Brassica's Pest Control Role in Apple Orchards Clarified

In Washington and California, among other states, biofumigation is gaining popularity as a natural means of controlling soilborne crop pests before planting time.

Biofumigation occurs when cover crops of mustard, canola, or other *Brassica* species decompose and release various chemical byproducts, particularly isothiocyanates, which are toxic to certain pathogens, parasitic nematodes, and insects.

However, against *Rhizoctonia solani* fungi—a culprit behind apple replant disease—mechanisms other than biofumigation are at work. So say Mark Mazzola and Michael Cohen, plant pathologists working to improve *Brassica* crops' use in integrated approaches to managing replant disease—traditionally, the target of chemical fumigants like methyl bromide. In the Pacific Northwest, the growth-sapping affliction of young apple trees can translate to diminished crop returns of $40,000 per acre over 10 years, an orchard's average production life.

While experimenting with different disease-control strategies, including applications of canola *(B. napus)* seed meal, Mazzola and Cohen observed that *Rhizoctonia* control—and to a lesser degree control of *Pratylenchus penetrans* nematodes—wasn't the result of isothiocyanates, but rather of changes the seed meal causes to the soil environment.

"Biofumigation implies that a *Brassica* soil amendment is releasing bioactive compounds. But control of *Rhizoctonia* in response to *B. napus* seed-meal amendment has nothing whatsoever to do with the yield of isothiocynates," says Mazzola, with ARS's Tree Fruit Research Laboratory, Wenatchee, Washington. Cohen is with Sonoma State University, Rohnert Park, California.

Evidence backing this assertion includes successful use of *B. napus* varieties that produced small amounts of isothiocynates and low *Rhizoctonia* levels weeks after the isothiocyantes had disappeared from the soil. Also, control of *Rhizoctonia* in seed-meal-amended soils occurred only when resident microbes were present; when researchers killed them off and then introduced *Rhizoctonia,* the seed meal did not stop the disease from developing.

Examination of apple roots also revealed fewer *Pratylenchus* nematodes, with control attributed to the pest's sensitivity to added nitrogen from the seed-meal amendment. But, notes Mazzola, "The nematode suppression was not prolonged."

MARK MAZZOLA (D467-1)

An ARS research apple orchard in Wenatchee, Washington, being replanted in spring 2005.

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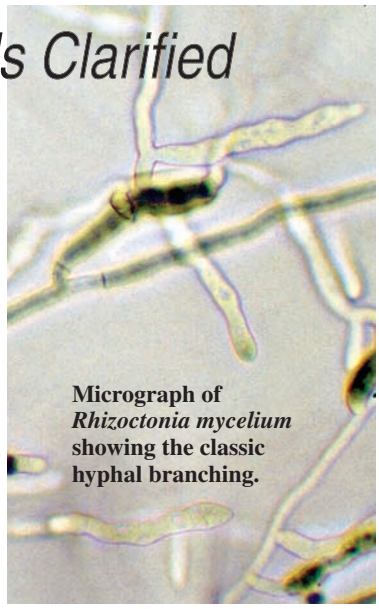

Micrograph of *Rhizoctonia mycelium* showing the classic hyphal branching.

What's at Work Here?

"We believe the *Rhizoctonia* suppression is due to production of nitric oxide," says Mazzola, who described the results in the November 2005 issue of *Plant Disease.* In plants, nitric oxide can mobilize a generalized pest-fighting response called "systemic acquired resistance."

Canola seed meal contributes nitrogen, from which nitric oxide is derived. It also provides carbon, which feeds growth of certain members of the soil's microbial community. Among these are nitric-oxide-producing strains of *Streptomyces* bacteria and *Pythium* fungi—another replant disease culprit.

"Our working hypothesis is that the apple tree resistance occurs because root-colonizing *Streptomyces* bacteria are producing nitric oxide," Mazzola says.

In commercial orchards, however, *Pythium* increases resulting from canola seed-meal applications would be problematic. Indeed, in their studies, the scientists had to combine the amendment with postplanting applications of the fungicide mefenoxam—a real-world reminder that *Brassica's* pest control abilities aren't so easily defined.

"The take-home message is that, in our studies, biofumigation was not the functional mechanism," says Mazzola. "It's all about the amendment's impact on soil biology, which is then responsible for the control of *R. solani.*" —By **Jan Suszkiw,** ARS.

This research is part of Methyl Bromide Alternatives, an ARS National Program (#308) described on the World Wide Web at www.nps.ars.usda.gov.

Mark Mazzola is with the USDA-ARS Tree Fruit Research Laboratory, 1104 N. Western Ave., Wenatchee, WA 98801-1230; phone (509) 664-2280, fax (509) 664-2287, e-mail mazzola@tfrl.ars.usda.gov. ✸