THE USE OF ENTOMOGENOUS NEMATODES FOR THE CONTROL OF BLACK VINE WEEVIL IN CYCLAMEN

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SUMMARY

A commercial formulation of the insect parasitic nematode *Heterorhabditis bacteriophora* gave effective control of black vine weevil (*Otiorhynchus sulcatus*) larvae in nursery cyclamen stock. More than 1,400 plants were treated by syringe and effectiveness assessed progressively over 4 months by examination of culled pots to determine the occurrence of weevils. The number of black vine weevil infected pots was reduced from 27% to 3.8% following treatment and the number of weevils by 73%. The results show that a commercial formulation of nematodes is a viable and practical control agent for black vine weevil.

INTRODUCTION

In New Zealand there has been a reliance on organochlorine insecticides to control a number of root feeding pests in nursery crops. At the end of 1989 the registration of these chemicals was withdrawn and alternative methods of control are now required. The success of entomophagous nematodes for the biological control of a number of root feeding insects, particularly black vine weevil (BVW), has been widely reported both in New Zealand (Barratt *et al* 1989; Jackson *et al* 1985) and overseas (e.g. Bedding and Millar 1981; Georgis and Poinar 1984). The success of this agent has created commercial interest and consequently a number of products are now available. In this trial a commercial formulation of nematodes was tested to determine its efficacy in a commercial growing situation.

METHOD

A glasshouse containing 2800 potted cyclamen was used to test a commercial formulation of the nematode *Heterorhabditis bacteriophora* (= *H. heliothidis*) (Bioenterprises (Pty) Ltd, Australia) in January 1990. The nematodes were produced and formulated in early December 1989 then transported to Lincoln and stored at 4°C until application. The cyclamen plants were grown in a potting mix of 12:1:1 peat, soil, sand. The glasshouse was divided into eight blocks with each block containing about 350 plants. Four blocks were treated with nematodes and four were untreated controls. Nematodes were applied at a rate of 80 nematodes/cm² (9,000 per pot) in 50 ml of water using 50 ml syringes to spread the suspension around the base of the plants. Samples of the suspension were taken during application and examined microscopically to determine the viability of the nematodes. Nematode survival in the pots was also determined after 6, 22 and 84 days by taking 10 g of soil from treated pots and placing it in tubes (2 tubes/pot) each with a larva of the greater wax moth (*Galleria mellonella*). After 4 days the wax moth larvae were examined to determine if nematode infection had occurred. Soil temperatures at 5 cm depth were recorded daily at 8.30 a.m. and 3.30 p.m. during the course of the trial. Soil samples were taken at the time of application to determine soil moisture content. The crop was managed by the grower during the trial according to normal practices.

Plants were culled progressively by the grower during the growing season and the pots examined to determine if BVW larvae were present. The data for BVW infestation of these pots and the total number of weevils present were analysed by fitting a generalised linear model using a binomial distribution.

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RESULTS AND DISCUSSION

Three hundred and sixty five treated and 322 untreated plants (in total, 24% of the crop) were culled by the grower and then examined to determine if BVW larvae were present. The majority of these plants were culled because of root rots attributed to poor quality peat causing waterlogging. The grower had not previously experienced a major problem with root rots and the main cause of rejection has usually been BVW infestation. In this trial it is likely that the numbers of BVW were substantially reduced by the condition of the potting mix.

Average 8.30 a.m. and 3.30 p.m. temperatures were 14.9°C and 21.3°C respectively. This is within the range for good *H. bacteriophora* activity (Jackson and Wouts 1987). The soil moisture content at the time of application ranged from 80.9% to 204% (mean = 154%).

Fewer treated pots were found to be infested with BVW than untreated ($P < 0.05$). Of the untreated pots 27% contained BVW compared with 3.8% of the treated pots (Table 1). Consequently there was a 73% reduction in weevil larvae found in treated pots ($P < 0.05$). The number of weevils in each infested pot was variable (range 1 to 26) and the means were not significantly different between treated and untreated pots.

TABLE 1: The effect of nematode application on survival of black vine weevil in potted cyclamens.

	Treated	Untreated
Total no. pots examined	365	322
No. pots containing BVW	14 (3.8%)	87 (27%)
Total no. BVW found	78	290
Mean no. larvae/pot $\pm$ SE	5.6 $\pm$ 2.6	3.3 $\pm$ 0.85

The application method used in this trial was relatively slow, (two people took over 4 hours to treat 1400 plants), but showed that at a relatively low water rate (50 ml per pot) good control of the weevil can be achieved. A separate trial showed that live nematodes could be applied to pots via the liquid fertiliser system. This gave much faster application to the pot surface in about 200 ml of water with one person taking 2-3 hours to treat over 2000 plants. For large scale applications this would be a more efficient method, particularly if it is possible to combine the fertiliser and nematode application.

Based on an estimated price for the nematode formulation of about \$NZ 1.00 per million nematodes (Meyers pers. comm.), treatment at the above rates would cost less than 1 cent per plant (excluding application costs). Thus for a high value crop such as cyclamen the cost of the product is negligible and a second application would be practical if a higher level of control is required.

At 6 and 22 days after application nematode survival was adequate to cause mortality in the wax moth larvae but at 84 days there was no nematode infection. This level of persistence (i.e. at least 21 days) is comparable with other reported results (Georgis *et al* 1983; Jackson and Trought 1982; Jackson *et al* 1983), and should provide an adequate level of protection from one application. Many modern chemicals have a similar residual effect.

A major obstacle to the use of many biologicals, including entomogenous nematodes, is their relatively short storage life. This formulation was used more than a month after production and formulation and still maintained its viability.

CONCLUSIONS

These results, and others (e.g. Bedding and Millar 1981; Georgis and Poinar 1984), show clearly that entomophagous nematodes can effectively control BVW. The development of formulations with extended storage life (greater than 1 month) and the potential for applying the formulation through conventional nursery equipment indicates that nematodes have the potential to replace chemical insecticides for the control of BVW in a variety of situations.

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