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Crop-Friendly Bacteria Tapped To Battle Fungal Marauders

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Soil-dwelling bacteria that depend on wheat and barley roots for their "room and board" could soon make good on their debt. Researchers are investigating the microbes' potential to biologically control root-rot fungi that cause crop yield losses of 10-30 percent annually in the U.S. Pacific Northwest and other parts of the world.

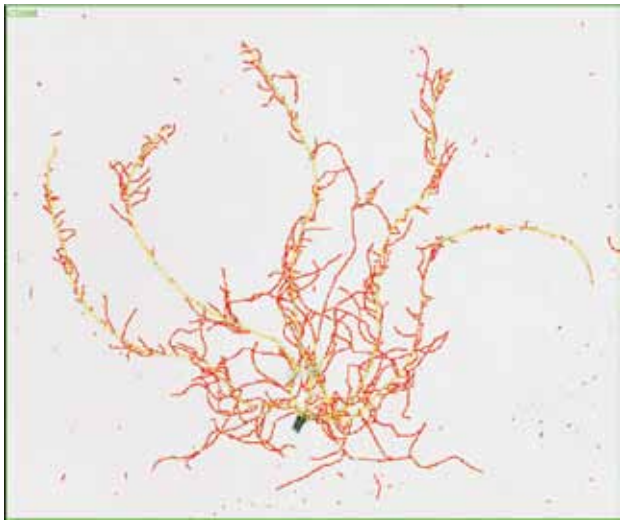
The bacteria are members of the genus *Pseudomonas* and include 11 strains that stymie the growth of *Pythium* and *Rhizoctonia* fungi, which are responsible for damping-off and root-rot diseases of wheat and barley. The pathogens thrive in cool, moist soils and can reach especially high levels in crop fields where conservation tillage is practiced to save on fuel costs, avoid soil erosion, and attain other ecological and environmental benefits.

"They're most problematic to seedlings of spring crops that are 4 to 6 weeks old," notes Pat Okubara, a geneticist in the Agricultural Research Service's Root Diseases and Biological Control Research Unit in Pullman, Washington. "Fungicides are not very effective, and there are no resistant wheat or barley varieties yet," she adds. Rotating wheat with nonhost crops is difficult too, because of the fungi's extensive plant-host range.

Over the past year, Okubara and university colleagues have evaluated the biocontrol potential of 26 *Pseudomonas* strains. From those, they chose 11 for further study based on 3 important characteristics: rapid colonization of and persistence on roots, high antifungal activity, and reduction of plant disease symptoms.

Prior studies show that *Pseudomonas* bacteria secrete powerful antibiotics to keep their fungal rivals at bay—to the benefit of wheat and other host crops. But other mechanisms are also at work, notes Okubara, whose collaborators are Chris Taylor (Ohio State University, Wooster), Olga Mavrodi (Washington State University, Pullman), and ARS technician Nathalie Walter.

PAT OKUBARA (D2715-1)



Digital scan of the roots of a wheat plant treated with a biocontrol bacteria strain. From the scan, root measurements are made, and this information helps ARS researchers evaluate the strain's effectiveness against root pathogens.

Some strains, for example, help the plants help themselves by triggering a sort of immune-system response called "induced systemic response." Others produce hormone-like substances that spur on root and shoot growth in the plants, enabling them to recover from fungal damage more easily.

Wheat roots being washed to assess disease severity and root growth following a biocontrol treatment.

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In nature, the bacteria and fungi compete for precious space and nutrients that both need to survive and grow. Unlike the fungi, however, these bacteria generally don't harm the plants and can greatly benefit plants when pathogens are present. It is this phenomenon that the researchers hope to exploit in the form of a biobased-pesticide seed treatment for wheat and barley and for greenhouse-grown ornamental and herb crops, such as lavender and basil.

In greenhouse tests with seedlings from the wheat cultivar Penawawa, use of five of the *Pseudomonas* strains diminished the severity of *R. solani* AG-8 root rot by 30-92 percent and *Pythium ultimum* by 32-56 percent. Two strains also reduced rot caused by *R. oryzae* and *P. irregulare,* which also plague Pacific Northwest wheat and barley crops.

A commercial product isn't likely for another few years. But the arrival of any new antifungal weaponry should be welcome news for wheat growers, especially those who've shied away from direct seeding or other conservation-tillage measures.

"Any means of reducing the pathogen in the field could also benefit crops used in rotation with wheat," adds Okubara.—By **Jan Suszkiw,** ARS.

This research is part of Plant Diseases, an ARS national program (#303) described at www.nps.ars.usda.gov.

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