CONTROL OF THE BLACK VINE WEEVIL IN STRAWBERRIES WITH THE NEMATODE *STEINERNEMA GLASERI*

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SUMMARY

The entomogenous nematode *Steinernema glaseri* was cultured on artifical media and applied to a strawberry crop infested with larvae of the black vine weevil (*Otiorhynchus sulcatus*). The application resulted in successful establishment of the nematode and a 74% reduction of weevil numbers in the treated plots. Laboratory tests showed an LD50 of 470 nematodes per weevil.

INTRODUCTION

The black vine weevil is a major pest of fruit and ornamental plants. Severe damage may be caused in strawberry crops where weevil larvae feed on the roots of the plant resulting in poor production, death of individual plants and a shorter crop life. Such damage has been prevented traditionally by the application of persistent chemical insecticides. However the lack of availability of some chemicals and a concern about side effects from their application has led to a reduction in the use of these chemicals and indicated the need for investigation into alternative methods of control.

Entomogenous nematodes provide one such alternative to chemical insecticides for the control of insect pests and have been particularly effective against soil dwelling insects (Poinar 1983). The black vine weevil has been successfully controlled by a number of nematode species in ornamental pot plants growing in glass houses (Bedding and Miller 1981; Simons 1981; Dolmans 1983; Georgis and Poinar 1984b)

Some trials have also been carried out in field crops. Miller *et al* (1982) reported high levels of parasitism of black vine weevil following application of *Heterorhabditis heliothidis* and a similar pest, the strawberry weevil (*Nemocestes incomptus*), has been successfully controlled in infested raspberries using neoaplectanid nematodes (Georgis and Poinar 1984a). Less successful were outdoor trials by Evenhuis (1982) and Dolmans (1983).

In this paper we report on a trial to investigate the potential of the nematode *Steinernema glaseri* (formerly *Neoaplectana glaseri*) as a control agent for black vine weevil in outdoor strawberry crops in New Zealand.

METHODS AND MATERIALS

Nematode culture

A culture of *S. glaseri* was supplied by Dr R.A. Bedding, CSIRO, Tasmania and bulked by sub-culturing on artificial media (Bedding 1981). The nematodes were extracted from the medium, washed and held in aerated water until immediately prior to application.

Laboratory tests

A dosage mortality test was carried out in the laboratory. Black vine weevil larvae were placed individually in 25 ml of soil and 1 ml of nematode suspension added to each tube. Nematodes were applied in seven measured dose rates from 0-4000/tube with 15 replicates of each dose. The tubes were held at 20 °C for 10 days. The larvae were then examined and separated into live and dead categories. The cadavers were then dissected to determine the presence of nematodes. The LD50 was determined by probit analysis (Finney 1952).

Field trial

A field trial was carried out in a 2 year old block of strawberries, cv Tioga growing on raised beds covered with a plastic mulch at the Riwaka Research Station. The trial area consisted of eight rows of 30 plants each, half of each row being randomly allocated to either nematode treatment or control. Nematodes were applied to soil beside the crown of each plant at a rate of 50,000/plant in 5 ml of water using a syringe, on March 15 1984. Weather conditions at the time of application were overcast, and the soil moist, (5.5 mm rain in the previous 24 h) and 105 mm of rain fell in the 2 weeks following application.

Six weeks after application five plants were removed from each plot together with the surrounding soil, and the root and soil were searched for weevil larvae. A 250 ml soil sample was also taken from each treated plot and tested for the presence of nematodes by using wax moth larvae (*Galleria mellonella*) as bait (Bedding and Akhurst 1975). Soil samples were taken from the control plots bulked and tested in a similar way. A second sampling of the plots was made after a further 6 weeks. No further sampling was possible as the strawberry bed was destroyed by cultivation. This is the normal practice of the Research Station due to plant deterioration.

RESULTS

Laboratory tests

Fifty-five percent of the treated black vine weevil larvae were killed in the biotest and, of these, 86% contained nematodes in the cadaver. All control larvae survived and mortality increased with dosage to 80% at the higest dose rate. The LD50 was calculated by probit analysis as 470 nematodes/larva (95% fiducial limits, 154-1193 nematodes).

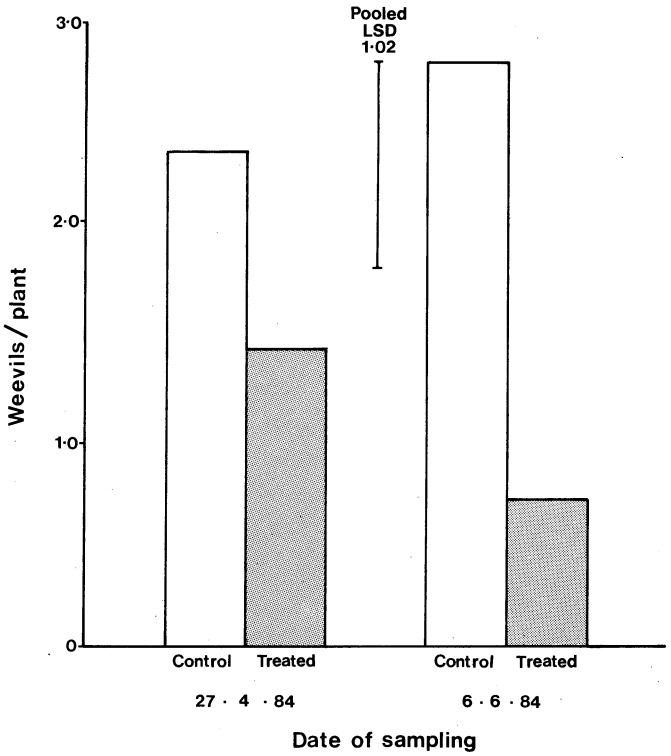

Fig 1: Effect of nematodes on number of black vine weevil per strawberry plant.

Field trial

A mean mortality of 85% (range 40-100%) attributable to nematodes was recorded in the wax moth larvae held in the soil from the nematode treated plots, demonstrating nematode establishment in all treatments. No mortality was recorded in the wax moth larvae held in the soil from the control plots. After 6 weeks some infected black vine weevil larvae were recovered from the treated plots. At this time there was a 30% reduction in weevil larvae in treated plots compared with the controls. After 12 weeks there was a corresponding significant ($P < 0.05$) 74% reduction in larval numbers in the treated plots (Fig. 1).

DISCUSSION

The results show that a high level of control of black vine weevil can be obtained with application of the nematode. The nematode induced mortality occurred during both the first and second 6 week periods. This shows that the nematode was able to persist in the soil, and may have re-cycled through the population. The mortality recorded in the second 6 week period occurred in the cooler soil temperatures of late autumn. This is particularly encouraging as both Evenhuis (1982) and Dolmans (1983) considered that low soil temperatures were the reason for failure of nematodes to control black vine weevil in outdoor crops in Holland. The environment provided under the polythene, however, is probably ideal for the nematode with a high humidity and temperature 3-4 °C above the ambient (R. Haynes pers. comm.).

The rate of nematodes applied in the field was many times greater than the number indicated by the LD50 test as necessary to kill the larvae. This suggests there may be considerable scope for lowering the rate of application through improved application technique and time of application. However, the rate used was not impractical and is comparable to that used in other successful trials. In the more favourable conditions provided by glasshouses only one third of the rate of nematodes per plant gave high levels of control (Bedding and Miller 1981, Georgis and Poinar 1984b) while in the field Georgis and Poinar (1984a) required twice the rate of nematodes to achieve more than 50% control of the strawberry weevil. The rate used in the field trial was approximately 2000 million nematodes/ha. According to Bedding (1984), once a production system is established, this number of nematodes could be produced in 9 kg of media for a cost of approximately NZ$60.00. Thus the control of black vine weevil with nematodes seems to be both technically and economically feasible.

In this trial the nematodes were applied as a curative treatment. While good control of weevil was obtained it is not possible to assess the effects of the treatment on plants due to the small plot size. As the objective of the grower in applying pest control measures is to maintain plant health and production, the use of nematodes as a prophylactic treatment should also be considered. If such an approach is adopted persistance of the nematodes in the soil will be a major factor for consideration in selection of an appropriate species.

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