Potato Progress

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Andrew Jensen, Editor. Submit articles and comments to: ajensen@potatoes.com
108 Interlake Rd., Moses Lake, WA 98837; Fax: 509-765-4853; Phone: 509-765-8845.

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The Potential for Using Insect Specific Pathogens for Control of Insect Pests of Potato

Lawrence A. Lacey, Ekaterini Riga and William Snyder.
USDA-ARS Wapato, WSU Prosser, and WSU Pullman, respectively.

Despite potent toxic chemical defenses, potatoes are attacked by many invertebrate pests including insects, mites, slugs, and nematodes. Insect pests and their relative importance vary from region to region, but most control efforts rely on broad spectrum conventional insecticides. In certain situations, especially organic farming, a softer approach may be required or desired. Microbial control offers an alternative to conventional insecticides that is safe for natural enemies of pest insects and mites. In this article we highlight the potential for microbial control of some of the more important insect pests of potato in North America.

The potato tuber moth (PTM) is considered the most serious pest of potato tubers in the field and in storage in warm, dry areas of Mexico, Central America, the inter-Andean valleys of South America and in several countries throughout Asia and Africa (CIP, 2003). It has recently been reported as a significant pest in the Pacific Northwest. Larvae of PTM bore into stored potatoes and along with the action of rot causing bacteria can rapidly destroy them. The most widespread of the tuber moths is the common potato tuber moth, *Phthorimaea operculella*. An insect specific-virus known as the PTM granulovirus can contribute to management of PTM in storage. The developmental research for a simple technique for multiplication and formulation of the virus was conducted at International Potato Center in Lima, Peru. Insect-specific nematodes and certain varieties of the caterpillar-active bacterium, *Bacillus thuringiensis* (*Bt*), also have potential for control of PTM and other tuber moths. *Bt* can be easily applied using conventional spray equipment.

The green peach aphid, *Myzus persicae*, is often viewed as the most important potato pest in the Pacific Northwest, mainly because of its role in transmitting potato leafroll virus and other viruses. Naturally occurring fungi are important regulators of aphid populations including aphids on potatoes in more humid areas. Although development of fungi as "mycoinsecticides" of aphids in potatoes has been studied, no large scale implementation has yet been attempted.

The Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, is a widespread defoliator of potato. When infestations are high, the crop can be completely defoliated before tubers are large enough to warrant harvest. Recent literature reviews address the potential for biological control of CPB including the integrated use of pathogens, predators, and parasites (Lacey et al. 2001). Until the mid-1980s, the fungus, *Beauveria bassiana* was the principal microbial control agent for CPB. Control of CPB ranged from poor to excellent using the fungus. *Beauveria bassiana* offers the advantage of recycling in host cadavers and persisting in the soil beneath potato plants thereby affecting the survival of subterranean stages of the beetle (Lacey et al., 1999). The discovery of *Bacillus thuringiensis* var. *tenebrionis* and other *Bt* toxins with activity against beetles broadened the options for microbial control of CPB. The bacterium provides excellent control of larvae, especially when applied against early instars. Timing and frequency of application, amount of inoculum, spray coverage, crop canopy, rainfall and UV inactivation can have strong influences on the efficacy of both pathogens.

Insect-specific nematodes, also known as entomopathogenic nematodes, have also been proposed as microbial control agents of CPB. Berry et al. (1997) reported that no potato beetle adults emerged from soil treated with the endemic entomopathogenic nematode, *Heterorhabditis marelatus.* In addition, they reported that exotic entomopathogenic nematodes were not as effective controlling CPB as the endemic nematodes. Nickle et al. (1994) reported that the entomopathogenic nematode, *Steinernema carpocapsae*, reduced CPB adult emergence by more than 90%. In many cases entomopathogenic nematodes can be applied in combination with synthetic pesticides without harming the nematodes (Georgis,1990). This compatibility between chemical and biological control should allow both organic and conventional growers to take advantage of insect control by nematodes.

The larvae of click beetles, also known as wireworms, can be locally important pests of potato tubers, especially if potatoes are rotated with crops preferred by the beetle, such as grains. There has been relatively little research on the microbial control of these pests. Toba et al. (1983) attempted unsuccessfully to infect larvae of *Limonius californicus* with entomopathogenic nematodes. Current research in the USDA-ARS Wapato laboratory indicates some potential for certain species of nematodes for control of the Pacific coast wireworm, *Limonius canus*, the most prominent wireworm pest of potatoes in our area. The fungus, *Metarhizium anisopliae*, has been reported from wireworms and is currently under development in Agassiz, British Columbia, Canada, Lethbridge, Alberta, Canada and in the Wapato laboratory for control of pest species. Wireworm larvae may take two years in the soil to develop to the adult stage. Both the fungus and nematodes are soil organisms and have good potential of being effective in the wireworm environment.

Recently, the authors are proposing to use several techniques to augment and establish populations of entomopathogenic nematodes and fungi in potato fields in order to control wireworms and Colorado potato beetle. They will also examine whether mustard cover crops will interfere with the establishment of beneficial fungi, nematodes and predatory insects, and if cover cropping, entomopathogenic nematodes and fungi will work together to control the beetle pests.

Table 1. Insect-specific pathogens reported from or proposed for microbial control of miscellaneous insect pests of potato.

Loopers, army worms	*Bt*, baculoviruses
Cutworms	nematodes, *Bt*, baculoviruses
White grubs	nematodes, *Bt*, *Paenibacillus spp.*
Grasshoppers	*Nosema locustae*, Entomophthorales, *Metarhizium*
Flea beetle larvae	*Bt*, nematodes, *Beauveria bassiana*
Root worms	nematodes

Several other insect species are regarded as potato pests, but their economic importance varies from region to region. Pathogens with potential for control of some of these species are presented in Table 1. Although many insect pests may be susceptible to microbial control agents, their control may not be practical under certain environmental conditions. For example, the use of fungi to control aphids in low humidity environments.

References Cited

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Upcoming Educational Events

- ✔ Columbia Basin Potato Workshops
  - January 7, Moses Lake.
  - January 8, Pasco.
- ✔ Washington State Potato Conference and Trade Show, February 3-5, Moses Lake.
- ✔ Western Washington Potato Workshop, February 27, Mount Vernon.

WSPC Research Proposal Review Schedule

The WSPC goes through an exhaustive process each winter to review its research program and choose projects to fund for the coming year. The final Research Review is coming up next month, and any interested growers or industry partners are welcome to attend the meetings and listen to the proposed research for 2004.

February 12-13: Final Research Review **Yakima**

This meeting is a full 1½ days of reports of 2003 research and proposals for 2004 projects. WSDA recertification credits will be available. All projects are scored by the research council during the meeting, and funding recommendations will be made during the afternoon of the 13th.

Potato Varieties in the Northwest

Data for the following table were gathered by the National Agricultural Statistics Service (NASS), and summarized here by the editor. In some cases, NASS does not report numbers for certain varieties, and these cases are indicated by the --. Several minor varieties not listed here were reported by NASS on occasion. Note the sudden increase in Alturas.

State	Russet Burbank	Russet Norkotah	Shepody	Ranger Russet	Umatilla	Alturas	Other
Idaho							
1996	79.7%	3.7%	10.0%	2.7%	--	--	3.9%
1997	79.7%	5.0%	7.1%	4.0%	--	--	4.2%
1998	77.9%	4.8%	5.6%	6.6%	--	--	5.1%
1999	74.4%	8.3%	4.2%	9.1%	--	--	4.0%
2000	74.9%	8.0%	3.9%	7.7%	1.3%	--	4.2%
2001	70.8%	8.4%	3.8%	11.1%	--	--	5.9%
2002	71.0%	7.5%	3.4%	12.0%	--	--	6.1%
2003	69.2%	10.1%	1.3%	12.9%	--	1.2%	5.3%
Oregon							
1996	35.4%	22.5%	25.8%	3.6%	--	--	7.1%
1997	30.9%	38.8%	18.2%	1.8%	--	--	7.9%
1998	39.5%	24.8%	17.2%	10.3%	--	--	7.2%
1999	42.9%	21.4%	12.5%	12.5%	--	--	8.9%
2000	32.7%	27.8%	9.8%	11.2%	3.1%	--	13.3%
2001	38.9%	12.3%	10.8%	22.5%	1.9%	--	13.6%
2002	24.3%	16.8%	18.8%	19.2%	1.8%	--	19.1%
2003	22.3%	25.6%	13.3%	15.4%	--	5.0%	18.4%
Washington							
1996	50.3%	17.8%	11.3%	8.7%	--	--	11.9%
1997	50.2%	17.5%	7.6%	15.5%	--	--	9.2%
1998	58.1%	13.2%	8.9%	11.4%	--	--	8.4%
1999	41.3%	15.4%	10.8%	17.6%	6.7%	--	8.2%
2000	33.7%	17.2%	10.8%	20.2%	12.3%	--	5.8%
2001	35.3%	19.3%	6.8%	19.9%	12.1%	--	6.6%
2002	34.8%	11.8%	10.3%	22.3%	8.1%	--	12.7%
2003	34.9%	11.1%	9.3%	22.1%	8.2%	1.5%	12.9%