Biological Control of the Sugarbeet Root Maggot via Pathogenic Fungi

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Biological control agents can be an important means of pest control and can play a significant part in integrated pest management systems. Their use requires specific environmental conditions and cultural practices to optimize their activity. This is not unlike the requirements for effective chemical pest control. It is important to realize, however, that the results of chemical control are frequently more immediate than biological control agents.

The sugarbeet research scientists at the ARS laboratory in Fargo are now studying the following five biological control approaches: (1) development and use of insect specific parasitic fungi; (2) development and use of insect specific parasitic nematodes; (3) development of genetically resistant breeding lines; (4) the use of *Bacillus thuringiensis* (Bt) as a toxic protein producer; and (5) natural root and insect associated bacteria.

Insect-Pathogenic Fungi

Fungi are unique among insect pathogens because they infect by penetrating the external cuticle instead of the gut.

We have identified pathogenic fungi which may become part of the arsenal for biological control of the sugarbeet root maggot. We are investigating the entomopathogenic fungi *Beauvaria bassiana* and *Metarhizium anisopliae* for their pathogenicity and virulence to the root maggot.

As with parasites and predators, introducing biotypes of pathogens adapted to the climate of the area of introduction can be crucial to successful establishment. Development of entomopathogenic fungi for control of insects is only feasible if these materials are safe. These two fungi are not obligate pathogens and are soil born. Based on studies with laboratory animals, neither species is considered infective or toxic to humans.

We have tested both of these fungi in the laboratory for their ability to infect and kill developmental stages of the larvae and the adult fly. We have determined that fungal infection is not limited to a single developmental stage. We have found infection in eggs,first, second, and third instars and in adults.

Infection and mortalities for the early larval stage of the insect (first instar) is presented in table 1. Mortality for *B. bassiana* infected larvae in the early stage of development ranged from 15% at 7 days to 100% at 13 days. For *M. anisopliae* fungi, mortality was 67% and 100% at 7 and 13 days respectively.

Table 1. % Infection and Mortality of Sugarbeet Root Maggot Larvae Exposed to Two Fungi (1st Instars).

Fungi	7 Days		13 Days	
	Infection	Mortality	Infection	Mortality
Beauvaria	6	15	54	100
Metarhizium	32	67	69	100
Control	6	7	13	100

For the important third instar stage of development, mortality after 7 days exposure was about 15% for both fungi. But at 15 days and beyond, infection by *M. anisopliae* resulted in 90-100% mortality versus 30-40% for *B. bassiana* (Table 2).

Table 2. % Infection and Mortality of Sugarbeet Root Maggot Larvae Exposed to Two Fungi (3rd Instars).

Fungi	7 Days		15 Days		29 Days	
	Infection	Mortality	Infection	Mortality	Infection	Mortality
Beauvaria	1	14	19	30	37	46
Metarhizium	4	15	90	94	100	100
Control	0	2	---	1	---	3

We have found that spore concentration in the inoculum is especially important with both of these fungi. Both infection and mortality were significantly increased when maggots were exposed to high levels of spore concentration.

Field Tests-

In 1994, preliminary field tests were conducted at Hillesboro and St. Thomas, North Dakota. Little can or should be concluded from these preliminary tests. However, third instar larvae were recovered which had been infected with *Beauvaria* and *Metarhizium*. Information sought in our future field tests (1995 and beyond) will include effective inoculation techniques, effective inoculum concentration, timing of inoculation, longevity of inoculum etc.