

LIFE CYCLE AND MULTIPLICATION OF MELOIDOGYNE INCOGNITA ON TOMATO AND EGG PLANT SEEDLINGS

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ABSTRACT

The development and duration of the life cycle of root-knot nematodes (*Meloidogyne* species) depends on the type of host and environmental factors. Due to the availability of optimal environmental conditions many tropical *Meloidogyne* spp. have a short life cycle and many generations occur annually resulting in high population densities in the soils with intensive agriculture. *Meloidogyne incognita* (Kofoid and White) is the most common root-knot nematode species in tropical climates. To determine whether the host type and the environmental factor (temperature) had any influence on nematode activity, the life cycle of *Meloidogyne incognita* race 1 was studied on 'Roma VF' tomato and 'Lunga violetta di Romagna' egg plant seedlings for 59 days in a glasshouse at 25 (± 2)°C. This nematode required 20 to 24 days to complete its life cycle from egg to egg laying females under the above conditions in both host plant roots. The nematode population reproduced better on the tomato cultivar than on the egg plant cultivar used in this study.

INTRODUCTION

Muller (1883) was the first to describe the life cycle of *Meloidogyne* spp. Later many contributions (Atkinson, 1889; Stone and Smith, 1898; Bessey, 1911; Nagakura, 1930; Goodey, 1932; Christie and Cobb, 1941; Chitwood, 1949; Elsea, 1951; Bird, 1959; 1974; Bird and Wallace, 1965) were

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made on the morphology of the different developmental stages and the duration of the life cycle of *Meloidogyne* spp. under different environmental conditions and with several host plants in relation to their age and nutritional status.

Godfrey and Oliveira's (1932) study of the development of *Heterodera radicolica* (Greef) Muller on root tissues of pineapple and cowpea at a temperature range of 20 to 30°C, provides information on the duration of the life cycle from initial inoculation to first egg development including the time required for embryonic development and for various juvenile moults. Tyler (1933) found that the minimum time required for the life cycle of *Meloidogyne* sp. (unknown) was 87 and 25 days on tomato seedlings at 16.5 and 27°C respectively. Tarjan's (1952) comparative study indicates that the egg production of females started 39 days after inoculation for *M. arenaria*, *M. incognita* and *M. javanica* and 37 days for *M. incognita* acrita Chitwood at 21°C on *Antirrhinum majus*. Milne and Du Plessis (1964) reported that 56 and 21 days were required for the life cycle of *M. javanica* at 14° and 21°C respectively.

This study was undertaken to investigate the duration of the life cycle and the multiplication of *M. incognita* race 1, a warm-climate *Meloidogyne* population on two types of hosts, tomato and egg plant seedlings in the glasshouse at 25 (±2)°C.

MATERIALS AND METHODS

A population of *M. incognita* race 1 reared as a pure culture on tomato cultivar 'Rutgers' in the glasshouse was used in this experiment. Seeds of tomato cultivar 'Roma VF' and egg plant cultivar 'Lunga violetta di Romagna' were germinated in plastic trays containing steam sterilized sandy soil (sand, 86.8%; clay, 7%; silt, 3.9%; organic matter, 2.3%). Sixty eight, uniform size seedlings of tomato (18 days) and egg plant (25 days) were transplanted in 170 ml plastic pots containing the same soil mixture. Four days after transplanting the plants were inoculated by placing one mature egg mass (containing 600—800 eggs and juveniles) near the root system. The pots were maintained in the glasshouse at 25(±2)°C. Roots of four plants each of tomato and egg plant were removed from the pots at intervals of 6 and 12 hours, 1, 3, 5, 7 and 9 days and then 5 days intervals for 59 days after inoculation. The roots were gently washed to remove soil particles,

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treated first with ploxin B solution (0.15g in one litre of water) for 15 minutes (Dickson and Struble, 1965) for staining egg masses, eggs were extracted by the NaOCl method (Hussey and Barker, 1973) and the root tissues were stained with hot acid-fuchsin solution (McBeith *et al.*, 1941).

The number of egg masses, eggs and juveniles in egg masses per root system and all developmental stages inside root tissues were observed and counted under a binocular microscope.

RESULTS AND DISCUSSION

Fig. 1 shows the different developmental stages of *M. incognita* race 1 observed during a 59 days period in 'Roma VF' tomato and 'Lunga violetta di Romagna' egg plant roots inoculated with a single egg mass. The second stage juvenile (J_2) penetration was observed 1 and 3 days after inoculation in tomato and egg plant roots respectively. Heavy additional penetration, migration towards the vascular region and marked concentration of J_2 juveniles at the region of root tip, and various developmental stages of J_3 were observed during the period of 7 days in both host roots after the first penetration. First observations, of J_3 , J_4 and young females and egg laying females were made on tomato roots 7, 14, 14 and 24 and on egg plant roots 9, 14, 19 and 24 days after inoculation. The development of root galls was observed with the development of nematode inside the roots while some showed root galls without juvenile penetration. The J_2 , J_3 and J_4 of the first generation was completed in 19, 19 and 29 days respectively in both tomato and egg plant roots. Between 24 to 39 days after inoculation, many young females had developed into egg laying females. The J_1 , J_2 of the second generation were observed around 44, 44 days respectively in egg plant roots. Few pre adult and adult males were observed at 34 days after inoculation in both host roots. The penetration of J_2 into egg plant roots was 2 days later than that of tomato. The J_2 period was 7 days in both plants and J_3 period was 8 and 6 days respectively in tomato and egg plant. The first development of eggs in both host plants occurred between 19 to 24 days after inoculation. No marked differences were observed in gall size between two hosts. In both hosts the size and the number of galls were increased with the nematode growth and development.

Godfrey and Oliveira (1932) observed that *Meloidogyne* J_1 penetrated roots of pineapple and cowpea 6 hours after inoculation. In this study with the inoculation of a single egg mass the juvenile penetration occurred 1 and 3

days in tomato and egg plant roots respectively. Janati (quoted by Bird, 1979) demonstrated that the rate of penetration of *Meloidogyne* J₂ is related to the type of host plant, the soil temperature and the species of root-knot nematodes. Comparative studies on the penetration of *Meloidogyne* spp. in resistant and susceptible cultivars of the same crop have been reported for several crops by many authors (Jatala and Russel, 1972; Hadisoeganda and Sasser, 1982), but there is not enough information with reference to different host types.

The duration of the parasitic phase of a nematode life cycle depends on the species of the nematode and the host type. Godfrey and Oliveira (1932) observed that the length of time required for the first egg development in cowpea and pineapple was 19 and 35 days respectively after inoculation with juveniles at temperature between 20 to 30°C. In the present study although there were minor differences in the length of juvenile periods, the time required to produce egg laying females after the initial inoculation was between 20 to 24 days at 25(±)°C. in both host plants.

The number of specimens/infested root system detected in both host plants at each interval after inoculation are indicated in Fig. 2. Both hosts followed the same pattern in the occurrence of number of specimens at each interval. It is very clear that at each interval the number of specimens observed in tomato roots was higher than in the egg plant. Initially the difference in the number of specimens of both hosts was very small. This difference had increased during the period from one week to 39 days after inoculation. After 39 days onwards the emerged juveniles of the second generation had also penetrated the roots thus showing a marked difference in the number observed at each interval in two hosts. The maximum number detected in the first generation was 134 and 124 and in the second generation were 3150 and 218 for tomato and egg plant roots respectively. *Meloidogyne* juvenile penetration and the development of parasitic phase inside the host tissues are dependent on the host type, genetic qualities of the host, the environmental conditions and the type of *Meloidogyne* spp. (Bird, 1979). Possibly due to the differences in the physiological characters of the two hosts more juveniles penetrated and reproduced in tomato than in egg plant roots.

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Similar results were obtained by Hadisoeganda and Sasser (1982) with susceptible and moderately resistant potato cultivars inoculated with *M. incognita* race 1. They observed that initially there was no significant difference in penetration between two cultivars, but 8 days after inoculation the numbers in the roots of the moderately resistant cultivar (Royal chico) was significantly lower than in the susceptible cultivar (Rutgers). This is an example of an alteration of the physiology of the host plant making it unsuitable to nematodes shortly after their initial invasion. This host alteration character varies with the host susceptibility for the nematode.

The number of eggs and juveniles per egg mass detected in both host plants are shown in Fig. 3. The graphs followed the same pattern. The number has gradually increased from 24 to 49 days after inoculation. In 49 to 59 days after inoculation the numbers in both host plants showed parallel decrease. In *Meloidogyne* spp. the average number of eggs and juveniles/egg mass were reported to be 500—1000 (Guiran and Ritter, 1979). In this study the maximum number was 960 and 856 at 49 days after inoculation in tomato and egg plant roots respectively. However, the number of eggs and juveniles at each interval from inoculation up to 49 days post inoculation was higher in tomato than in egg plant roots. Most probably the same root-knot nematode does not produce the similar numbers of eggs per egg mass in different types of susceptible host plants. At 54 and 59 days after inoculation two graphs show an overlap and the number of eggs and juveniles/egg mass at these two intervals appear to have decreased in both hosts. This is due to the hatching and migration of emerged juveniles into the soil.

Considering the higher number of specimens/root system and the eggs and juveniles/egg mass at each interval it is clear that this nematode population reproduced better on tomato than on egg plant under the conditions of the experiment. However, very few adult males were observed in both host plant and were in equal numbers. This may be due to the availability of good nutritional conditions during the experimental period.

CONCLUSION

It can be concluded that the time required for this population of *M. incognita* race 1 to complete its life cycle from egg to egg-laying females was between 20 to 24 days in both host plant roots at 25 (± 2)°C under the glasshouse conditions of this study. Tomato cultivar 'Roma VF' is a better host than egg plant cultivar 'Lunga violetta di Romagna' for multiplication of this *Meloidogyne* population under conditions of this study.

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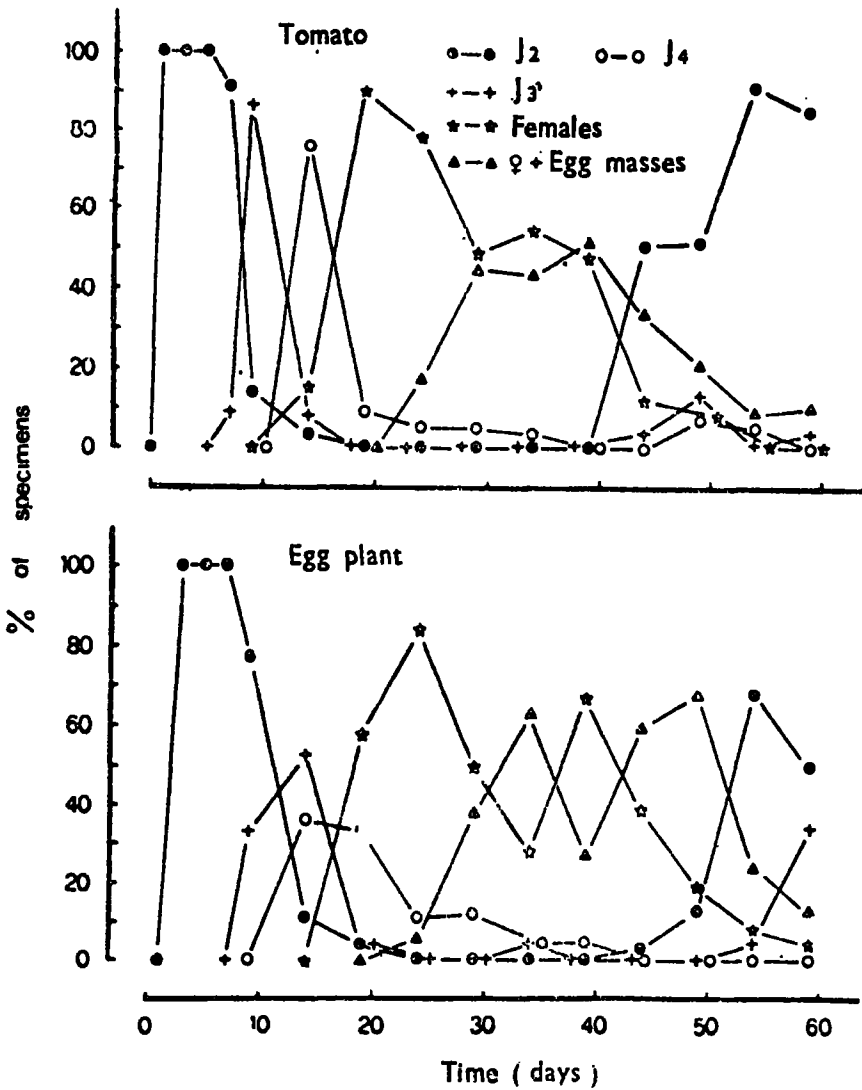


Fig. 1. Percentage of different developmental stages of *M. incognita* race 1 observed on 'Roma VF' tomato and 'Lunga violetta di Romagna' egg plant roots each inoculated with a single egg mass.

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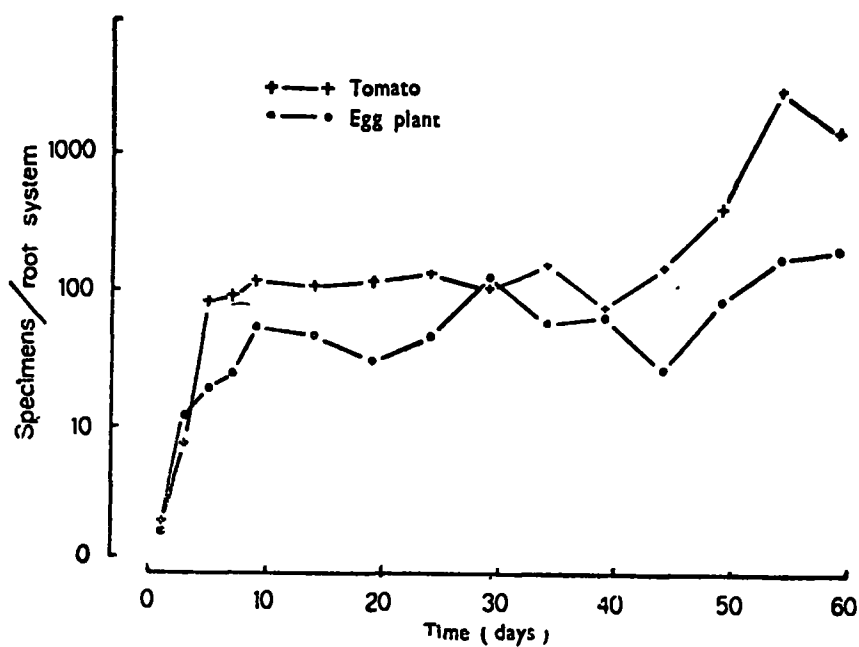


Fig. 2. Number of specimens of *M. incognita* race 1 (log scale) recovered in 'Roma VF' tomato and 'Lunga violetta di Romagna' egg plant roots each inoculated with a single egg mass.

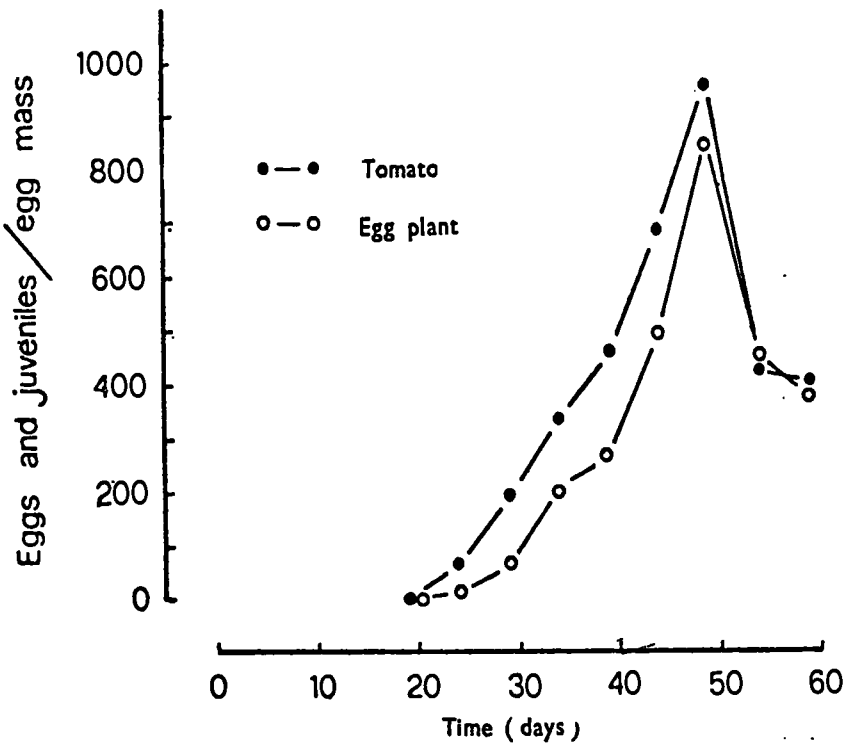


Fig. 3. Number of eggs and juveniles per egg mass detected in 'Roma VF' tomato and 'Lunga violetta di Romagna' egg plant roots each inoculated with a single egg mass of *M. incognita* race 1.