazers, such as sheep.

Scientists believe that the "bitter taste" trait is heritable, passed from parents to their young. Scientists have launched a series of studies to discover if they can accurately identify and breed sheep with these specific "herbivory" or plant selection preferences. If successful, these unique sheep may be used to manage rangelands and make them more resistant to catastrophic wildfire and invasive and noxious plant species, which are the greatest threats to the survival of sagebrush ecosystems.

Centipedegrass Provides Food for Our Pollinators

Centipedegrass is a popular lawn grass in the southeastern U.S., mainly due to its excellent heat tolerance and low maintenance requirements. As an added benefit, researchers at ARS's Crop Genetics and Breeding Research Unit in Tifton, GA, discovered that bees were collecting pollen from centipedegrass flower heads. This is important because pollinator populations – which pollinate numerous fruit and vegetable crops—have been in decline worldwide for several decades. The increase in turfgrass lawns is frequently cited as contributing to this decline, because grasses do not support bees and because pesticides applied to lawns to protect them from insects might also kill pollinators.

From this discovery, homeowners and landscape managers are recommended to apply insecticides conservatively to maintain essential pollinator populations visiting landscape plants such as centipededgrass.

Preserving Our Waterways

Aquatic Plants to the Rescue!

Farmers sometimes remove aquatic plants growing in drainage ditches because they believe these plants will impact water flow or are unpleasing to the eye. However, ARS researchers at the Water Quality and Ecology Research Unit in Oxford, MS, a part of the National Sedimentation Laboratory, found that keeping plants in drainage ditches can benefit the aquatic ecosystem. Their research has shown that allowing managed vegetation to remain in farm ditches can result in significant nitrogen and phosphorus removal through the biological activity of bacteria and algae, and uptake by the associated aquatic plants.

Nitrogen and phosphorus in surface runoff can be serious threats to our waterways. Although these nutrients are naturally present in aquatic ecosystems, too much in the environment can pollute air and water. This pollution can result in hypoxia, a state of low or depleted oxygen in a water body. Managing vegetation in ditches can impede runoff, providing optimal conditions for nitrogen removal by denitrification and retaining excess nitrogen and phosphorus. Reducing excess nitrogen and phosphorus in agricultural drainage networks could help lessen the farm impact of excessive nutrients in our waterways.

When the Grass is Greener on All Sides

Fertilizers that are widely used on lawns and other vegetation contain nitrogen, an element that helps plants grow – but can also cause significant problems. Because nitrogen dissolves easily in water, events like rain and irrigation wash it into surrounding waterways. There, it can cause overgrowth of algae and free-floating aquatic plants, blocking light. As this growth dies and degrades, it also depletes oxygen from the water, harming aquatic animals.

ARS researchers at the Soil and Water Management Unit in St. Paul, MN, investigated whether vegetative filter strips – essentially, 50-foot-wide borders of live plants – could remove this excess nitrogen from runoff. They selected and grew a fine fescue grass mixture, then measured levels of two forms of nitrogen in runoff entering and leaving the strips. The result: the strips removed 40-98% of the excess nitrogen from the surfaces they bordered, providing a promising approach to protecting our valuable waterways.

Innovative Research to Improve Human Health

Turning Wine Waste into Gut Power

Millions of tons of wine grapes are grown in California annually. That's good news for wine drinkers. Unfortunately, approximately 40 percent of wine grape harvest is waste. ARS researchers at the Healthy Processed Foods Research Unit in Albany, CA, have teamed up with wine growers to determine whether waste from wine grapes can be converted into healthy food components.

Previous research found that grape seeds, skins, and juices contain natural substances that may have health benefits, such as reducing the amount of bad gut bacteria, introducing more healthy gut bacteria, and decreasing chronic inflammation in the body. ARS researchers are studying whether they can add these natural substances from grape waste into foods that we eat every day, and perhaps one day help reduce the risk of chronic metabolic diseases that begin in the gut, such as diabetes, heart disease, and high blood pressure.

Can a Mother Help 'Program' Better Health into Her Baby?

Human milk is a dynamic system, and mothers may be able to use their milk to direct the future health of their children, say ARS researchers at the Arkansas Children's Nutrition Center (ACNC) in Little Rock, AR. To better understand how excessive maternal weight changes human milk composition, ARS-funded researchers investigated how the content of oligosaccharides differed in milk produced by women with normal weight, overweight, or obesity. Oligosaccharides are complex sugars that contribute to the development of an infant's microflora and immune system.

Scientists found that milk from the sets of mothers differed in oligosaccharide content and that these sugars affected growth and body fat content. The differences are important to understand so that scientists can develop interventions to optimize human milk and promote healthy growth, including designing infant formulas that promote healthier trajectories.

Long-Term Planning to Keep Honey Bees Safe and Healthy

Building a Better Honey Bee

Honey bees face multiple health threats, commonly known as the four “Ps” – parasites, pathogens, pesticides, and poor nutrition. ARS researchers at the Honey Bee Breeding, Genetics, and Physiology Research Unit in Baton Rouge, LA, are studying genetics and breeding to make honey bees more resilient to these threats. Their multi-faceted research program focuses on understanding how these threats affect honey bees, identifying and selecting traits for breeding more resilient honey bees, and developing management strategies for enhanced honey bee populations.

To build better honey bee populations, ARS researchers are studying different approaches to combatting the four “Ps”. Notable research developments include: developing two Varroa mite-resistant honey bee breed stocks; developing edible vaccines for the deformed wing virus using nutritious microscopic algae, known as microalgae, that can be introduced into honey bees’ diets; examining pesticide resistance in mites that harm honey bees; and updating genetic information and tools to inform and improve breeding efforts by commercial beekeepers.

California's Long-Term Honey Bee Research Monitoring Network

ARS researchers have initiated a long-term honey bee monitoring network to better understand how factors such as nutrition, pesticides, extreme weather, and natural events impact colony performance and survivorship over multiple seasons. Researchers at the Invasive Species and Pollinator Health Unit in Albany, CA, are working with farmers, almond growers, and beekeepers to monitor the health of honey bee colonies as they experience stress while providing critical pollination services in almond orchards, sunflower fields, and other regions where pollination-dependent crops are grown in California.

Within the next several years, ARS researchers will expand the network to include more monitoring sites across the state and use the apiary performance metrics gathered to evaluate how environmental factors impact production of pollinator-dependent regional crops, nutrient availability for honey bees, as well as the effects of agrochemicals on bee reproduction and performance.

Monitoring the Spread of Viruses and Pathogens

Stopping a Deadly Virus at the Border

Japanese encephalitis virus (JEV) is an endemic disease in Asia. It is carried by mosquitoes and belongs to the same genus as Dengue, Zika virus, yellow fever, and West Nile virus. The mortality rate of symptomatic cases is high (20-30%), and up to half the survivors experience significant neurological symptoms.

Although JEV has currently not reached the United States, previous studies determined this country as high risk for its introduction. To keep JEV from entering our country, ARS researchers at the Foreign Arthropod-Borne Research Disease Unit in Manhattan, KS, collaborated with Kansas State University researchers to study areas of vulnerability, including increases in wild animal populations that can transmit the disease, illegal animal importation and movement, the reduction in mosquito control in regions with highest risk, and changing patterns of viral strains. Identifying these gaps and more closely monitoring animal and mosquito incursion of JEV can reduce the potential consequences of the virus entering the United States.

Determining Risk Factors of Avian Influenza Outbreaks

Highly Pathogenic Avian Influenza (HPAI) is a serious disease and requires rapid response because it is highly contagious and often fatal to chickens. An HPAI outbreak in 2022 affected over 50 million birds in the U.S., including over 600 commercial and backyard flocks. Previous HPAI outbreaks have resulted in millions of bird deaths and cost billions to the agricultural industry.

ARS researchers at the Exotic & Emerging Avian Viral Diseases Research Unit in Athens, GA, collaborated with the Universities of Georgia and Connecticut to study intervention strategies to prevent and control future avian influenza disease outbreaks in both commercial and backyard flocks. Researchers found diverse risk factors in 2022 compared to previous HPAI outbreaks, mainly the virus being spread by wild birds and from environmental contamination in affected farms. They also found fewer occurrences of farm-to-farm spread. This information is critical to understanding the epidemiology of HPAI viruses and developing methods to prevent and control the disease.

Plant Diseases Hide Where They're Least Expected

One of the greatest threats to plants is invasive pathogens, disease-causing microbes that come from outside a local ecosystem. To help combat this challenge, researchers at the ARS Foreign Disease Weed Science Research Unit in Fort Detrick, MD, set out to examine how invasive pathogens could travel and spread. Port inspectors and others who protect our nation's borders already check many plants for known pathogens. However, the researchers suspected that some pathogens slip through because they are hidden in unexpected places, such as in plants that do not show any disease symptoms or visible signs of the pathogen.

To test this idea, researchers isolated microbes from rhododendron plants growing in native stands that looked healthy. Using DNA sequencing methods to identify the microbes, the researchers discovered that several microbes recovered from the native rhododendron plants are known pathogens of other plants. These results confirmed that pathogens can evade detection by living as "endophytes" in plants that show no disease symptoms. In making this discovery, the researchers highlighted a major gap in current plant protection policies, and a potential opportunity for improving those policies.

Examining Forever Contaminants

The Toxin that's Hiding in Plain Sight

ARS scientists are studying the potential health risks of a set of toxic chemicals that have been in our homes, our food, and our agricultural production for decades. Perfluorooctanoic acid (PFOA) is a man-made chemical that has been used to coat many consumer products, including cooking pans. In addition, fertilizers contain the chemical. It remains in the environment where crops may absorb it. PFOA is a possible carcinogen because it can bind to receptors of hormones and disrupt the endocrine system.

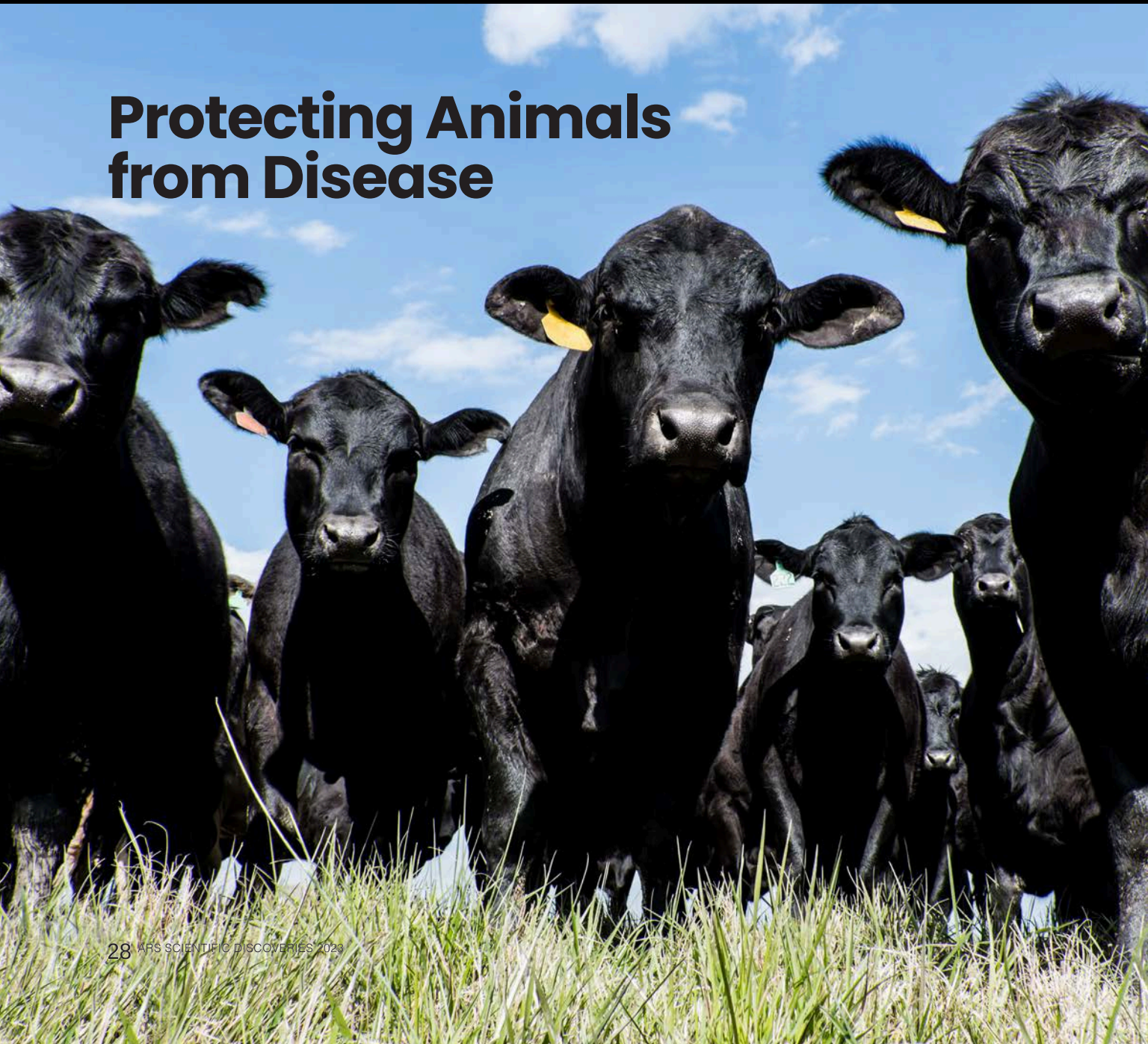
In Fargo, ND, an ARS team at the Edward T. Schafer Agricultural Research Center is examining how rats absorb PFOA from contaminated alfalfa, and how long the chemical remains in their systems. Data shows that PFOA was readily absorbed, but quickly excreted in urine. After 2 days, less than .5% remained in liver, blood, kidney, and skin tissues.

An Easier Way to Detect Mercury in Food and the Environment

Mercury is a naturally-occurring element that can be found in soil, water, and air. It can also be found in our food, and high levels of exposure from any source can cause neurological and kidney damage. Current methods for detecting mercury in environmental samples are complex, time-consuming, and require specialized training. They're also laboratory-based, making them unsuitable for on-site mercury detection.

Now, a solution is at hand, thanks to an ARS-funded research project at Purdue University in West Lafayette, IN. Researchers developed a dual-detection biosensor that couples a color-measuring capability with electrochemical sensing. The resulting biosensor is faster, more user-friendly, and just as effective and accurate as existing methods. It is also portable, enabling on-site testing of samples for mercury in the parts-per-million range and displaying the results on a smartphone. The biosensor can also be adapted to multiplex, low-cost strip devices for on-site detection of toxins, pathogens, and heavy metals other than mercury.

Protecting Animals from Disease



Unlocking The Code to Protect American Cattle

Two types of ticks pose a particular hazard to the American cattle industry. *Rhipicephalus microplus* and *Rhipicephalus annulatus* can carry and transmit serious diseases, including cattle fever and anaplasmosis. While the ticks have been successfully eradicated in the United States, the risk of re-entry persists, as both are found in Mexico. ARS scientists in Kerrville and Edinburg, TX, and their university research partners collaborated to sequence and assemble the ticks' genomes, focusing for the first time on strains specific to the United States. They utilized the latest technology to produce genomes that were more complete and detailed than any prior versions.

Researchers found several vaccine candidates using the improved genomes, and two of them had a patent application filed after testing in partnership with a major pharmaceutical company. These discoveries will contribute to the development of cattle vaccines that specifically target *R. microplus* and *R. annulatus*, interfering with their ability to transmit disease to cattle, and keeping the animals safe and healthy.

Liver and Onions, Please. Hold the Abscess

In a groundbreaking study, ARS researchers showed for the first time that changes in cattle rumen associated with liver abscesses remain well after the early development of rumen acidosis caused by high corn diets. Beef cattle liver abscesses are the highest cause of liver being deemed unsuitable for human consumption. Costs to the beef industry are estimated at a minimum of $64 million annually and up to $400 million in a combination of product loss, reduced animal production efficiency, and health.

ARS scientists at the U.S. Meat Animal Research Center in Clay Center, NE, helped identify associations between differentially expressed genes in rumen tissue and the bacterial species attached to the rumen. These findings will lead to additional study of liver abscess development, help identify animals susceptible to liver abscesses, and promote animal production efficiency and welfare.

New Varieties of Cotton, Wheat, and Winter Peas

ARS Researchers Use Careful Screening to Breed Superior Cotton

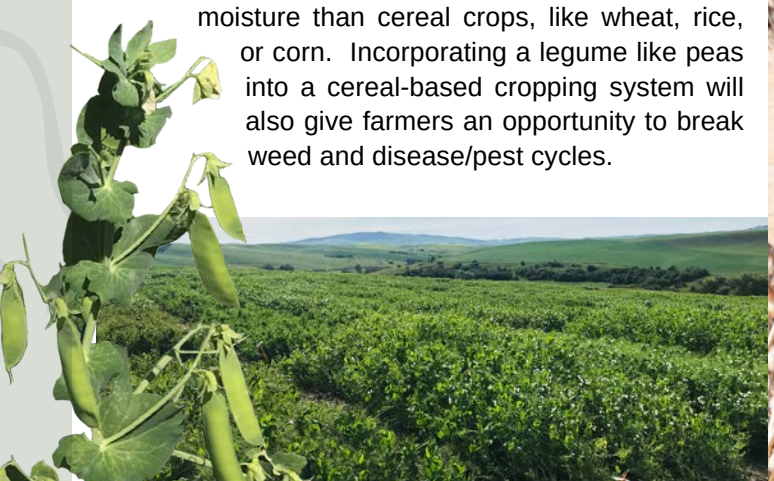
Cotton growers normally have two goals for their plants: high-quality fibers, and lots of them. Unfortunately, these two goals are usually at odds: the better the quality of the fibers, the lower the yield, and vice versa. Until now.

Through careful genetic analysis and selective breeding, researchers at the ARS Cotton Fiber Bioscience Research Unit in New Orleans, LA, have broken the linkage, producing new strains of cotton that offer both quality and abundance. Building on earlier work by ARS colleagues in Starkville, MS, the researchers evaluated over 500 different cotton lines. A combination of field data and DNA markers helped them identify seven lines with the qualities they sought: fibers that are long, strong, and plentiful. They have now released those lines to commercial and other public plant breeders, who have begun using them to improve the seed that will make varieties with improved cotton fiber available for American growers.

Easy Peas-y: USDA Improves Fall Planting Options with New Pea Cultivars

Many farmers practice crop rotation, growing different crops each year to maximize the use of their land and to ensure continued soil health. However, there have historically been few crops to plant during the fall because many plants do not tolerate colder weather well. To provide farmers with more options, ARS researchers recently developed and released three new pea cultivars that can be grown in the cooler months. They are the first winter pea cultivars designed specifically for human consumption rather than feed for livestock.

The cultivars, named “USDA Dint,” “USDA MiCa,” and “USDA Klondike,” will provide farmers with a variety of benefits. In addition to offering more options for fall planting, the peas will help to fix atmospheric nitrogen into a form that is available for subsequent crops, and will use less soil moisture than cereal crops, like wheat, rice, or corn. Incorporating a legume like peas into a cereal-based cropping system will also give farmers an opportunity to break weed and disease/pest cycles.



New Wheat Alters Glucose and Insulin Responses

Research at the ARS Western Human Nutrition Research Center (WHNRC) in Davis, CA, revealed that consuming a new type of wheat may help control blood sugar. ARS scientists tested baked products prepared with resistant starch (“RS2”) wheat, a variety developed by a research partner using selective breeding methods. Results showed that eating these products for one week lowered blood glucose and insulin levels compared to consuming baked products made with conventional refined wheat.

Reducing glucose and insulin may help prevent as well as help potentially manage health conditions such as type 2 diabetes.

Providing Farmers with New Tools and Tactics

Helping Small Farmers in South America Adapt to Climate Change

The Andean region of South America has one of the highest soil erosion rates in the world, which forces many smallholder farmers in the region to abandon their land. ARS scientists from the Soil Management and Sugarbeet Research Unit in Fort Collins, CO, collaborated with institutions to investigate practices that might help smallholder farmers increase sustainability of their lands and adapt to a changing climate.

This team studied practices such as maintaining the soil cover, using no-till or minimum tillage, improving crop rotations, and performing better nitrogen management. They found that these practices reduced erosion, increased yields and economic returns, improved sustainability, and increased the potential to adapt to climate change. The team determined that conservation agriculture methods could help increase the food security and economic returns of 200,000 smallholder farmers in Ecuador.

How Healthy is Your Soil? Digging Deeper for Answers

How much carbon is stored in soil? The answer is crucial, both for the soil's fertility and its ability to combat climate change. Researchers at the ARS Plant Science Research Unit in Raleigh, NC, have developed a new, easier way to find the answer. Using a combination of deep soil samples and a mathematical model, researchers obtained soil carbon estimates comparable to those from more traditional approaches, but with much less time and effort.

The approach has many potential applications, including better assessments of soil health and changes in carbon levels; one immediate use could be tracking soil carbon levels on farms that receive incentive payments for sequestering carbon. The issue is particularly important because some agricultural practices, such as tillage, disturb the soil in ways that cause it to lose carbon; improved measurement techniques might help conservation specialists in their efforts to monitor and restore soil carbon and soil health.

Novel Earth-Friendly Methods for Pest Control

Beneficial Wasp May Help Put Sting in Fruit Pest

Spotted-wing drosophila (SWD), a tiny fruit fly from Asia, poses a major threat to soft-skinned fruit crops in the U.S. Its larval stage bores into the fruit to feed and develop, reducing yield and marketability. In California alone, such attacks can inflict losses up to 80% in cherry, blueberry, raspberry, and other soft-skinned crops worth $4.37 billion annually.

ARS and University of California-Berkeley scientists are evaluating the potential of a natural enemy imported from East Asia to biologically control SWD. They recently released the parasitoid wasp *Ganaspis brasiliensis* at sites in California after ensuring it was not a danger to non-host insects. After mating, female wasps lay their eggs on SWD larvae, and the broods that hatch eat the larvae alive before emerging as young adults. If successfully established, the wasp could help fruit growers dial back their insecticide use against SWD, reducing costs as well as environmental and human health concerns.

New Ways to Sterilize Mosquitoes May Help Fight Deadly Diseases

Yellow fever mosquitoes *(Aedes aegypti)* can spread dangerous diseases to humans, including Zika fever, dengue fever, and yellow fever. To protect people, researchers have studied ways to reduce the mosquito population. Pesticides have helped, but they can also have negative environmental impacts.

Researchers have recently explored sterilizing male mosquitoes. The sterile males mate with females, which then lay infertile eggs. While effective, the techniques used to sterilize the mosquitoes have been complex and expensive, making them difficult to employ widely. ARS researchers at the Center for Medical, Agricultural and Veterinary Entomology in Gainesville, FL, collaborated with scientists from the University of Florida to develop a simpler method. They are combining radiation and mosquito-rearing methods that they believe could be widely replicated and used in place of pesticides.

Improving Aquaculture

Better Water, Happier Fish

Research into the health of farm-raised rainbow trout revealed that one of the secrets to fish survival is in the water. ARS scientists at the Cool and Cold Water Aquaculture Research lab in Leetown, WV, found that fish raised in reused water faced significantly higher mortality rates than those grown in tanks supplied with fresh spring water.

Fish farmers often reuse water to conserve freshwater resources, but the magnitude of risk associated with short- or long-term reused water exposure and its impact on fish genetics and vaccine response was unclear. Researchers examined the health of fish that were vaccinated and those that had received mock vaccinations when raised in either reused or freshwater. Results showed that fish exposed to constant reused water without any acclimation had a mortality rate at least 46-fold over fish raised in freshwater. This research demonstrated the importance of freshwater in improving profitability and fish wellbeing.

Leftovers Make Good Fish Food

Rising costs and ecological concerns are driving the need to find new ingredients for farmed fish feed. ARS-funded researchers in Tallahassee and Fort Pierce, FL, home of the U.S. Horticultural Research Laboratory, determined that clam byproducts and hemp fibers (byproducts of the textile industry) meet the nutritional needs of the farmed fish Florida pompano. Both products are plentiful and provide growth-promoting and healthy nutrients.

These findings will help manufacturers develop more sustainable fish feeds and create alternative revenue streams for other industries.

Saving Tomatoes and Sweetpotatoes from Rot and Root Knot

ARS Researchers Identify Genes that Keep Tomatoes Fresher

Picking the perfect piece of fruit is an art form: it requires finding the one item that's colorful and firm, not yet tipping into the descent of softening and eventual rot. Making that selection just got a little easier, thanks to a team of researchers at the ARS Robert Holley Center at Cornell University, in Ithaca, NY. They have identified a tomato gene that's responsible for the softening process in the fruit as it matures, and found a way to inhibit the gene, keeping tomatoes firmer, longer.

The discovery marked a major step forward in shelf stabilization of fruit because most previous approaches to preserving fruit's appeal interfered with the entire ripening process, serving consumers end products that were not quite ready for prime time, and never reached peak flavor. By understanding this gene, researchers and breeders can now delay the softening process without affecting the fruit's ability to reach that ideal end state.

ARS Researchers Identify Sweet-potato Varieties Fit to Fight Pests

In recent years, farmers in the southeastern United States have struggled with the invasive guava root-knot nematode (GRKN), a microscopic roundworm. GRKN infects and damages a variety of crops, particularly sweetpotato, which had historically been resistant to other species of nematode. To combat this worm, ARS researchers at the U.S. Vegetable Laboratory in Charleston, SC, tested sweetpotato lines from the agency's expansive germplasm collection, which safeguards seeds and other biological material that USDA maintains to ensure the genetic diversity of our food supply.

Within that collection, the researchers were able to identify 20 sweetpotato lines with strong resistance to GRKN. The researchers published their findings, which are already helping sweetpotato breeders at USDA and universities to develop new GRKN-resistant sweetpotato varieties. Once released, these new varieties will help growers protect their crops from GRKN.

Awardees

Presidential Rank Award Winners

Meritorious Executive Winners

Joon Park, ARS's acting associate administrator for research management and operations, was recognized as a 2022 Presidential Rank Meritorious Executive Winner. This award recognizes a select group of career members of the Senior Executive Service for exceptional performance over an extended period of time.

Dr. Archie Tucker, area director for ARS's Southeast Area, was recognized as a 2022 Presidential Rank Meritorious Executive Winner. This award recognizes a select group of career members of the Senior Executive Service for exceptional performance over an extended period of time.

Meritorious Senior Professional Winners

Dr. Joan Lunney, supervisory research scientist with ARS's Animal Parasitic Diseases Laboratory in Beltsville, MD, was recognized as a 2022 Presidential Rank Award Winner. This award recognizes senior career employees with a sustained record of exceptional professional, technical, and/or scientific achievement recognized on a national or international level.

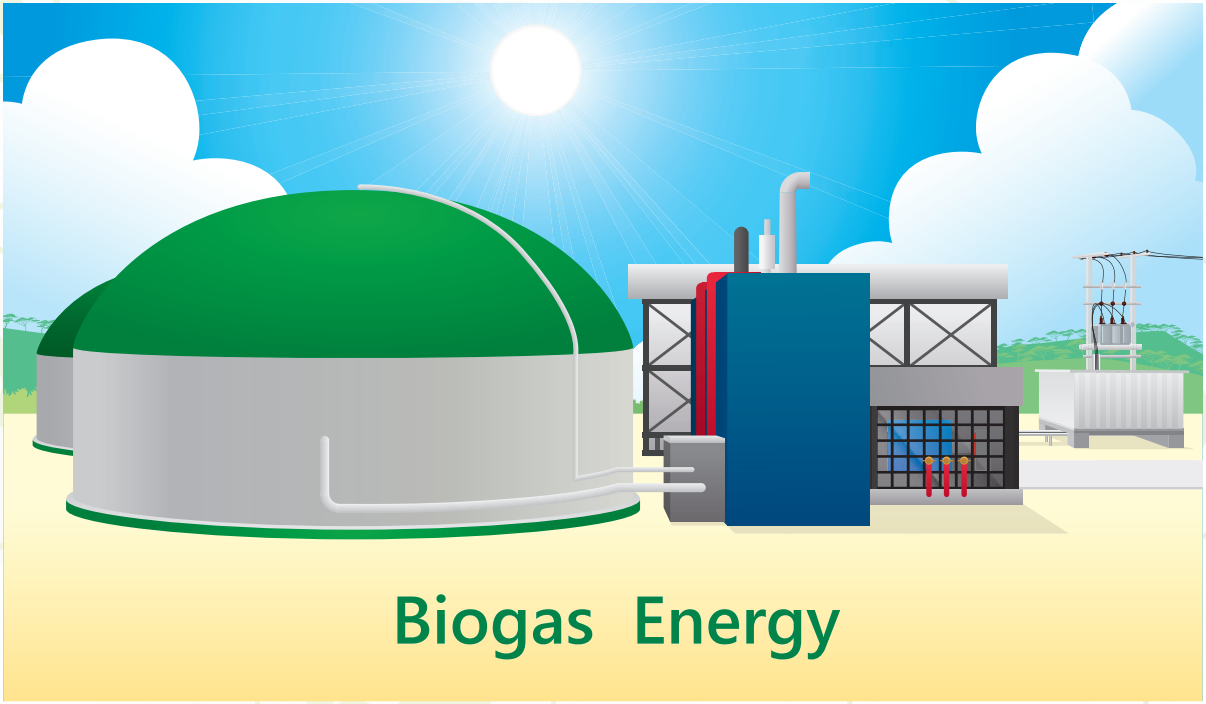
Dr. Matias Vanotti, research soil scientist with ARS's Coastal Plains Soil, Water and Plant Research Center in Florence, SC, was recognized as a 2022 Presidential Rank Award Winner. This award recognizes senior career employees with a sustained record of exceptional professional, technical, and/or scientific achievement recognized on a national or international level.

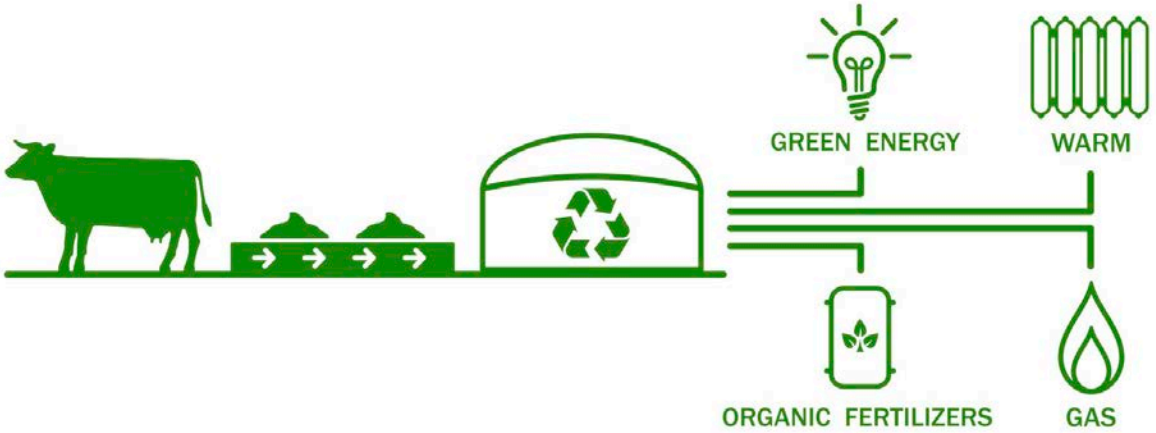
Arthur S. Flemming Award

Dr. Douglas Gladue, research microbiologist with ARS's Plum Island Animal Disease Research Center in Orient Point, NY, received the 2021 Arthur S. Flemming Award for his exceptional achievements in basic science. Dr. Gladue earned the award for the successful, expedited development of the first safe and effective vaccine against African swine fever virus.

Samuel J. Heyman Service to America Medal

Dr. Mark Williams, research agricultural engineer with ARS's National Soil Erosion Research Laboratory in West Lafayette, IN, was a finalist for the Samuel J. Heyman Service to America Medal for Excellence in Water Quality Research. Dr. Williams has become a recognized authority on the movement, distribution, and management of water in agricultural settings, and how that water transports pollutants stemming from the use of fertilizers.


Biogas Energy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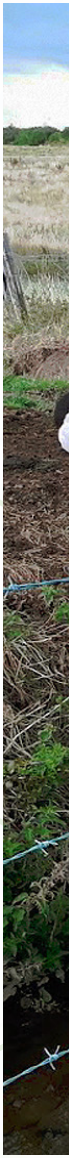

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