*Department of Plant Pathology - Faculty of Agriculture*
*Alexandria University - Alexandria - Egypt*

# HOST-PARASITE RELATIONSHIP OF MELOIDOGYNE INCOGNITA (Kofoid *et* White) Chitw. ON RICE (1)

by
I. A. IBRAHIM, I. K. A. IBRAHIM and M. A. REZK

In a previous paper, the writers recognized occasional nematode infection in some scattered rice fields, and identified *Meloidogyne incognita* (Kofoid *et* White) Chitw. and. *M. javanica* (Treub) Chitw. as the incitants of the disease. The former was found to be generally distributed in all surveyed localities, while the latter was found only within Kafr El-Sheikh Governorate. The symptoms and galls produced by each species were similar and growth of infected plants was considerably reduced, as determined by fresh and dry weight, number and vigour of roots and tillers.

This paper reports investigations on the life cycle and the effect of the parasitizing larvae of *M. incognita* on the invaded tissues of rice roots.

## *Materials and methods*

*Meloidogyne incognita* used in this study was isolated from infected rice roots. A single egg mass of an identified female was placed in distilled water and the hatched larvae were then reared on isolated tomato-plants, grown in steamed clay soil.

Rice grains 'Nahda' were planted in steamed clay soil in 15 cm. pots, and after germination were thinned to 6 seedlings per pot. Inoculation was carried out by adding 1,000 second stage larvae per pot around the roots of rice seedlings, 3 days after emergence. 44 pots were inoculated and 22 were left uninoculated to serve as

(1) Paper presented at the « Third Congress of the Mediterranean Phytopathological Union » 22-28 October, 1972, Oeiras, Portugal.

controls. Root samples of both infected and control plants were taken one day after inoculation and then at intervals of two days up to the 10th day, then at intervals of 5 days up to the 40th day. Four infected pots and two control ones were used in each test.

Root samples were washed in water, cut into small portions and then fixed in F.A.A. solution. Fixed samples were stained with acid fuchsin-lactophenol (Goodey, 1957) and examined for the presence of the different stages of the nematode larvae and for any anatomical changes in the root tissues resulting from a reaction to larval invasion and gall formation. Other fixed root samples were sectioned with a rotary microtome and stained with safranin-light green or with hematoxiline and eosine (Johanson, 1940).

## *Results*

Microscopic examination of fresh samples and preparations of rice roots infected by *M. incognita* and stained by the acid fuchsin-lactophenol method, revealed the followings:

A) *Life Cycle of the Pathogen*:

1. Deposited egg masses involved eggs at various stages of embryonic development. Egg masses, isolated from infected rice-roots and placed in distilled water at room-temperature hatched in 2 to 8 days.

2. Second stage larvae were seen within the root tissues 24 hours after soil infestation and their penetration was mostly through rootlet-tips. In a few cases, however, penetration in the region of root-elongation was detected.

3. Some of the invading larvae appeared to remain within the apical meristem, while others were located within the tissues of the vascular elements. Orientation of the larvae within the root tissues was either parallel with respect to the longitudinal axis of the root or at right or acute angles.

4. Eight days after inoculation, the feeding third stage larvae were found within the meristematic, cortical, and vascular tissues of the infected roots.

5. Fourth stage larvae were observed in the tissues of root samples taken 10 days after inoculation. In general, larval heads were

embedded within the tissues of the endodermis and pericycle and their posterior portion extended through the cortical tissues.

6. Young females were first seen in root galls taken 15days after inoculation. Typical adult females were found within infected roots 20 days after inoculation.

7. Mature females, associated with egg-masses deposited in gelatinous matrices, were observed in preparations of infected roots 25 days (or more) after inoculation. Hatched larvae from the egg masses were found in infected root-tissues 35 days after inoculation, thus indicating the start of the second generation.

B) *Histopathological observations*:

Microscopic examination of stained sections of infected roots, showed the followings:

Second stage larvae usually penetrated the rootlets through the apical meristem and clear traces were seen of the larval movement between the cells towards the root centre. Two days after inoculation typical hypertrophic-reaction of the cells started to develop around the feeding sites of the larvae. Cell necrosis and distortions within the cortical tissues occurred as a result of larval movement.

Cortical cells, in which stylets of the feeding larvae were inserted, were hypertrophied and some of the surrounding cells showed symptoms of hyperplasia (Fig. 1). In some cross sections the anterior portion of a mature female was embedded within the cortical tissues, whereas the posterior part was extended outside the root surface and egg masses were deposited externally on the root surface (Fig. 2).

Giant cells formed adjacent to feeding sites of the larvae were first noted in preparations made 10 days after inoculation. Up to 6 giant cells were formed around the anterior portion of a single larva. These giant cells, however, were formed only in cortical tissues and xylem elements (Figs. 3 and 4).

Cells of the endodermis showed symptoms of hypertrophy and hyperplasia as a result of nematode-feeding, whereas these of the pericycle showed only hypertrophy (Fig. 4).

There was no evidence from the preparations that phloem cells were feeding sites for the nematode larvae but it was noted, however, that a considerable number of phloem cells were mechanically damaged. That may be attributed to the pressure exerted as a result

Fig. 1 - Longitudinal section of infected rice root, showing hypertrophy and break down of cortical cells, invaded by larvae of *M. incognita.*

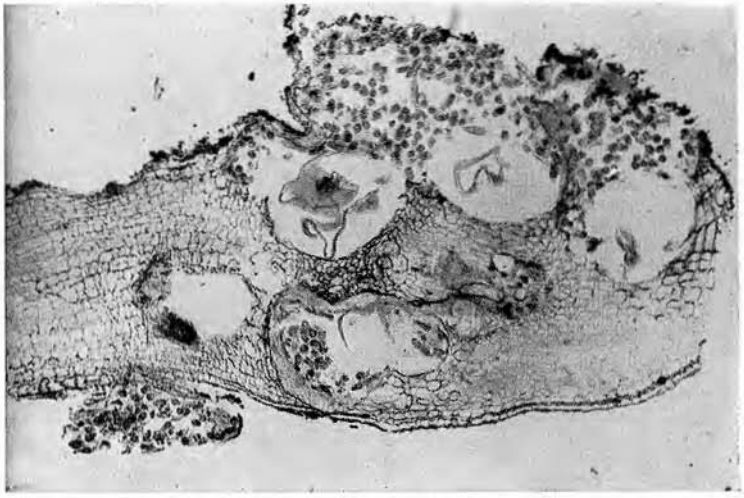

Fig. 2 - Longitudinal section of infected rice root, showing mature females and egg masses of *M. incognita* protruding outside the root.

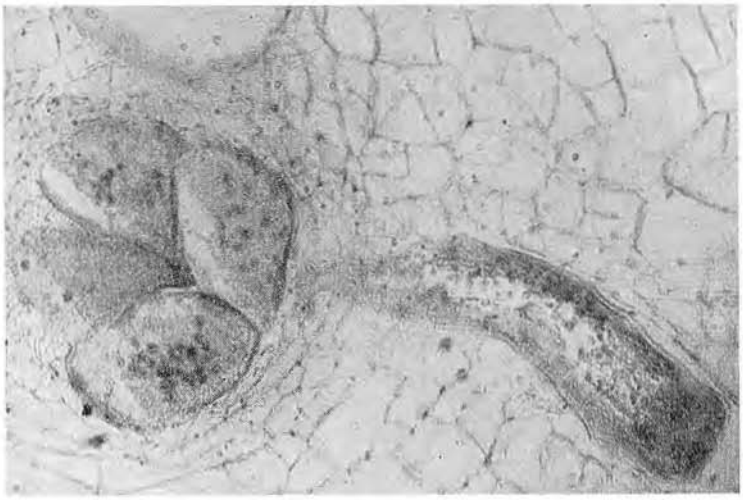

Fig. 3 - Cross section of infected rice root, showing four giant cells around larvae of *M. incognita.*

Fig. 4 - Cross section of infected rice root with *M. Incognita,* showing endodermis and pericycle with hypertrophy and thickening of cell walls.

of the formation of hypertrophied and giant cells within the nearby xylem elements. Malformations were observed in the xylem elements due to the nematode feeding and also to the expansion and development of hypertrophied tissues and giant cells.

## *Conclusion*

The life cycle of the rice root-knot nematode, *M. incognita*, was completed within 25 to 30 days. Second stage larvae usually penetrated rootlets at the tips and less frequently in the region of root elongation. Third and fourth stage larvae and young females were observed within the tissues of infested roots 10, 15 and 20 days after inoculation, respectively. Egg-laying females were detected 25 to 30 days after inoculation. Infestation with *M. incognita* caused hypertrophy and hyperplasia within the meristematic cells, cortical and endodermal tissues, pericycle and xylem elements. Giant cells were formed in the meristematic tissues, cortex and xylem elements. The phloem was, however, free from the parasitizing larvae and therefore is not regarded as a site for nematode feeding.


## SUMMARY

Studies carried out on the biology of *Meloidogyne incognita* (Kofoid *et* White) Chitw. have shown that the life cycle of the nematode was completed within 25 to 30 days in rice roots. Second stage larvae usually penetrated rootlets at the tips and less frequently in the region of root elongation. Third and fourth stage larvae, and young females, were observed within the tissues of infested roots 10, 15 and 20 days after inoculation, respectively. Egg-laying females were detected 25 to 30 days after inoculation. Infestation with *M. incognita* caused hypertrophy and hyperplasia within the meristematic cells, cortical and endodermal tissues, pericycle and xylem elements. Giant cells were formed in the meristematic tissues, cortex and xylem elements. The phloem was, however, free from the parasitizing larvae and therefore is not regarded as a site for nematode feeding.

## RIASSUNTO

Relazioni ospite-parassita di *Meloidogyne incognita* (Kofoid *et* White) Chitw. su riso.

Studi condotti sulla biologia di *Meloidogyne incognita* (Kofoid *et* White) Chitw. hanno mostrato che il ciclo vitale del nematode si compie in 25-30 giorni

in radici di riso. Le larve di seconda età, di solito, penetrano nelle radici nei pressi dell'apice e, meno frequentemente, nella regione posteriore all'apice. Le larve di terza e quarta età e le femmine sono state osservate nei tessuti infestati rispettivamente 10, 15 e 20 giorni dopo l'inoculo, mentre l'ovodeposizione è iniziata 25-30 giorni dall'inoculo stesso. L'infestazione di *M. incognita* ha causato reazioni di ipertrofia e iperplasia nelle cellule meristematiche, nei tessuti corticali ed endodermici, nel periciclo e negli elementi dello xilema. Cellule giganti furono osservate nei tessuti meristematici e corticali e negli elementi dello xilema, mentre del tutto esente da infestazione risultò essere il floema.


## RÉSUMÉ

Relation hôte-parasite de *Meloidogyne incognita* (Kofoid *et* White) Chitw. sur riz.

Des études effectuées sur la biologie de *Meloidogyne incognita* (Kofoid *et* White) Chitw, ont montré que ce nématode termine son cycle vital, sur racines de riz, en 25-30 jours. Les larves de second âge pénétrent ordinairement près de la pointe des racines et, moins souvent, dans la région postérieure de la même.

Les larves de troisième et quatrième âge et les femelles ont été observées dans les tissus infestés, respectivement 10, 15 et 20 jours après l'inoculation et 25, 30 jours, après la même, est commencée la déposition des oeufs.

L'infestation de *M. incognita* a causé des réactions de hypertrophie et de hyperplasie dans les cellules du méristème, dans le tissu cortical et de l'endoderme, dans le péricycle et dans les éléments du xylème.

Des cellules géantes ont été observées dans le tissu cortical et du méristème et dans les éléments du xylème; le phloème, au contraire, est résulté exempt d'infestation tout à fait.


## LITERATURE CITED


GOODEY, J. B., 1957. Laboratory methods for work with plant and soil nematodes. Ministry of Agric., Fish. and Fd., Tech. Bull. N. 2, 47 pp.

IBRAHIM I. K. A., IBRAHIM I. A. and REZK M. A., 1972. Pathogenicity of certain parasitic nematodes on Rice. *Alex, J. Agr. Res. 20*: 175-181.

JOHANSON, D. A., 1940. Plant Microtechnique. McGroow Hill Book Co., Inc. New York, 523 pp.