

# INVASION AND POST-INFECTIONAL BEHAVIOUR OF *MELOIDOGYNE JAVANICA* IN DIFFERENT HOST PLANT SPECIES

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## ABSTRACT

Invasion ability and post-infectional behaviour of second stage juveniles ( $J_2$ s) of *M. javanica* in six different host plant species were studied. Invasion studies revealed that all host plant species tested namely, tomato (*Lycopersicon esculentum* var. Tiny tim), aubergine (*Solanum melongena* var. Dusky), chilli (*Capsicum annuum*), soybean (*Glycine max*), cowpea (*Vigna unguiculata* var. Black eye) and navybean (*Phaseolus vulgaris*) were susceptible in varying degree to the invasion of *M. Javanica*  $J_2$ s. However, studies carried out 6 weeks after inoculation disclosed that the root systems of soybean and chilli varieties used in the present study did not contain any developmental stage of the nematodes, although the host plants were susceptible to the invasion of  $J_2$ s. Rest of the host plant species showed varying amounts of nematodes at different stages of their growth at 6 weeks after inoculation.

**KEY WORDS:** Invasion, Leguminosae, Post-infectional behaviour, Root- knot nematodes, Solanaceae.

## INTRODUCTION

Root- knot nematodes (*Meloidogyne* spp.) can be considered as one of the most serious plant pathogens because of the quantitative and qualitative yield losses caused by them to many agriculturally important crops. Crop damages of root-knot nematodes are prevalent in many tropical, sub-tropical and temperate regions in the world.

*Meloidogyne* spp. are sedentary endoparasites and have a vast range of host plants. Also, the root-knot nematodes are obligate pathogens and only second stage juveniles ( $J_2$ s) of the nematode have the ability to invade the host plant roots for the continuation of their life cycle. According to Kaplan and Davis (1987) nematodes usually enter roots of susceptible and resistant host plants equally. However, there could be variations in invasion rate of plant pathogenic nematodes. The possible reasons for varying degree of attraction towards the host roots could be gradients of mineral salts and  $CO_2$ , and root diffusates present in the rhizosphere (Prot, 1980)

In addition, the post-infectious development, reproduction and fecundity of root-knot nematodes vary according to the genotypic characteristics of individual host plant (Moura *et al.*, 1993). Host plants which allow the favourable rate can be called as susceptible host plant species. Partially or highly resistant host plants do not provide the conditions needed for the development or reproduction (Moura *et al.*, 1993). Invaded  $J_2$ s emigrate from the roots when the host is partially or totally resistant to the nematode. Additionally, very slow development and reproduction rates were experienced in those of the nematodes which remained in the host roots of resistant plants (Herman *et al.*, 1991; Moura *et al.*, 1993)

These characteristics are worthwhile investigating as their outcome could be used in developing effective measures for controlling the root-knot nematodes.

Therefore, the potential of six different host plants with respect to their susceptibility to the invasion of a root-knot nematode species and the possible variations in the nematode's ability of completing a life cycle in the different host plants were investigated in the present study.

## MATERIALS AND METHODS

All laboratory (Nematology Laboratory) and pot (greenhouse) experiments were carried out in the University of Reading, Earley Gate, UK.

Six different host plant species which were believed to be susceptible to root-knot nematodes were selected. Three host plant species were selected from the family Solanaceae and the rest were selected from the family Leguminosae. The species used were, tomato (*Lycopersicon esculentum* var. Tiny tim), aubergine (*Solanum melongena* var. Dusky), chilli (*Capsicum annum*), soybean (*Glycine max*), cowpea (*Vigna unguiculata* var. Black eye) and navybean (*Phaseolus vulgaris*).

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Four-week old solanaceous plants were used for the experiment. To be of equivalent level of root and shoot growth with the solanaceous plants, one-week old legume plants were used. All the seedlings were planted in plastic pots (0.3 l capacity). John Innes No.2 commercially sterilized compost mixture was used as the potting media.

Each plant was treated with 2000  $J_2$ s of *Meloidogyne javanica* as a soil drench. These  $J_2$ s were extracted from the eggmasses present on tomato (var. Tiny tim) roots. Eggmasses were picked, placed on hatching trays and incubated at 28°C. Plants were inoculated with 1-3 day old  $J_2$ s.

Each host species had five replicates and the plants were arranged in a completely randomized design. Plants were watered gently according to the requirement. The average day temperature during the experimental period was 26-28°C.

Eight days after inoculation, plants were uprooted and washed carefully. Washed root systems were stained with 0.1% Acid Fuschin ( Bridge *et al.*, 1982) . Stained root systems were macerated and the different growth stages (i.e.  $J_2$ s and developing stages of the nematodes) were observed. The nematodes which expressed a thicker and saccate appearance were considered as developing stages.

A set of host plants which were treated identically (i.e. inoculated at 2000  $J_2$ s per plant and maintained in the similar manner) was kept for 6 weeks under similar environmental conditions. Six weeks after inoculation, this set of plants was uprooted. Cleaned root systems were stained according to the method of Bridge *et al.* (1982) and observed for the total nematode population in the root system. At this stage total nematode population included the eggs,  $J_2$ s, developing stages of the nematode ( $J_3$ + $J_4$ s) and adult females present in the root system. Where appropriate, homogeneity tests were carried out.

## RESULTS

### Invasion of $J_2$ s into root system

Mean number of invaded *Meloidogyne*  $J_2$ s of six host plant species when inoculated at a density of 2000  $J_2$ s per plant, 8 days after inoculation is shown in Fig.1.

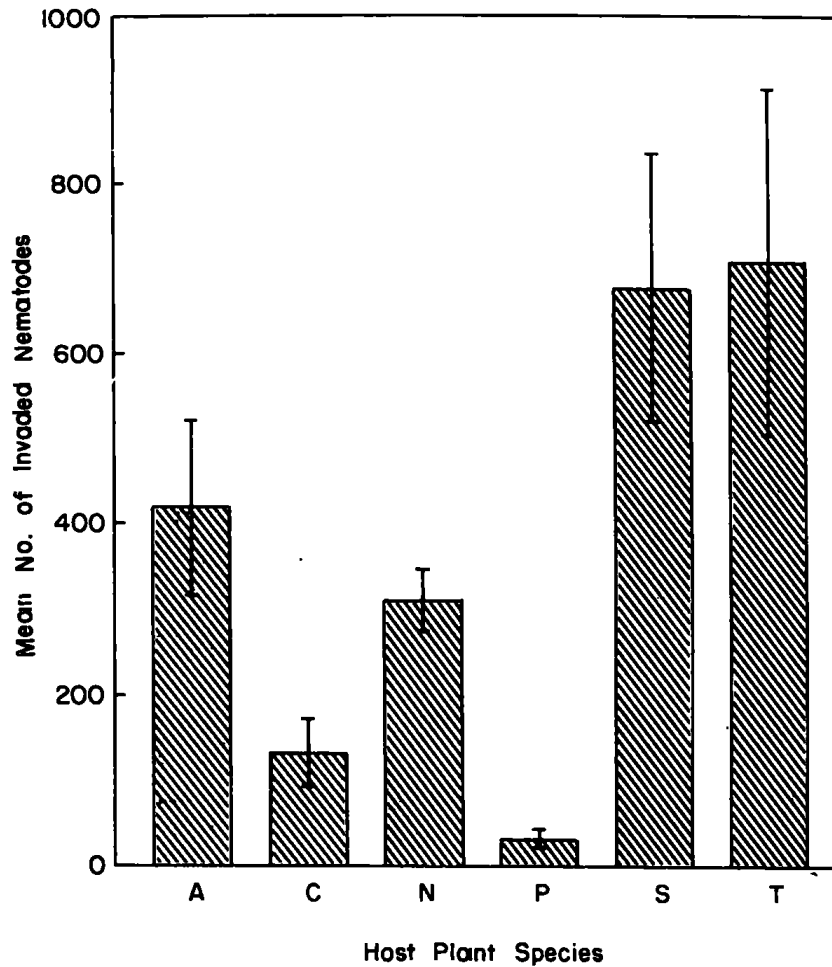


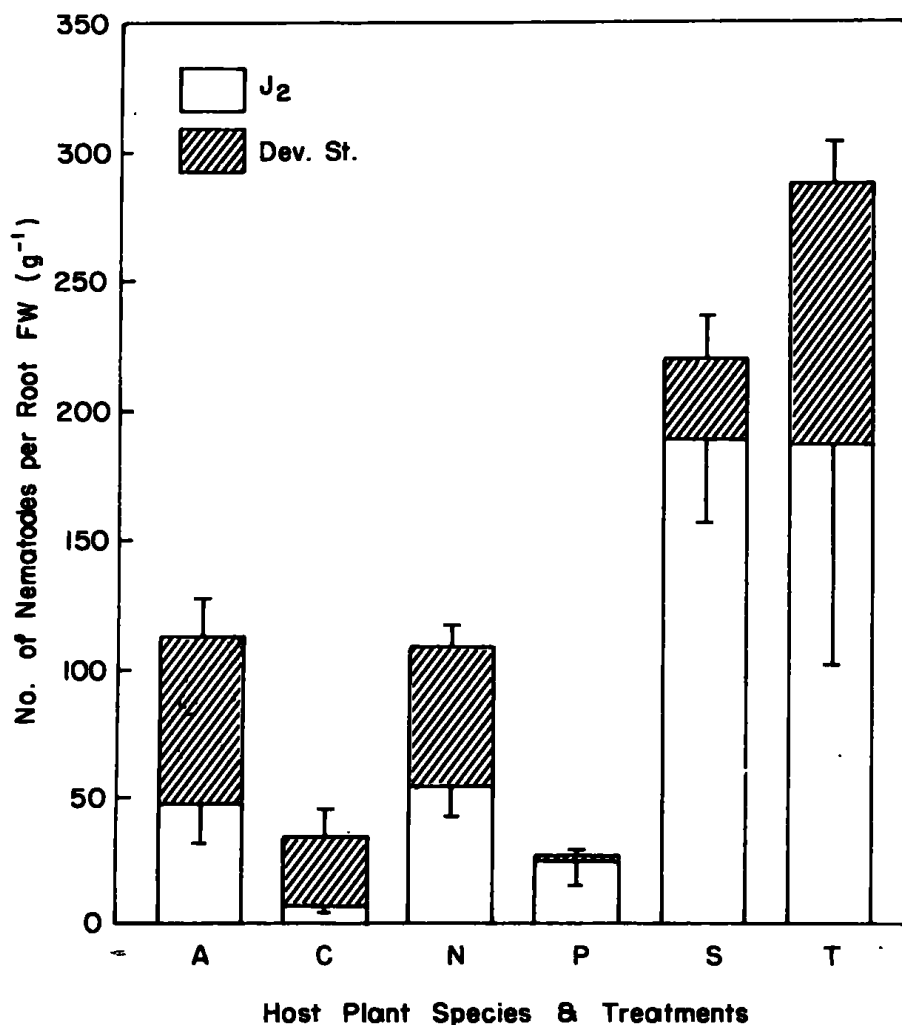
Fig. 1. Mean number of invaded second stage juveniles of *Meloidogyne javanica* in different host plant species (8 days after inoculation at a density of 2000 J<sub>2</sub>s per plant). A = Aubergine; C=Cowpea; N=Navybean; P=Chilli; S=Soybean; T=Tomato. The vertical error bars are the standard errors of the means.

Invasion of J<sub>2</sub>s was highly influenced by host plant species (P<0.001). The highest invasion was shown by tomato var. Tiny tim whereas chilli had the lowest invasion rate among all tested host plant species.

#### Nematodes present in the root system

Fig. 2 illustrates the different stages of *M.javanica* found in a unit root fresh weight of host plants 8 days after inoculation.

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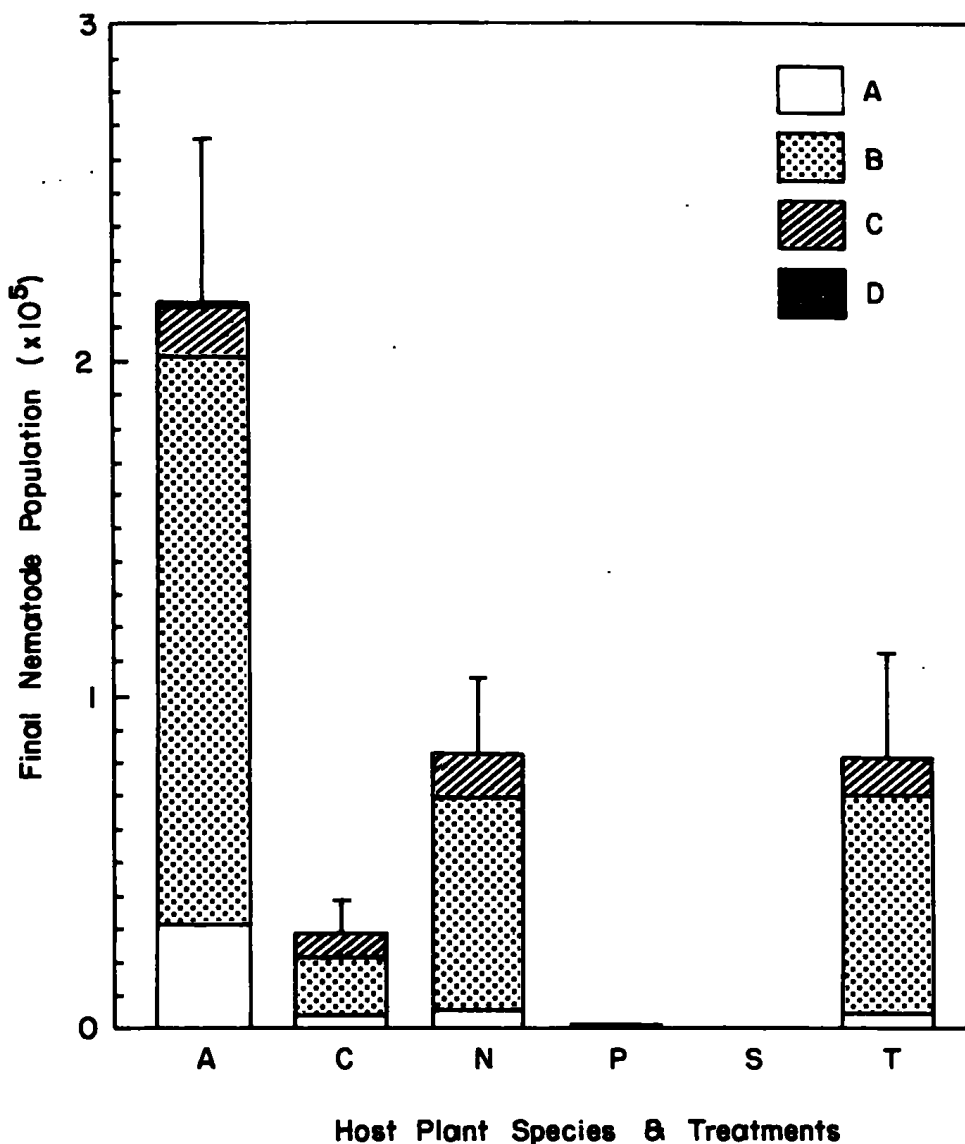


**Fig. 2.** Mean number of different stage nematodes per unit root fresh weight in different host plant species (8 days after inoculation). J<sub>2</sub>= Second stage juveniles; Dev.St.= Developing stage juveniles. Host plant species: A = Aubergine; C=Cowpea; N=Navybean; P=Chilli; S=Soybean; T=Tomato. The vertical bars are the standard errors of the mean number of each different stage nematodes.

All host plant species showed developing stages of the nematode in varying degrees. Host plant species had a high influence on the development of the invaded J<sub>2</sub>s ( $P < 0.001$ ). In the experiment the highest percentage of the developing stages of the nematode was shown by cowpea (var. Black eye). Although invasion was high in soybean, a very low percentage of developing stages of *M. Javanica* was observed subsequently. Chilli plants too had a very few number of developing stages, but unlike soybean, it had the lowest invasion rate.

**Nematode population in root systems**

Different growth stages of *M.Javanica* (i.e. eggs, J<sub>2</sub>s, J<sub>3</sub>+J<sub>4</sub>s, adult females) found in the root systems of six host plant species, 6 weeks after inoculation are shown in Fig. 3.



**Fig. 3.** Mean final total nematode population and its breakdown into different stages in different host plant species. Different stages: A=Adult females in root; B=Eggs in root; C=J<sub>2</sub>s in root; D=Developing stages (i.e. J<sub>3</sub> and J<sub>4</sub>) in root. Host plant species: A = Aubergine; C=Cowpea; N=Navybean; P=Chilli; S=Soybean; T=Tomato. The vertical error bars are the standard errors of the mean total nematode populations.

Chilli and soybean plants did not contain any nematode population. The highest nematode population was observed in aubergine, and lowest was in cowpea.

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## DISCUSSION

According to the results of the present study, invasion of *M.javanica* into the host root system is clearly influenced by the host plant species. Migration towards the roots can be affected by varying levels of stimulating root exudates secreted (Prot, 1980; Ferris and Van Gundy, 1979). Therefore, different host species may be subjected to varying levels of invasion.

Although all host plants showed root penetration by *M.javanica* J<sub>2</sub>s, their development has not occurred in chilli and soybean host plant species when observed 6 weeks after inoculation. The particular varieties of chilli and soybean used in the present experiment did not possess a favourable environment for the development of nematodes during the first six weeks following invasion.

As in the root penetration of J<sub>2</sub>s, the development of nematodes varied significantly between different host plants and even between different varieties of the same host plant species (Netscher and Taylor, 1979). Lack of a suitable environment for further development and emigration of invaded J<sub>2</sub>s from the roots back into the soil could be possible reasons for the post-infectious reduction of nematodes (De Guiran and Ritter, 1979; Herman *et al.*, 1991) observed in chilli and soybean.

The chilli and soybean varieties used in the experiment were susceptible to the nematode infection but were not suitable hosts for further development of the nematode. When introducing a nematode control programme host plant species or varieties such as chilli and soybean used in the present study may have an importance in reducing the nematode problem. Therefore, further studies would be needed for verification of the suitability of such crop species.

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