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Novel Ways To Combat Plant Pathogens

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Plant diseases must be managed to successfully and reliably produce crops to meet humanity's growing food, fiber, feed, and fuel needs. Plant disease management relies on many different types of tools—from disease-resistant plant varieties and pesticides to cultural and biological strategies. Agricultural Research Service scientists are seeking new methods of managing plant diseases, more efficient means of using older methods, and combinations of these methods. Two of the oldest ways of reducing plant diseases are crop rotation and organic amendments to soil.

In Orono, Maine, for example, ARS scientists are evaluating a holistic approach to suppressing soilborne pathogens of potato, including 2- and 3-year rotations with barley, ryegrass, canola, and rapeseed. In one study, the regimen reduced the incidence of *Rhizoctonia* by as much as 50 percent. They also examined the effectiveness of biological soil amendments, such as compost tea (compost steeped in water) and cover crops of winter rye, against various types of scab, black scurf, and other potato diseases. (See story in the next issue.)

Historically, heat has been used to rid plants of some pathogens—at temperatures and durations that won't damage the plants in the process. Indeed, in Fort Pierce, Florida, ARS researchers are evaluating such a method to rid citrus seedlings of the bacterial agent that causes Huanglongbing (HLB), also known as "citrus greening." The citrus disease has caused serious economic losses in the "Sunshine State" and in other citrus-growing regions of the world for decades. The disease weakens, and can eventually kill, afflicted trees as well as render their fruit unmarketable.

The Fort Pierce team found that heating potted citrus seedlings in growth chambers for periods ranging from 2 to 10 days reduced or eliminated HLB infection. They found that all of the heat treatments were equally effective, regardless of temperatures and exposure times. The next step is to adapt these methods for field applications. (See story that begins on page 4.)

Biological control—the use of beneficial microbes, insects, or other organisms to reduce populations of insect pests or plant pathogens—is another crop-protection strategy. In Peoria, Illinois, ARS researchers are evaluating this method as a way to slow the spread of two fungal pathogens of avocado (*Raffaelea* and *Fusarium*) that are disseminated, or "vectored," by small ambrosia beetles.

Although these beetles cause damage on their own, the fungi they transmit can kill avocados. So, in addition to attacking the beetles with biocontrol agents, the team is also targeting the fungi, which the beetles cultivate inside the trees—and which cause diseases that threaten America's $322-million avocado crop. (Story on page 20.)

Plant viruses commandeer the cellular machinery of plants to replicate and spread—typically at great cost to their host's health and productivity. But what if that same cell-infecting ability could be turned to good use? That's a question ARS researchers in Beltsville, Maryland, are working to answer. They're exploring approaches for using certain viruses to genetically transform plants into "bio-factories" capable of making therapeutic products, including antimicrobial peptides and animal vaccines. Plant-based vaccines are an especially intriguing prospect because of the potential for greater availability, lower production costs, ease of use in immunizing large numbers of livestock animals, safety advantages, and other benefits.

Under the Plant Diseases national program and other ARS national programs, ARS researchers collaborate with university scientists, private industry, and other partners in efforts to sequence the genomes of major crop pathogens, including *Phytophthora infestans*, which causes potato late blight, *Fusarium graminearum*, the culprit behind wheat scab, and *Candidatus* Liberibacter asiaticus, which causes HLB in citrus.

Genome mapping can shed new light on how pathogens cause disease, evade host defenses, or reproduce and spread. It can also reveal weak links that can be exploited to design novel controls that mitigate yield and quality losses in host crops. Another focus is developing sensitive, easy-to-use, and reliable diagnostic assays to detect and identify pathogens. Some of these can identify multiple pathogens simultaneously and return results within hours or minutes of processing a sample. This capacity can be critical to decisionmaking in both the field and at regulatory agencies charged with safeguarding agriculture and natural resources.

Computer modeling, epidemiology, bioinformatics, and other fields of study also figure prominently in ARS's plant diseases research program, which prioritizes crop pathogens for study by their high impact on crops and producers' incomes, regulatory or quarantine significance, importance to national biosecurity, and usefulness as a model organism for understanding other pathogens.

ARS research program areas are designed to be crosscutting and collaborative, and the Plant Diseases national program is no exception. It will continue to draw on and complement the strengths of other research programs in responding to stakeholder needs in a manner that is timely, relevant, and sustainable, both environmentally and economically.

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