

MORPHOLOGY AND HISTOPATHOLOGY OF SPECIES OF *Meloidogyne*  
ON SELECTED CROPS IN BRAZIL<sup>a</sup>

N. Vovlas<sup>1</sup>  
F. Lamberti<sup>1</sup>  
R.D. Sharma<sup>2</sup>  
R.R.A. Lordello<sup>3</sup>

Root-knot nematodes were collected from different hosts in three geographical locations in Brazil. Species were determined using Scanning Electron Microscopy (SEM) and Light Microscopy as described here. Particular consideration was given to the lip profile, the location of the excretory pore and the configuration of the perineal pattern. Symptoms and histopathological changes induced in infested roots were investigated and are illustrated.

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<sup>1</sup> Istituto di Nematologia Agraria, C.N.R., Bari, Italy.

<sup>2</sup> EMBRAPA/CPA Cerrados, Planaltina, DF. Brazil.

<sup>3</sup> Lab. Nematologia - IAC, Campinas, SP, Brazil.

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## MATERIALS AND METHODS

Egg-producing females infiltrated with glycerin were used for SEM observations. Gold coated specimens were observed and photographed with a Jeol 50A JSM microscope operating at 10 kV accelerating voltage.

For histological examination of infested tissues, galled roots of naturally infested plants were fixed in formalin-acetic acid-alcohol solution, dehydrated in tertiary butyl alcohol series and embedded in paraffin. Root segments were sectioned at 10-12  $\mu\text{m}$  and the sections stained with safranin and fast-green for microscopic examination (JOHANSEN, 1940).

## OBSERVATIONS

*Meloidogyne arenaria* (Neal) Chitwood  
(Figs. 1 A, B - 3 A, B - 4 A)

Complete females of *M. arenaria* with the body shape as in Fig. 4A and with large egg-masses were found in infested Tomato (*Lycopersicon esculentum*) roots collected at the Centro Nacional de Pesquisa de Hortaliças (CNPQ), EMBRAPA, Brasília-DF. The perineal patterns, excretory pore locations and lip profiles were consistently as in Figs. 2 A,B, 4 A while the excretory pore-anterior end distance (EP) divided by the stylet length (ST) was 2.36 ( $n = 13$  specimens examined).

Multinucleate giant cells (usually 3-6) were adjacent to the head of each adult female. Abnormal and interrupted xylem elements were also observed in many sections (Fig. 3 A,B) located in vascular tissues near the giant cells, formed as the result of the nematode feeding activity and direct injury of xylem parenchyma.

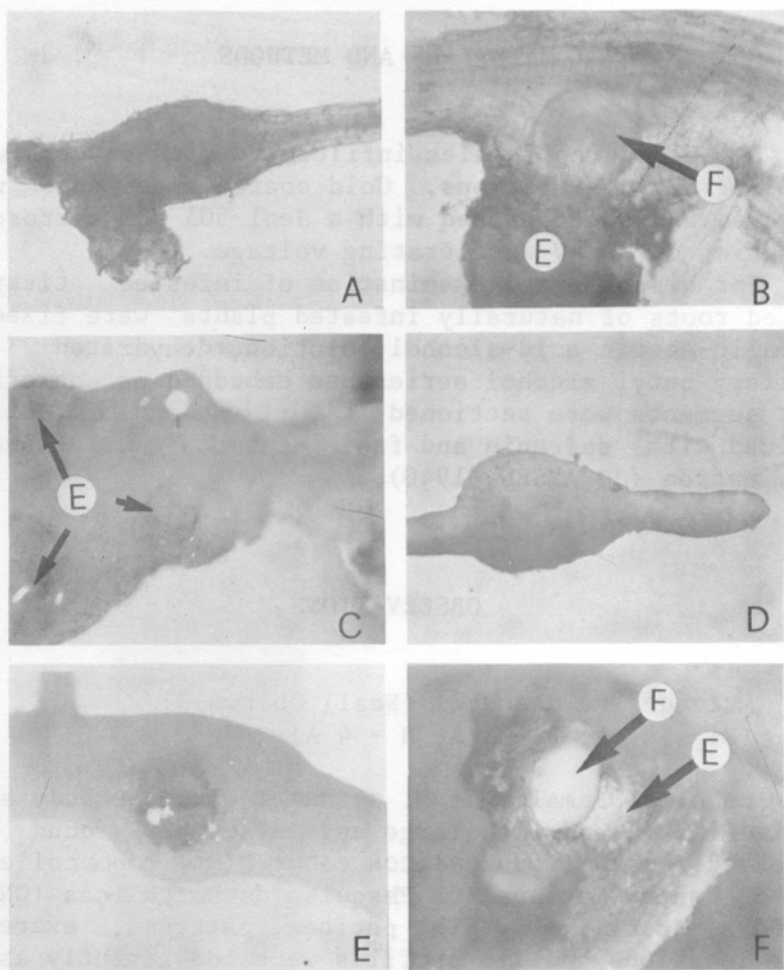


Fig. 1. A,B) Intact and partially dissected galls on tomato roots, induced by *Meloidogyne arenaria*. (F= female body; E = eggs); C) Intact gall on Black grass root induced by a colony of *M. incognita* (E = egg masses on the root surface); D,E) Terminal and non terminal galls induced by *M. exigua* on coffee roots. Note the necrotic tissues in Fig. E; F) Partially dissected gall showing a female (F) and egg-mass (E) of *M. exigua* still inside the cortical tissues of an infested coffee root.

*Meloidogyne incognita* (Kofoid & White) Chitwood.

Colonies of egg-laying females of *M. incognita* were found in single galls on Black grass (*Mondo japonicum* (L. f.) Farwell - syn. cient. *Opheopogon japonicus* Ker - Gawl.) roots collected from a lawn on the campus of the University of Brasilia. The female body shapes were as in Fig. 4B. The perineal patterns, excretory pore locations and lip profiles were consistently as illustrated in Figs. 2 C,D, 4B. The EP/ST = 1.37 (n = 17).

Enlarged giant cells in the roots were associated with the adult females and occupied up to 1/3 of the stele (Figs. 3 C,D) with consequent compression of the xylem elements and general disorder of the vascular system at the feeding site of the nematode.

*Meloidogyne exigua* Goeldi.

Numerous terminal and non-terminal galls induced by *M. exigua* were observed on the roots of *Coffea arabica* collected at the Instituto Agronomico, Campinas, São Paulo State (Fig. 1D, E, F). The perineal patterns, excretory pore locations and lip profiles were consistently as in Fig. 2 E,F - 4 C. EP/ST = 2.09 (n = 14).

The occurrence of more than one female in single galls was common, but each female was associated with a variable number (3 - 6) of giant cells (Figs. 2 E, F). Often mature egg-masses were still inside the cortical tissues (Fig. 1F) while outside the gall a large necrotic area was evident (Fig. 1E).

Giant cells always occurred in the central cylinder causing disorder and collapse of the vascular elements (Figs. 3 E,F).

## DISCUSSION

The characterization of Brazilian species of *M. arenaria*, *M. incognita* and *M. exigua* is: complete body

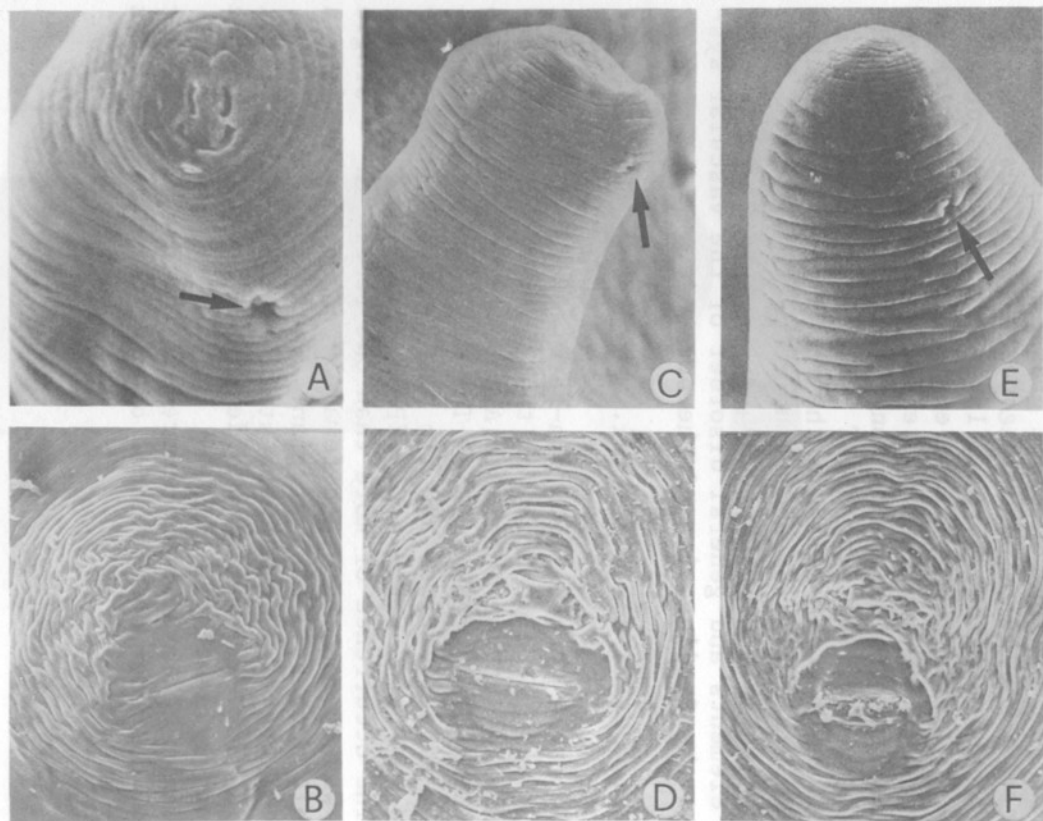


Fig. 2. SEM photomicrographs showing the excretory pore position (arrowed) and the perineal pattern. A,B) = *M. arenaria*; C,D) = *M. incognita*; E,F) = *M. exigua*.

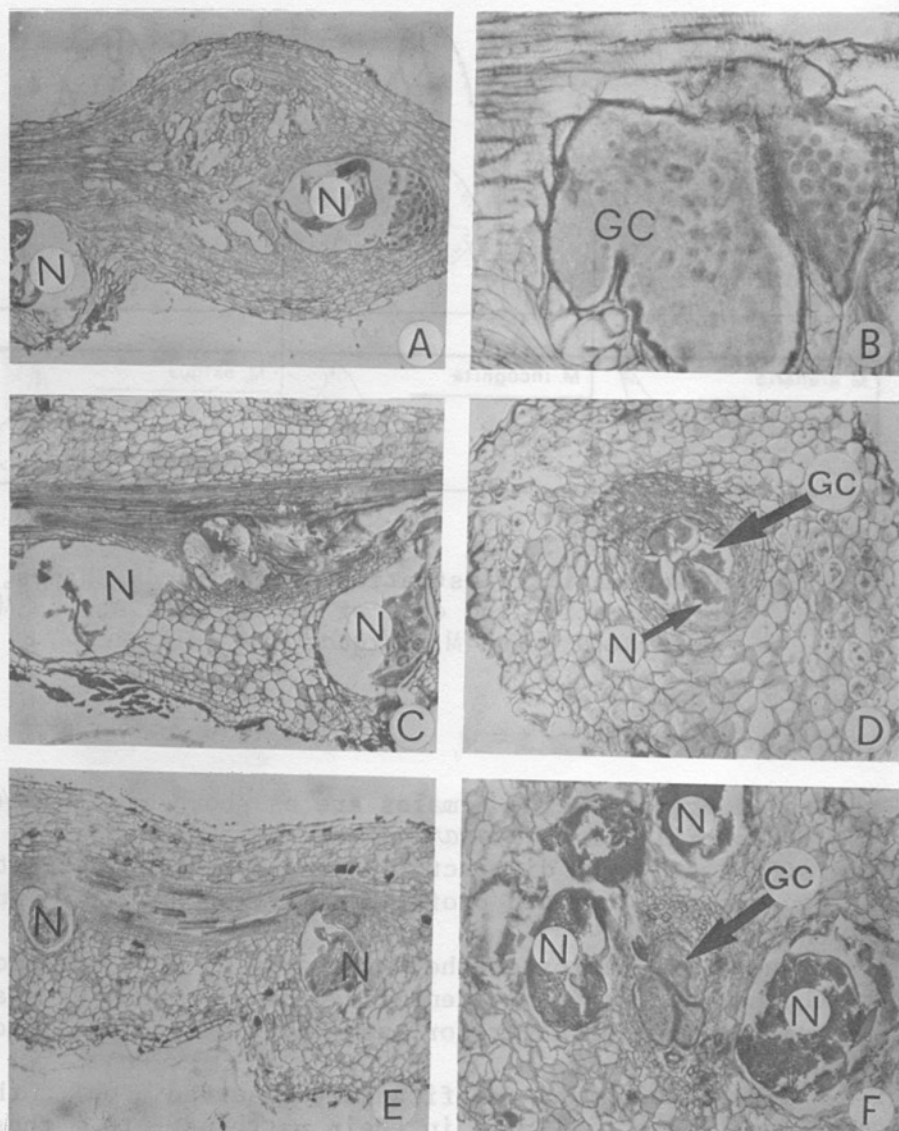


Fig. 3. Histopathological changes induced by *M. arenaria* on tomato roots (Figs. A,B), by *M. incognita* on Black grass (Figs. C,D) and by *M. exigua* on coffee roots (Figs. E,F).

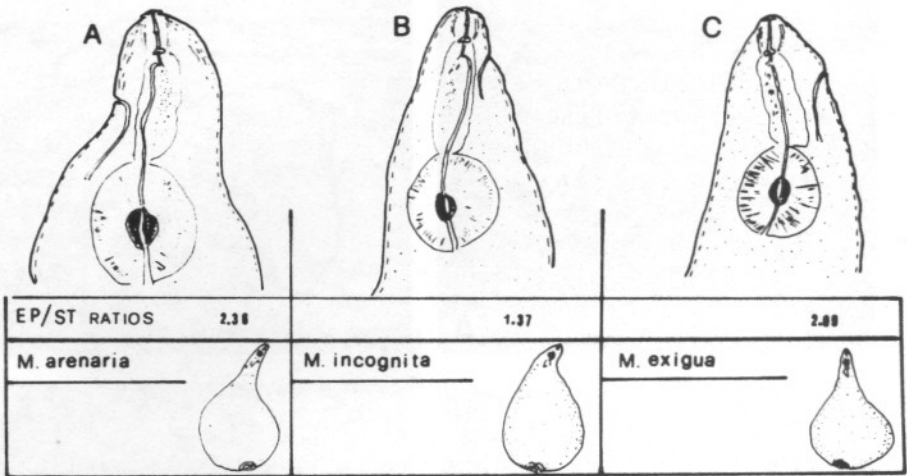


Fig. 4. Diagrammatic illustration of full body shapes, EP/ST ratios and ends of *M. arenaria* A, *M. incognita* B and *M. exigua* C.

shapes of egg-producing females are as shown in Fig. 4. The lip profile of *M. arenaria*, with head region slightly offset and with distinct lip annules is in contrast to the smoothly rounded profiles of *M. incognita* and *M. exigua*.

The EP/ST ratios of the three species in addition to the perineal pattern identification give another stable diagnostic character for easy and routine identification.

The histological modifications observed on the three hosts are similar - in their patterns - to those reported for other root-knot nematodes and hosts (TAYLOR & SASSER, 1978).

## SUMMARY

Morphological characteristics of taxonomic importance for three Brazilian *Meloidogyne* species (*M. arenaria*, *M. incognita* and *M. exigua*) are illustrated. Particular consideration is given to the female lip profiles, excretory pore locations, perineal patterns and complete female shapes. The histological changes induced by the three species are also illustrated in section of roots of tomato, grasses and coffee, infested respectively by *M. arenaria*, *M. incognita* and *M. exigua*.

## RESUMO

MORFOLOGIA DE ESPÉCIES DE *Meloidogyne* E  
HISTOPATOLOGIA DE RAÍZES PARASITADAS DE ALGUMAS  
CULTURAS NO BRASIL

Características morfológicas de importância taxonômica para três espécies de *Meloidogyne* do Brasil (*M. arenaria*, *M. incognita* e *M. exigua*) são ilustradas. Particular consideração é dada ao contorno dos lábios das fêmeas, localização do poro excretor, configuração perineal e forma geral das fêmeas. As alterações histológicas induzidas pelas três espécies são, também, ilustradas em cortes de raízes de tomateiro, grama preta e café, infestados respectivamente por *M. arenaria*, *M. incognita* e *M. exigua*.

## LITERATURE CITED

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TAYLOR, A.L. & J.N. SASSER, 1978. **Biology, identification and control of root-knot nematodes** (*Meloidogyne* spp.). North C. S.U. Graphics, 111 pp.

## RESUMO

MORFOLOGIA DE ESPÉCIES DE MELOIDOGYNE E HISTOPATOLOGIA DE RAÍZES PARASITADAS DE ALGUMAS CULTURAS NO BRASIL

Características morfológicas de três espécies de Meloidogyne (M. arenaria, M. incognita e M. exiguus) são ilustradas. Particular consideração é dada ao contorno dos lábios das fêmeas, localização do poro excretor, configuração perineal e forma geral das fêmeas. As alterações histológicas induzidas pelas três espécies são também ilustradas em cortes de raízes de tomateiro, grama-preta e café, infestados respectivamente por M. arenaria, M. incognita e M. exiguus.

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