

Biological Control Agents of Insect Pests on Potatoes

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I'm going to talk about biological control agents of pests of potatoes. I'm going to try to stick to the major pests—the potato beetle, of course; the aphids; and the European corn borer, which is becoming a real problem here in Atlantic Canada these days.

Biological control agents are generally found naturally in your fields. The problem with the natural populations is the way they increase in population. The increase in predator population usually follows the prey populations. As the prey increases, the predators increase. But usually by the time they reach a point where they can have significant effect on the pest population, it's too late. You want them to have an effect right now. So a lot of times you have to augment the population—introduce biological control organisms into your field.

I'm going to go through predators, pathogens, and parasites here. One very well-known predator is *Perillus bioculatus*. I worked with it in Quebec, and I think Gilles has worked with it too. It's very efficient. The only problem with this insect is that it's very specific—it likes potato beetles only. As a result, at the end of the season when the potato beetles go into overwintering, this insect is left without food, and they can't survive. They do eat other insects, but they prefer potato beetles. There is a problem with mass rearing, so because of that they're not commercially available right now. The people are working on it; research is being conducted to try to mass rear this predator so that it would be commercially available.

Another predator is *Podisus maculiventris*. It's a generalist predator and it feeds on Colorado potato beetles and also there is some information out there that it may be feeding on the European corn borer. It still has to be looked at in more detail. It feeds on the eggs, the larvae, and the adults. Here we have a nymph feeding on potato beetle larva and also on the eggs. We do need to do more research on release rates: How many insects do we need to release into the field to get effective control? Because it is a generalist predator, it can feed on other insects when the potato beetle is not there. So it would survive and feed on other insects. It does prefer potato beetles if offered a potato beetle as compared to another worm or something. It is commercially available and you can get it from several places that sell biological control agents; you can get them in Canada. We are conducting research at the moment on the release rates of these bugs. We did do some research on them during the last couple of summers and what we've found was that there was a significant decrease in the defoliation when we used the predators in the field. We did use a vacuum and Novodor and a combination of the vacuum and Novodor and also we dusted Admire. So, as you can see, the bugs do significantly decrease the defoliation in your fields.

Carabid beetles are another one that you commonly find in your fields. They will feed on aphids and CPB as well as weed seeds. There are several different species; one or two feed on potato beetles. We need more studies on how to manipulate the habitat and how to enhance the population within your field. They are normally present. They are not commercially available, so you'd have to enhance the population within your fields and we are trying to do more studies related to habitat and manipulation.

Coccinellids or lady beetles are very good predators of aphids. We do know that natural populations exist and they do control aphid numbers quite effectively; however, a lot of times the aphid population is really high so you have to have periodic augmentative releases of the lady

beetles. One thing I would like to mention is that if you are buying lady beetles, it is better to find out what species they are so that you're not introducing a species that may displace the native species that are present wherever you are introducing them. They are commercially available, so you can buy them in Canada. Most of the time, if I say something is commercially available, it is available in Canada.

Aphidoletes is a little midge—a fly. They are very effective in greenhouses to control aphids. There are a few studies in California that have looked at potato aphids, and it has shown that these are effective in controlling potato aphids. There are not a lot of studies on potatoes; mostly it's used in greenhouses. It is commercially available in Canada. It would be nice to do some more studies on potatoes to see if it really does work in a field situation. It is used on fruit trees. In BC I think they use it on fruit trees.

A lot of people might have seen little white eggs on potato beetles late in the season. These are parasitoids called tachinid flies. They're fairly big flies—a little bigger than a housefly. In general, they control the fourth instar larvae and the adults. You'll see them laying their eggs on the fourth instar larvae and adults. The problem with tachinid flies is that they come very late in the season. They are there for the fourth instar larvae, and by that time all of the damage is already done; the larvae have been feeding on your plants, defoliation has already occurred. This is why they are not really considered very good biocontrol agents. They may reduce the overwintering population by decreasing the fourth instar larvae before they go into the ground to pupate. They'll usually lay their eggs on the fourth instar larvae, go into the ground, pupate, and instead of a beetle coming out, you'll have a fly coming out. So they might control the overwintering population, but it's not very significant. Because of that, they're not being studied as much and they are not commercially available. But I've put them in here because a lot of people see them in their fields.

Trichogramma is a little wasp which infects European corn borers. It is used in corn to control European corn borers in Ontario and Quebec. It hasn't really been tried on potatoes. They are commercially available. We can try it on potatoes, and we are starting some studies this year to try to determine the efficacy of this wasp.

Nematodes are commercially available. They are effective in controlling the Colorado potato beetle; however, nematodes need moist environments. So if you spray your field with nematodes, as soon as the spray dries on your leaves it's not going to work—they will die. It works very well in the soil. Because it works in the soil, it's most effective against the pupa and the adults of the potato beetle. You do need massive doses to control this insect. It has been found effective. I think Gilles worked with it in New Brunswick, and Jeff Stewart worked on it here on PEI.

Beauveria bassiana is a fungus that infects the larvae and adults. It is found to be quite effective. Timing of application is very critical because *Beauveria bassiana* spores die in sunlight. So if you spray during the peak of the day when the sun is shining, they're all going to die. So you have to spray when it's cloudy or in the evenings. It is available commercially in the United States. It's a registered product. Studies in Maine have shown that it is effective and if you keep applying it to your field over and over again it does accumulate to a certain extent and you do have better control of larvae that go into the soil to pupate. It's not registered yet in Canada, and we're hoping that it will get registered here sooner or later.

Bacillus thuringiensis (Novodor, Bt) is a bacterium that works against the Colorado potato beetle and gives very effective control if you apply it when they're just hatching. It's very effective against early instar larvae. It is registered in Canada; however, there is some debate about its use in organic production because of the inert material that is in the product. I would suggest that you contact your certification body before you use Bt.

Spinosad is registered under the brand name Success for commercial producers. It is a bacterial fermentation product registered for use against the Colorado potato beetle and the European corn borer. Again, it works best against the younger larvae as compared to the adults and fourth instar larvae, so if you apply it just as soon as they start to hatch you will get better control. It is not presently registered for organic production in Canada; however, it is registered under the brand name Entrust in the United States for organic producers. The company, Dow AgroSciences, is now pursuing registration in Canada and we're hoping that it will be registered soon for use by organic producers under the brand name Entrust.

Q: Do the stink bugs overwinter in Canada?

A: The *Perillus* doesn't, but the soldier bugs do overwinter.

Q: So there's the capacity to build up the population.

A: Yes.

Q: I have two questions. Is the reason Success is not registered for organic because of the inert ingredients?

A: Yes, it is because of the inert material that's in the product. It's not considered organic, so that's why they have changed it.

Q: Do you have any price range for the *Trichogramma*? I know some parasites are used in food crops which are high-value, small acreage, but when they're used with field crops, what sort of costs are you looking at for introducing...

A: I'm looking into what the cost would be. It's not too expensive—it was \$38 for about 2000 *Trichogramma*. But now we have to find out how many we have to introduce in potato fields and at what rate. We're going to try to figure out how many, and if they do work in potatoes. They do work in corn, but I don't know about potatoes.

Q: What about the nematodes? Is it the same method as in soybean production?

A: You have to have massive doses of nematodes, and it has to be moist. If you don't have the moisture, the nematodes die.

Q: Are you sure you're talking about the same type of nematodes? There are many different types of nematodes out there. Are you talking about a root feeder?

A: This is a biological control agent; it will not feed on your roots. It's a specific entomopathogen so it will only feed on insects.

Q: Is there any kind of guide available online that would have pictures of predatory insects and biological controls?

A: If you go to some of the companies that sell these products, they would have it online. Also, the Entomological Society of Canada is putting together a website.

Q: Just a comment about nematodes (inaudible)

A: Yes, that's the problem with nematodes. They're costly, and if you have a dry summer you're just killing everything. Also, you have to have massive doses to get proper control.

Q: Maybe you could speak about the potential problems with biological controls and fungi in particular.

A: *Beauveria bassiana* is a fungus that can attack several kinds of insects, so you may run into problems where it is killing your beneficials. When we do studies we look at the isolate we're using. Different isolates affect different insects and at a different rate, and sometimes they're immune to the isolate that you're looking at. There are several isolates out there. Generally, when we're doing research, we do try to see if it is going to affect any of the beneficials that are going to be present in the field. But there is always the potential that you are going to be infecting your beneficials.

Q: What is the possibility of raising the tachinid flies in greenhouses?

A: You would have to do some more research on them. A lot of times you must have the host to rear the predator or parasitoid or whatever. So you have to grow the host to rear the predator. If the host costs you so much to rear, you're going to have problems—the cost-effectiveness is not there. As far as I know that's why they don't rear these tachinids.