**CONTROL OF BLACK VINE WEEVIL
(*OTIORHYNCHUS SULCATUS* (F.)) LARVAE
WITH PARASITIC NEMATODES AND FUNGAL PATHOGENS**

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SUMMARY

The parasitic nematode, *Heterorhabditis bacteriophora*, and fungal pathogens *Metarhizium anisopliae* and *Beauveria bassiana* were used in a trial for control of black vine weevil (*Otiorynchus sulcatus* (F.)) larvae in nursery rhododendron stock. Black vine weevil larvae were seeded into planter bags containing rhododendrons and the nematodes and fungi were applied 2 weeks later. After 5 weeks the number of surviving larvae was recorded. *H. bacteriophora*, *Metarhizium* and *Beauveria* gave 93, 32 and 39% control of black vine weevil larvae respectively. The results suggest that biological agents such as these could be developed as alternatives to chemical pesticides for the control of black vine weevil in New Zealand nurseries.

INTRODUCTION

The black vine weevil (BVW), *Otiorynchus sulcatus* (F.), is a cosmopolitan pest which attacks a wide range of plants including many ornamental species. It has become a recognised problem in nurseries in Otago and Southland and its survival is apparently favoured by moist conditions in potting mix used in planter bags. The adults feed on foliage causing irregular notches in the leaves but this is insignificant compared with damage caused by the larvae which feed on roots, sometimes to the extent that plants are completely root-pruned and ring-barked.

Several studies have reported poor results with organophosphate insecticides used to control BVW larvae (e.g. Parrella and Keil 1984) and many nurseries in New Zealand are currently using dieldrin or DDT. These are not only hazardous materials to handle, but also they will no longer be available in New Zealand from the end of 1989. Research overseas using parasitic nematodes for BVW control have shown considerable promise (Bedding and Miller 1981; Georgis and Poinar 1984). Entomopathogenic fungi have also been shown to be highly effective against this pest (Soares *et al* 1983) and for this reason two New Zealand isolates of the fungal pathogens *Metarhizium anisopliae* and *Beauveria bassiana* were also used in this trial. Fungal pathogens are potentially easier to store and apply by incorporation into potting mixes, and may be more persistent in nursery conditions than nematodes. The objective of the trial reported here was to investigate the potential in New Zealand of these biological agents for control of BVW in potted rhododendrons.

METHOD

BVW larvae collected from nurseries in Otago and Southland during early February 1988 were seeded into planter bags containing rhododendron plants 20-30 cm high in mid-February. The larvae used were mainly in the final or penultimate instar. Five larvae were seeded into each planter bag by dropping them into 10 mm deep holes made in the surface of the potting mix around the stem of the plant. After a 2 week period for the larvae to establish, the treatments were applied as follows:

1. Untreated.
2. *Heterorhabditis bacteriophora* (Poinar) strain V16. Nematodes were cultured in larvae of the greater wax moth (*Galleria mellonella*), extracted and stored in rubber

Proc. 42nd N.Z. Weed and Pest Control Conf.

foam prior to use. The rate applied to each pot was 25 cc of foam containing approximately 300,000 nematodes.

3. *Metarhizium anisopliae* (Metschn.) Sorok. strain LCZ3. This strain was originally isolated from a grass grub (*Costelytra zealandica*) larva and cultured on kibbled wheat to a maximum spore loading of 2×10^8 per g. This medium was applied at 20 g per pot giving a dose rate of approximately 4×10^9 spores per pot.
4. *Beauveria bassiana* (Bals.) Vuill. strain LCBZ was isolated from adult Argentine stem weevil (*Listronotus bonariensis*) and cultured as for *Metarhizium*. Maximum spore loading was 10^9 per gm, with 20 g of medium applied to each pot giving a dose rate of approximately 2×10^{10} .

The fungi and nematodes were applied (29 February and 4 March respectively) to the previously scuffed surface of the potting mix and gradually watered in with 500 mls water, avoiding flooding or drainage out of the bags. The numbers of replicates of each treatment are shown in Table 1.

During the trial, the plants were subjected to normal nursery conditions with daily overhead sprinkler irrigation but no pesticides were applied. Potting mix temperatures at this time of year had previously been found to be in the range of 16-24°C, which is high enough for good *H. bacteriophora* activity (Jackson and Wouts 1987). Five weeks after treatment, the planter bags were destructively sampled to recover surviving BVW larvae.

The data for BVW larval survival were analysed by fitting a generalised linear model using a binomial distribution with a logit link.

TABLE 1: Proportion of BVW larvae surviving 5 weeks after treatment (values predicted by the model).

Treatment	No. of replicates	Proportion of larvae surviving $\pm$ SE
Untreated	29	0.92 $\pm$ 0.02
<i>H. bacteriophora</i>	16	0.06 $\pm$ 0.03
<i>Metarhizium</i>	15	0.63 $\pm$ 0.06
<i>Beauveria</i>	5	0.56 $\pm$ 0.10

RESULTS AND DISCUSSION

BVW survival in untreated pots was high (92%) indicating that the method of establishing larvae was successful. Larval survival was reduced significantly in all treatments (Table 1) with nematodes giving significantly higher mortality ($P < 0.01$) than the *Metarhizium* and *Beauveria* treatments which were not different from each other ($P > 0.05$). The level of control achieved with *H. bacteriophora* was similar to that recorded by Bedding and Miller (1981) with *H. heliothidis* applied at rates of 5,000-20,000 nematodes per pot for control of BVW larvae in potted cyclamens. BVW have also been controlled in strawberries in the field with a rate of 50,000 *Steinernema glaseri* nematodes per plant (Jackson *et al* 1985). Those results suggest that effective control may be obtained with lower rates of the nematode, an avenue that should be investigated further.

The control obtained with *Metarhizium* and *Beauveria* might have been improved had the experiment been allowed to run longer, or if the pathogens had been applied earlier, when the BVW larvae were in an earlier stage of development. These factors are worthy of investigation since both fungi showed some pathogenicity for BVW larvae, and research overseas has indicated good potential control from these organisms (Soares *et al* 1983; Zimmermann 1986).

In order to provide an effective replacement for the chemical insecticides currently being used in nurseries for BVW control, further work will be necessary to select appropriate strains of biological agents, and to develop economic application methods.

CONCLUSIONS

The biological agents used in this experiment, and particularly the parasitic nematode, *Heterorhabditis bacteriophora* showed potential for BVW control in nursery rhododendron stock. With the development of a suitable application system, nematodes could be used to replace organochlorine insecticides with the additional advantages of safety to users and the environment. The entomopathogenic fungi should be further studied since they have potential for longer term effects within the nursery environment, with, possibly, an easier method of application than nematodes by incorporation into potting mixtures.

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