Microbes for Sugarbeet Maggots

By Dr. Stefan T. Jaronski, Research Entomologist
NPARL, 1500 N. Central, Sidney, MT, 59270; sjaronski@sidney.ars.usda.gov; 406-433-9486

The following is the latest offering in a monthly series discussing ongoing research efforts at the USDA-ARS Northern Plains Agricultural Research Laboratory (NPARL) in Sidney, Mont.

It's a small fly, with an imposing, almost unpronounceable name: *Tetanops myopaeformis*. But the fly can have a major impact on a crop familiar to Richland Country farmers, the sugar beet. Although not currently a threat to local growers, the fly, commonly called the sugarbeet root maggot, is a consistent, serious problem to beet farmers on about 100,000 acres in the northern Red River Valley of North Dakota. There fly populations are often thirty times more numerous than here and infestations left untreated will suffer as much as 40 percent loss in yield. In fact, the sugarbeet root maggot has been listed as *the* most important pest on the 1.4 million acres of U.S. sugar beets.

Existing Control Tools and a "Natural" Alternative

Farmers do have a couple of chemical tools to combat this insect. Almost 50 percent of those acres were treated with chemicals for the maggot in 2001. However, several are so highly toxic that their use is restricted to certified applicators and the chemicals must be applied with many safeguards to the farmer.

Nature may be the source of an alternative to synthetic chemicals. That alternative consists of an insect pathogen (or disease causing agent). Yes, insects have their pathogens, just like humans -- viruses, bacteria, protozoa, fungi, even worms. These insect pathogens can be important natural control agents. For example, the dreaded Gypsy Moth is now controlled in parts of the Northeast by a fungus that unexpectedly appeared in the early '90s.

The Environmental Protection Agency, which regulates the use of pesticides, recognizes these pathogens as a distinct group – microbial pesticides. Several microbes have actually been commercialized in the U.S.: a bacterium for controlling various caterpillars, another for mosquitoes, a virus to control a forest pest, and several fungi to attack various insect pests.

A "Fatal Athlete's Foot?"

I work with fungi that attack insects. I like to think of these fungi as "fatal athlete's foot of insects." That's sort of how they work. Spores, akin to spores of bread molds, will germinate when they land on the surface of an insect. Using a cocktail of enzymes and mechanical pressure, the fungi penetrate through the skin of an insect within 24 hours and start to grow through the body. There is not much defense an insect can offer. Infection is almost always fatal within 4-7 days. These fungi are specific to insects. They don't infect amphibians, or fish, or birds, or mammals. That's part of their appeal to EPA.

Two of these fungi may be just what the "Bugdoc ordered" to manage sugarbeet maggot problems (and wireworms too). The two fungi have the names *Beauveria bassiana* and *Metarhizium anisopliae*. Both have been known for hundreds of years and attempts to use them to control insects date back to 1879. Neither is genetically manipulated; both are natural. In some countries they have been widely used against insects. One fungus is being mass-produced on a ton scale in Butte, Mont., for use against vegetable and flower pests.

I and my staff at the USDA lab, Julie Grace, Selene Gaffri and Bryan Fitzgerald, have been researching these fungi for the past two years. We have been identifying the best strains to use, learning the best methods to apply them to sugar beets, and studying factors that may affect their effectiveness.

For instance, we have found that the fungi infect and kill maggots better in some soils than others and that the range of normal soil moistures during the growing season does not impair their survival during the time one would need to use them.

Application Options and Some Results

How would one use these fungi? One way could be to apply the fungus to the seed coat, or as granules to the soil around the seed at planting. Or, the most promising option, the spores can be made up in water and sprayed using normal equipment, just like an agricultural chemical. The fungi can then be applied to the bases of the growing sugarbeet plants, right where the flies lay their eggs in early June. In this manner the fungus spores are in the soil around the base of the beet plant, waiting for the eggs to hatch, ready to intercept the larvae as they move to the beet root.

In a field trial on the station this summer, we observed that this "peak fly spray" of fungus gave protection equal to the main chemical used in sugar beets, under the low to moderate fly numbers existing in the valley this summer.

Related Research Efforts

But there is a larger context to our research. We have teamed up with researchers at Montana State University, North Dakota State University, University of Minnesota, the USDA lab in Fargo, and others to come up with other microbes, cultural practices and sugarbeet hybrids to deal with all the sugarbeet pathogens and nematodes. The ultimate goal is a pest management system that integrates *all* the available tools to lessen the amount of toxic chemicals that have to be used.

Bacteria: An MSU researcher, Dr. Barry Jacobsen, has developed a bacterium to control the various soil fungi that attack germinating beet seeds, and another that seems to be pretty effective against another beet disease – Rhizoctonia Crown Rot. A third bacterium may give considerable protection against Cercospora Leaf Spot.

Cover Crops: Dr. Mark Boetel, of NDSU, has been researching how planting beets into an oat or barley crop can lessen the attractiveness of the sugar beets to the flies and thus lessen their impact. The grains are later killed off during normal weed control operations and don't seem to affect yield.

Another Fungus: A fungus that might control sugarbeet cyst nematode has been commercialized in Australia and Europe. A fungal metabolite has also been commercially developed in the U.S. for use in other crops. Either might provide another component in this integrated pest management scheme.

Hybrids*:* Dr. Larry Campbell, USDA, Fargo, has developed sugarbeet hybrids with increased tolerance to a certain amount of maggot feeding. These hybrids are being incorporated into commercial beet lines to increase yields. Our fungi, coupled with one of these future lines, may provide a combination that would allow Red River Valley farmers to use less insecticide in the face of their large insect numbers.