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Short note

Effect of spores of *Pasteuria penetrans* on the motility of second-stage juveniles of *Meloidogyne incognita*

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The hyper-parasite *Pasteuria penetrans* (Thorne, 1940) Sayre & Starr, 1985, is considered one of the few microorganisms which has potential for the control of root-knot nematodes (RKN), *Meloidogyne* species (Stirling, 1984; Brown *et al.*, 1985).

Infection begins with adherence of endospores of *P. penetrans* to the cuticle of second-stage juveniles as the nematodes migrate through the soil. Following root invasion by encumbered juveniles, spores germinate, undergo different developmental stages which results in egg production by RKN females being suppressed, and finally the body cavity of female nematodes becomes filled with bacterial spores (Mankau & Imbriani, 1975; Mankau & Prassad, 1977; Sayre & Wergin, 1977). Apart from suppressing reproduction of its host, *P. penetrans* can affect RKN infectivity by altering the movement of second-stage juveniles (Stirling, 1984; Davies *et al.*, 1988; Sayre & Gherna, 1990).

The objective of the study was to assess the incidence of spore burdens on the recovery of RKN juveniles in an extraction method requiring active migration of the nematodes.

Potting soils from a greenhouse experiment were mixed as two batches: one infested with *Meloidogyne incognita* and the other with both RKN and spores of *P. penetrans*. Five soil samples of 250 cm^3 were collected from each batch, and juveniles extracted using the Seinhorst (1962) elutriation method.

The mixture of juveniles, soil particles and other debris collected from the elutriator was decanted through a set of 4 sieves (50 μm). The residue retained on these sieves was washed onto a coarse sieve (2 mm), lined with double-ply paper tissue, and placed in an uncovered Petri dish filled with tap water. Petri dishes were placed on a laboratory bench at 28 °C and 6, 24, 48 and 72 hours after extraction, the contents of the Petri dishes were emptied into test tubes and fresh tap water added to the dishes. RKN juveniles recovered at each sampling period were identified and counted under a compound microscope. Those extracted from *Pasteuria*-infested soil were further examined under an inverted microscope (x 400) to determine their spore burdens. Second-stage juveniles were assigned to one of 8 classes of spore burdens: 0, 1-5, 6-9, 10-15, 16-20, 21-30, 31-40 and > 40 spores per juvenile

Most juveniles migrated through the tissue filter in Petri dishes during the first 24 hours following elutriation (Fig. 1). Nematode recovery was greatest during the first 6 hours, more so in the absence of *P. penetrans* than in its presence ($P < 0.01$). However, this trend was reversed during the final 48 hours ($P < 0.01$).

Most unencumbered juveniles, and those bearing 1-5 and 6-9 spores on their cuticle, were recovered rapidly within the first 24 hours after elutriation. However, juveniles encumbered with >10 spores migrated very slowly, with most of these juveniles being recovered in the final 48 hours of the experiment (Fig. 2).

Nematodes move short distances, with undulatory movement being achieved by sequential waves of body contraction and relaxation (Lee, 1965; Croll, 1970). Attachment of *P. penetrans* endospores to the nematode cuticle results in an alteration of these contractions, with higher spore burdens imparting greater alteration. Consequently, nematode movement becomes less efficient and according to previous work between 15 and 40 spores are required to impede juvenile motility (Stirling, 1984; Brown & Smart, 1985; Davies *et al.*, 1988; Sayre & Gherna, 1990). In the present study 10 spores had a detrimental effect on juvenile motility, and it is probable that in field soils such an effect will be accentuated.

The results obtained also suggest that extraction techniques, such as the Baerman funnel method, which require active migration of nematodes probably under-estimate the recovery of highly encumbered juveniles from soil samples.

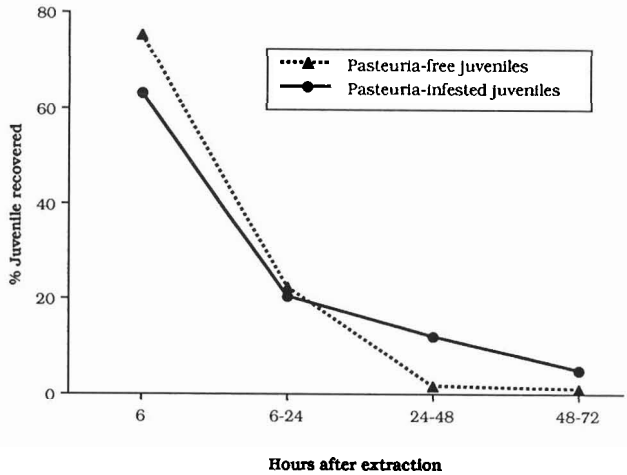

Fig. 1. Recovery rates of juveniles as affected by the presence of *Pasteuria penetrans.*

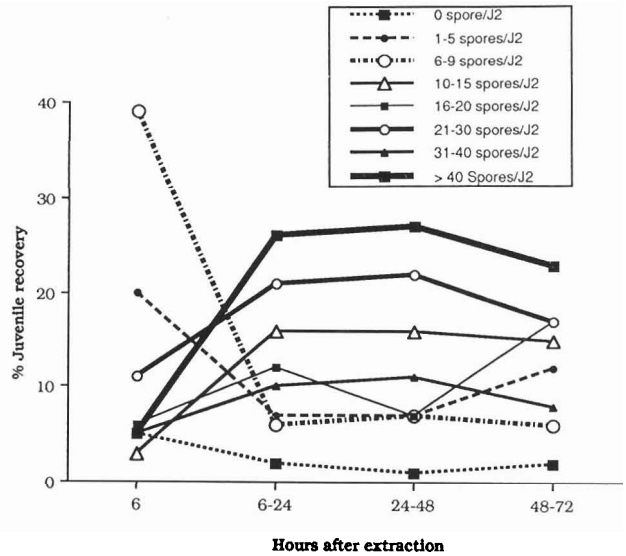

Fig. 2. Effect of spore burdens on the recovery rate of juveniles of *Meloidogyne incognita.*

REFERENCES

Brown, S.M., Kepner, J.L. & Smart, G.C. 1985. Increased yields following application of *Bacillus penetrans* to field plots infested with *Meloidogyne incognita. Soil Biology Biochemistry* 17: 483-486.

Brown, S.M. & Smart, G.C. 1985. Root penetration by *Meloidogyne incognita* juveniles infected with *Bacillus penetrans. Journal of Nematology* 17: 123-126.

Croll, N.A. 1970. *The Behaviour of Nematodes.* New York, St. Martin's Press. 117pp.

Davies, K.G., Flynn, C.A. & Kerry, B.R. 1988. The life cycle and pathology of the root-knot nematode parasite *Pasteuria penetrans. Brighton Crop Protection Conference.* Pests and Diseases 1221-1226.

Lee, D.L. 1965. *The Physiology of Nematodes.* San Francisco, W.A. Freeman & Co. 154 pp.

Mankau, R. & Imbriani, J. 1975. The life cycle of an endoparasite in some Tylenchid nematodes. *Nematologica* 21: 89-94.

Mankau, R. & Prassad, N. 1977. Infectivity of *Bacillus penetrans* in plant-parasitic nematodes. *Journal of Nematology* 9: 40-45.

Sayre, R.M. & Wergin, W. 1977. Bacterial parasite of a plant nematode : morphology and ultrastructure. *Journal of Bacteriology* 129: 1091-1101.

Sayre, R.M. & Gherna, R.L. 1990. Attachment and host specificity of a bacterium, *Pasteuria penetrans*, that parasitizes the root-knot nematode, *Meloidogyne arenaria.* In: *Plant Nematology Laboratory Manual.* (B.M. Zuckerman, W.F. Mai and L.R. Krusberg, Eds.). pp. 247-250. Revised Edition. Amherst Agriculture Experimental Station. University of Massachusetts.

Seinhorst, J.W. 1962. Modification of the elutriation method for extracting nematodes from soil. *Nematologica* 8: 117-128.

Stirling, G.R. 1984. Biological control of *Meloidogyne javanica* with *Bacillus penetrans. Phytopathology* 74: 55-60.

Stirling, G.R. 1992. *Biological Control of Plant Parasitic Nematodes.* Progress, problems and prospects. CAB International, Wallingford. 282 pp.