

What ARS Does:

Improving Crop, Livestock, and Aquaculture Production

Researching genetic diversity is key for creating novel sources of resistance in crops and improving their resilience to disease, pests, and pathogens. ARS scientists are developing new crop varieties by exploring gene function, using in vitro production, and tracking differences in DNA sequences to identify genes.



In 2022 ARS researchers made advances in crop resilience with the development of two Fusarium head blight (FHB)-susceptible wheat cultivars that enable additional resistance research. In addition, ARS scientists are using fluorescent marker proteins in work to control Huanglongbing (HLB) and determine the origin of the bacterium CLas, which causes HLB and is transmitted to citrus trees by the Asian citrus psyllid. They are also leveraging advanced technology for infested tomato plants.

New gene editing system for validating wheat Fusarium head blight resistance gene function. Fusarium head blight (FHB) is a devastating disease in wheat that reduces grain yield and quality. The market value of infected grain is reduced from mycotoxin contamination associated with FHB, and estimates suggest farmers and food processors incur hundreds of millions of dollars in FHBrelated losses each year. Gene editing can provide an effective tool to create new sources of resistance but using gene transformation to deliver CRISPR/Cas9 and guide RNA into wheat plants to study is successful in only a few cultivars. ARS researchers in Manhattan, Kansas, developed and optimized a new RNA delivery system to produce transgene-free mutant plants. A major FHBsusceptibility gene was successfully edited in two FHB-susceptible wheat cultivars and the gene-edited trait was heritable in different wheat genetic backgrounds. This gene editing system can be used to create novel mutations for a wide array of applications in wheat breeding, including improving resistance to FHB. (NP 301)

Use of SymbiontTM technology for in vitro production of therapeutic molecules. In work funded by a \$15 million 5-year NIFA grant, ARS researchers in Fort Pierce, Florida, and Ithaca, New York, demonstrated that proprietary Symbiont technology can be used for in vitro production of large quantities of therapeutic molecules. The multidisciplinary work, which is also part of a CRADA with the agricultural biotechnology company AgroSource, Inc., demonstrated that symbiont tissue can be cultured in vitro for the costeffective production of molecules that are secreted into the culture media and continuously harvested. This was demonstrated using fluorescent marker proteins and by production of a special class of antibodies called nanobodies. The collaborating scientists studied the ability to make nanobodies in their Symbiont system because they are also developing nanobodies against effector proteins produced and secreted by the bacterium that causes HLB. These effectors induce HLB disease symptoms in infected citrus plants, and other lines of research indicate that binding antibodies/nanobodies to these effectors prevents disease development. The scientists also demonstrated that functional nanobodies can be produced in plant cells using a gene encoding a nanobody that targets SARS-CoV-2 spike proteins. This nanobody was found to inhibit the interaction of the SARS-CoV-2 spike protein and the surface antigen on mammalian cells that it uses to enter the cell. This work shows that the plant-based Symbiont cells can be used to produce therapeutic molecules, and current research is underway to evaluate the Symbiont system for producing therapeutic candidates to treat citrus HLB disease. (NP 304)

New, highly protective vaccine for Marek's Disease. Repeated emergence of more virulent Marek's Disease Virus (MDV) strains in vaccinated chicken flocks prompted urgent research focused on enhanced Marek's Disease (MD) vaccines. ARS researchers in East Lansing, Michigan, and Athens, Georgia, collaborated with a researcher at Simon Fraser University (Vancouver, Canada) and used innovative, recombinant DNA technology and naturally occurring genetic variation in a targeted gene to develop a new, highly protective MD vaccine candidate. Genomic discoveries and newly developed recombinant vaccine methodology allowed researchers to respond quicky to ever-changing and emerging disease threats on the farm. A next step will include regulatory approval, offering the U.S. poultry producers the new MD vaccine to reduce mortality and morbidity; improve poultry health, well-being, and production efficiency; and support economic sustainability of the poultry industry. (NP 101)

How new foot-and-mouth disease viruses emerge in nature. Foot and mouth disease (FMD) is a devastating disease of livestock this is easily transmitted, and the virus is capable of persisting without causing disease, which has important implications for FMD control strategies. This phenomenon is called the "carrier state" and was widely perceived as a dead end because of the belief that persistently infected cattle could not transmit the virus to other animals. ARS scientists in Orient Point, New York, demonstrated that when persistently infected carriers of FMDV were exposed to a different strain of the virus, the two viruses exchanged genetic material (recombined) to give rise to new viruses containing distinct parts of each of the parental viruses. This discovery demonstrates a novel process whereby new strains of FMDV may evolve and emerge in the field, and contributes towards preparing for a potential outbreak of new and emerging FMDV strains that could pose a threat to the U.S. homeland. (NP 103)



Learn more about National



Program 101

Learn more about National Program 103



Learn more about National Program 301



Learn more about National Program 304

Stay up to date with ARS! Learn how we're solving major agricultural problems.



Agricultural Research Service U.S. DEPARTMENT OF AGRICULTURE

www.ars.usda.gov





USDA is an equal opportunity provider, employer, and lender.