FINAL REPORT
Nursery Research, Oregon Department of Agriculture
635 Capital Street NE
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PROJECT TITLE:
Evaluation of the fungus, *Metarhizium anisopliae,* as a rescue treatment for container-grown nursery stock infested with black vine weevil.

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PROJECT OBJECTIVE:
The objective of the proposed project was to determine the efficacy of the fungal insecticide Met52 (Earth BioSciences, Fairfield, CT) as a curative drench for control of black vine weevil (BVW). Trials were performed in collaboration with nursery growers throughout the Willamette Valley.

RESULTS:
Experiments took place on-site in collaboration with 8 nursery growers (container production) throughout the Willamette Valley in the fall of 2004. There were a total of 40 pots at each location (20 drenched with fungal spores and 20 control pots). Because I was most interested in evaluating how this product worked under the constraints of the production system of each cooperating grower, the growers provided the plant material for the trials (plant species and container size of their choosing). This allowed each grower to have a vested interest in the experiment by evaluating plant species and a container size that they historically infested with BVW at each individual nursery. Due to the spotty nature of BVW infestations, all pots were artificially infested with fifteen 5th instar BVW (obtained from a BVW colony maintained at USDA-ARS Horticultural Crops Research Laboratory, Corvallis OR). The larvae were allowed to establish in the pots for 7-10 days prior to treatment. Once larvae became established, the treated pots were drenched with fungal spores using a CO_2 sprayer in late November, 2004. Treated pots received 5.4 _ 10^9 fungal spores/L potting media. Most trials were maintained outdoors, however, plants were maintained in a hoop house at two locations. In order to give the fungus a chance to infect as many larvae as possible; the pots from five of the outdoor trials were gathered from the field in late May and maintained in the greenhouse at the laboratory for two weeks before evaluation. Overall, the level of control was not as high or as uniform as we had hoped. While there were significantly fewer live larvae at most locations in the treated pots, the

fungal treatment was not as effective as we have seen in some of our preliminary work. Ideally, nursery growers require a product that can eliminate as near to all of the weevil larvae as possible. A summary of the fall drench application data are enclosed (Table 1).

Metarhizium anisopliae has been able to eliminate nearly all of the larvae in my preliminary work, so I chose to perform additional studies to understand more clearly why the fungus did not do so in these experiments. I believe that as with other biological control agents (i.e. nematodes); low soil temperatures limited the effectiveness of the fungus in the fall trials. Since the applications were made late in the fall (November), soil temperatures were never adequate for high levels of infection to take place. To investigate this hypothesis I performed follow up studies in the field, greenhouse and laboratory. Laboratory studies were performed at a range of temperatures to determine the speed at which the fungus grows and kills BVW larvae at various temperatures (Figure 1). While the fungus grew at all of the temperatures evaluated, it is clear that fungal grow and infectivity was severely retarded at low temperatures. In addition, follow up drench applications were made in the spring (April 27th) of 2005 following the same experimental protocols as described in the proposal, with the exception that pots were infested with 10 BVW larvae. Forty pots were treated and maintained in the greenhouse at 70˚F and an additional 40 pots treated and maintained outdoors. The plants maintained in the greenhouse were evaluated for the number of live larvae after 14 days and the outdoor trial after 28 days. The warmer soil temperatures in the greenhouse and outdoors in the spring allowed the fungus to nearly eliminate the BVW infestations (Figure 2).

It is clear that drench applications of *M. anisopliae* spores are extremely effective at killing BVW larvae infesting container-grown nursery stock if soil temperatures are adequate for fungal activity. Therefore, applications will likely have to be made as early in the fall as possible once weevil egg laying has ended. However, weevil larvae are often small at this time of year making scouting difficult. Another alternative maybe to move infested plants to a location were temperatures could be moderated, such as a hoop house or greenhouse for 10-14 days. It is clear that when temperatures are above 60˚F, fungal drenches can be nearly 100% effective at eliminating weevil larvae. There will undoubtedly be additional expenses associated with moving plants, but if the return is great enough, some growers may be willing to do so.

Table 1. Summary of fall 2004 fungal drench applications.

Nursery	Environment	GH	Mean Number of Live Larvae Control	Treated
1	Outside	2 wks in GH	10.7	1.9
2	Outside	2 wks in GH	32.9	31.6
3	Outside	2 wks in GH	6.3	3.3
4	Outside	2 wks in GH	1.9	0.7
5	Outside		1.8	2.3
5	Hoop house		13.5	4.1
6	Outside	2 wks in GH	11.3	3.1
7	Hoop house		9.7	6.2
8	Outside		11.5	4.3
USDA	Outside		11.8	1.9
USDA	Greenhouse	2 wks in GH	6.4	1.8