# THE POTENTIAL USE OF NEMATODES FOR THE CONTROL OF PASTURE PESTS

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## SUMMARY

The entomophagous nematodes *Neoaplectana glaseri, Heterorhabditis heliothidis* and *H. bacteriophora* were tested as potential control agents for grass grub (*Costelytra zealandica*), porina (*Wiseana* sp), white-fringed weevil (*Graphognathus leucoloma*) and black beetle (*Heteronychus arator*). All pest species were found to be infected by each of the nematodes.

## INTRODUCTION

Entomophagous nematodes of the family Steinernematidae have long been considered to have a potential for insect control as their infectivie juveniles can seek out insects, enter them and release a toxic symbiotic bacteria; death of the insect soon follows and the nematode reproduces within the cadaver (Poinar 1979). The nematodes may be cultured in the larvae of the greater wax moth (*Galleria mellonella*) (see Poinar 1979) or on artificial diets (Bedding 1976).

As long ago as the 1930's*Neoaplectana glaseri* was used in an extensive programme for the control of Japanese beetle (*Popillia japonica*) in the United States (Glaser *et al* 1940) and in New Zealand the same nematode was released in an attempt to control grass grub (Hoy pers comm). However the early use of nematodes failed because of difficulties in rearing the large numbers of suitable infective stages needed for field application and their high costs in relation to conventional insecticides. With the development of cheap mass rearing methods (Bedding 1981) and the rapid increase in the costs of insecticides interest in this form of biological control has revived.

Nematodes have now been successfully used to control pests such as the currant clearwing (*Synanthedon tipuliformis*) (Bedding and Miller 1981a), black vine weevil (*Otiorhynchus sulcatus* (Bedding and Miller 1981b) and the lemon tree borer (*Oemona hirta*) (Clearwater and Wouts 1980).

This paper reports the results of some preliminary screening tests with three parasitic nematodes against four common pasture pests, grass grub, porina, white-fringed weevil and black beetle.

## METHODS

The nematodes used in these studies were:

*Neoaplectana glaseri*
*Heterorhabditis heliothidis* (N.Z. strain)
*H. bacteriophora* (V 16 strain)

Small samples of each of these species were imported from Tasmania in early 1981 and were freshly extracted from culture medium (Bedding 1981) or infected larvae of the greater wax moth. The developmental stages of the insects used in these studies are given in Table 1. All insects are collected from the field 24 to 48 hours before testing.

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**TABLE 1: Susceptibility of various pasture pests to attack by entomophagous nematodes.**

| Pest | Nematode | Insect stage | Rate* | Susceptibility+ |
|---|---|---|---|---|
| Grass Grub | *N. glaseri* | Larva (2) | III | H |
| | | | II | M |
| | | | I | M |
| | *H. heliothidis* (NZ) | Larva (2) | III | M |
| | | | II | L |
| | | | I | L |
| | *H. bacteriophora* (V16) | Larva (2) | III | H |
| | | | II | M |
| Black beetle | *N. glaseri* | Pupa and | III | M |
| | | prepupa | II | M |
| | | | I | M |
| | | Larva (2,3) | III | M |
| | | | II | L |
| | | | I | L |
| | *H. heliothidis* (NZ) | Pupa and | III | M |
| | | prepupa | II | M |
| | | | I | L |
| | | Larva (2,3) | III | M |
| | | | II | M |
| | | | I | L |
| Porina | *N. glaseri* | Larva (3,4) | II | M |
| | | | I | M |
| | *H. heliothidis* (NZ) | Larva (3,4) | II | M |
| | | | I | L |
| White-fringed weevil | *N. glaseri* | Larva (3,4) | III | H |
| | | | II | M |
| | | | I | L |
| | *H. heliothidis* (NZ) | Larva (3,4) | III | L |
| | | | II | L |
| | | | I | L |
| | *H. bacteriophora* (V16) | Larva (3,4) | III | M |
| | | | II | L |
| | | | I | L |

* Rate I = 0.7 — 1.4 nematodes/ml soil
II = 1.4 — 14 nematodes/ml soil
III = 14—70 nematodes/ml soil

\+ Susceptibility based on mortalities corrected by Abbots formula (Busvine, 1971). H, over 67% mortality; M, 67-33%; L, less than 33%.

( ) larval instar

Each test insect was placed in approximately 75 ml of moist soil in a screw-topped container. Infective juvenile nematodes suspended in 1 ml of water were added at three dosage rates which ranged from 0.7 to 70 nematodes/ml of soil. In all cases the insects were kept at about 20°C (room temperature) until assessment 5-7 days later. On examination the insects were noted as live or dead, and those dead were placed on moist filter paper for a further 7 days or dissected to determine the presence of nematodes.



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## RESULTS AND DISCUSSION

In nearly all cases the dead larvae in the treated plots were shown to contain nematodes. It was not always clear however whether nematodes were the cause of death since they are also attracted to cadavers. For reasons of simplicity and to aid comparisons between insects, the mortalities for each dosage were divided into three classes (see Table 1).

The results show that all of the insects tested were susceptible to some degree, to the test nematodes and that, generally, mortality was related to dosage rate. Both grass grub and white-fringed weevil mortalities were high at the high dosage rates of *N. glaseri,* the former suffering 90% mortality at a rate of 70 nematodes/ml of soil and the latter 74% mortality at a dosage of 50 nematodes/ml. When grass grub was tested with even higher numbers, 100% mortality occurred (umpub.). *H. bacteriophora* also cause high mortality of grass grub at 70 nematodes/ml and considerable mortality also occurred at lower dosages. For grass grub 39% mortality occurred with only 0.7 *N. glaseri/ml* of soil and for porina a 47% mortality followed exposure to the same dosage of this nematode.

These preliminary results and recent field studies with porina (Kain *et al* 1981) indicate a potential for the use of parasitic nematodes to control some of New Zealand's major pasture pests. Studies on the inundative use of nematodes to control these pests such as those carried out by Bedding and Miller (1981 a,b) and Kain *et al* (1981) and comparative studies of the various species to determine those most effective and how their performances are affected by environmental factors are required.

Nationally, pasture pests are of great importance, but the range of other pest species which may be controlled is great (Poinar 1979). For example other tests conducted by us have shown that white butterfly (*Pieris rapae*), green looper (*Chrysodeixis eriosoma*) and light brown apple moth (*Epiphyas postivittana*) are all remarkably sensitive to at least one of the three nematodes studied.

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