Nematol. medit. (1976), 4: 175-181.

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HISTOLOGY OF PEANUT UNDERGROUND PARTS INFECTED WITH *MELOIDOGYNE INCOGNITA*

by

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The histological changes in legume nodular tissues induced by the infection of the root-knot nematodes (*Meloidogyne* spp.) have been studied by Robinson (1961) on velvet bean (*Stizolobium* sp.), Taha and Raski (1969) on Dutch white clover (*Trifolium repens* L.), and Yousif (1972) on common beans (*Phaseolus vulgaris* L.). Their findings revealed the formation of giant cells inside the vascular bundles while the structure of nodular tissues was not disturbed.

Observations on infection of peanut (*Arachis hypogaea* L.) roots (Minton and Jackson, 1967; Oteifa *et al.*, 1970) and pods (Minton and Jackson, 1967; Minton *et al.*, 1969) by root-knot nematodes stimulated the present histopathological study on *Meloidogyne incognita* (Kofoid *et* White) Chitw. on peanut roots, nodules, pegs (gynophores) and pods (fruits). Oteifa *et al.* (1970) found *M. incognita* with other species infecting peanut roots grown in new reclaimed irrigated lands in Tahrir Province, Egypt.

Materials and Methods

Peanut plants « Giza 1 » potted singly in sterilized sand were inoculated with (i) liquid culture of *Rhizobium* sp. (cowpea group) or (ii) rhizobia plus 50 egg-masses per 30-cm pot of *M. incognita* derived from a culture sustained on tomato plants (*Lycopersicon esculentum* Mill. « Commune »). Pots were maintained outdoors from May till mid-August (105 days) and watered daily with tap water and with nitrogen-free nutrient solution once a week (Rending and McComb, 1959).

Healthy and infected nodules and also nodules developed on *M. incognita* galls, pegs and pods were sampled and prepared for histological study. They were fixed in FAA, serially dehydrated in ethyl alcohol, cleared in xylene, embedded in paraffin, sectioned at 9 μm, and stained with safranin-fast green (Jensen, 1962). Infected pods were also cut longitudinally with a razor blade.

Results and Discussion

M. incognita infection took place at the basal connection of the nodule to the root and also at any place in the nodule where vascular bundles are found (Figs. 1, 2, 3, 4). The vascular system of the peanut nodule emanates from the central stele of the root at the nodule base (Bond, 1948). Furthermore, unlike nodules of most leguminous crops which are of cortical origin (exogenous type), peanut nodules are of pericyclic origin (endogenous type) (Allen and Allen, 1940; Bond, 1948). Therefore, disruption of the nodule vascular connection with the root stele by nematode infection and, in addition, the harmful effect exerted by the dislodged vascular strands on the pericycle layer, hampered the normal development of the nodule (Fig. 3). Bond (1948) stated that the earliest evidence of peanut nodule formation is the meristematic activity in the pericyclic cells adjacent and in juxtaposition to the same protoxylem strand from which a rootlet has emerged. Feeding sites of *M. incognita* were produced inside the vascular bundles (Figs. 3, 4).

The mature gynophore (peg) has a typical stem structure (Hector, 1936). The pith is large; about 15 vascular bundles with fascicular cambium interconnected by additional bands of meristem, the interfascicular cambium; the cortex is somewhat narrow (Fig. 5). The infection occurred in the vascular bundles only where egg-masses, females and their feeding sites were found (Figs. 6, 7).

The first evidence of infection of peanut fruits was observed by small protuberances with dark brown spots which marked the location of the gelatinous matrices. Cracks also appeared in the ovary wall, future pericarp, through which several females could be detected using a dissecting microscope (Fig. 8a, b). Cutting the infected fruits in half revealed many swollen females embedded in the cortex of the ovary wall (Fig. 9a, b).

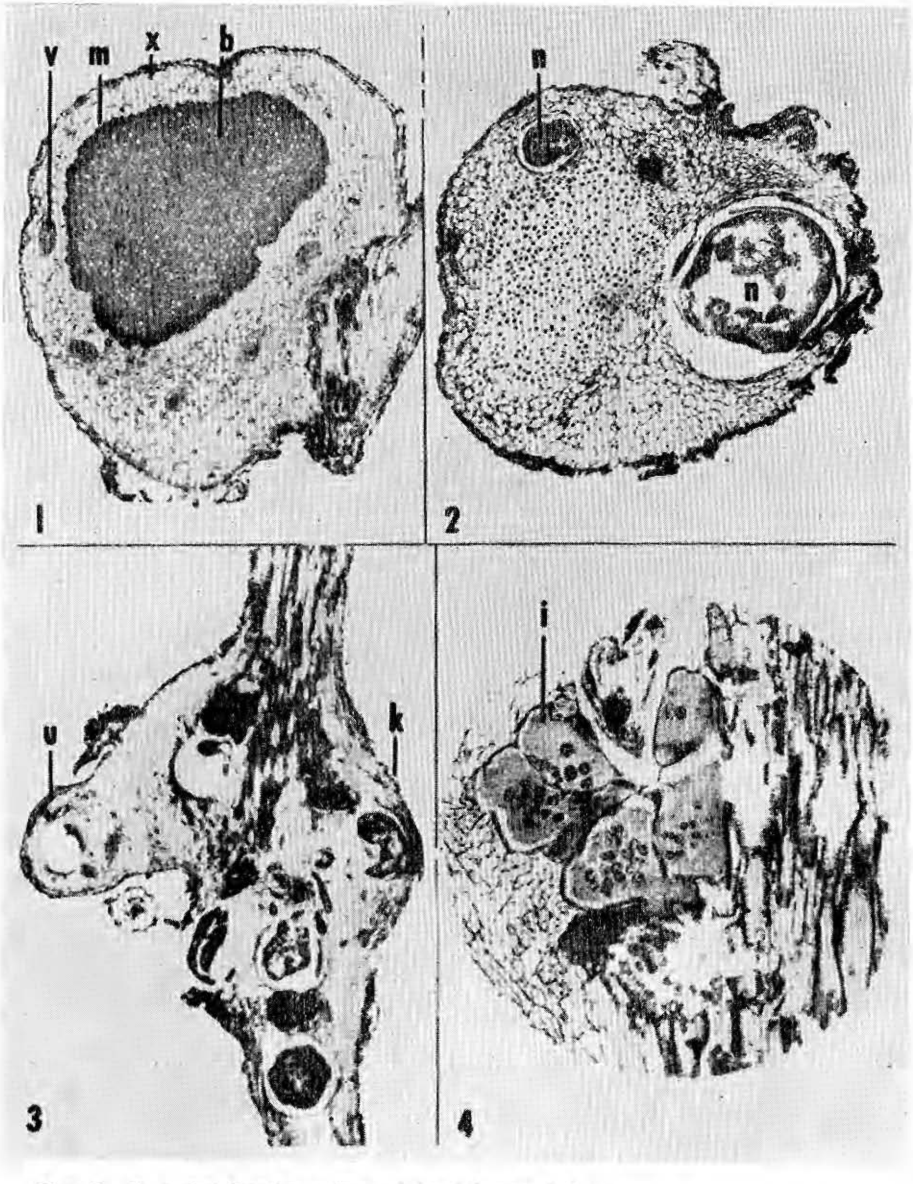

Fig. 1 - Longitudinal section of healthy nodule.
Fig. 2 - Longitudinal section of *M. incognita*-infected nodule.
Fig. 3 - Longitudinal section through galled root tissues from which underdeveloped nodule arises.
Fig. 4 - Longitudinal section of *M. incognita* giant cells inside the stele of the root.
(b = bacterial tissue; i = giant cell; k = gall; m = hemispherical meristem; n = nematode; u = nodule; v = vascular bundle; x = cortex)

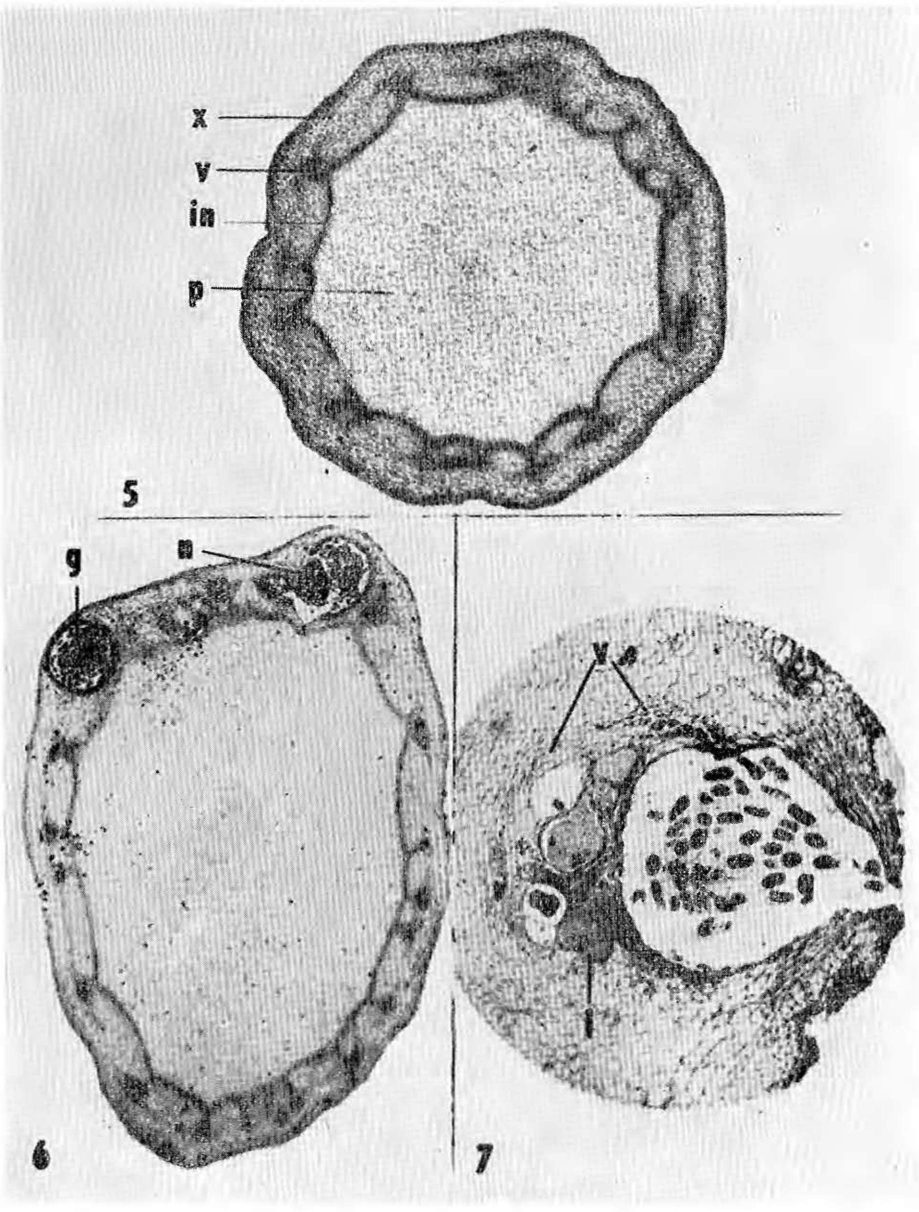

Fig. 5 - Transverse section of healthy gynophore (peg).
Fig. 6 - Transverse section of *M. incognita*-infected gynophore.
Fig. 7 - Transverse section of *M. incognita* giant cells and egg-masses inside vascular bundle of gynophore.
(g = egg-mass; i = giant cells; in = interfascicular cambium; n = nematode; p = pith; v = vascular bundle; x = cortex)

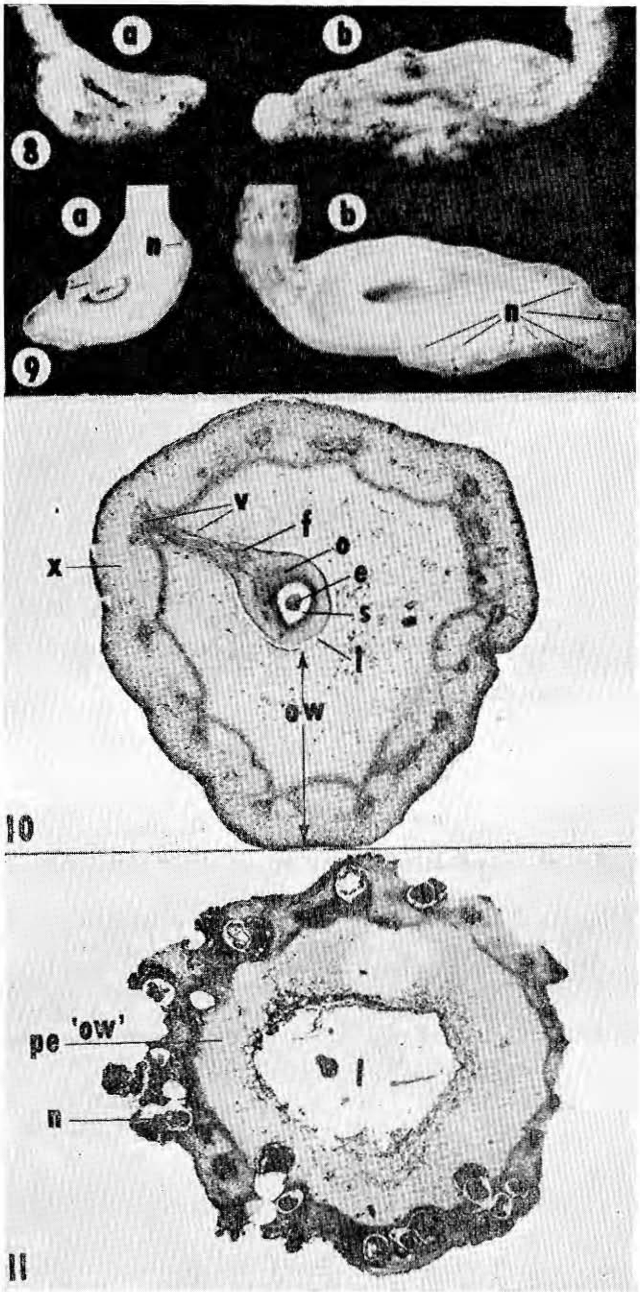

Fig. 8 a, b - *M. incognita*-infected fruits (pods) showing cracks in ovary wall.

Fig. 9 a, b - (a) Infected fruit cut open longitudinally to show vascular bundles running across ovary wall supplying developing seed (ovule with its embryo). (b) Longitudinal half of infected fruit showing several *M. incognita* females embedded in ovary wall (pericarp).

Fig. 10 - Transverse section of newly-formed fruit.

Fig. 11 - Transverse section of heavily infected fruit.

(e = proembryo; f = funiculus; l = ovarian locule; n = nematode; o = ovule; ow = ovary wall; pe = pericarp; s = embryo sac; v = vascular bundle; x = cortex)

Histological study of a healthy newly formed peanut fruit (Fig. 10) showed the occurrence of many vascular bundles well-established in the ovary wall, and also diverging into the central part of the ovary and the ovule. All these bundles were subjected to *M. incognita* infection (Fig. 11). Egg-masses, females and giant cells were found all-over the pericarp which became dark and soft and heavily stained. Translocation of food through the vascular tissues is important in seed development (Esau, 1953) and it appears that *M. incognita* infection ultimately hindered the transfer of food and/or drained the host plant nutrients during seed formation.

SUMMARY

The histology of peanut nodules, gynophores and fruits infected with *Meloidogyne incognita* was studied. Giant cells were formed inside the vascular bundles of all infected parts. The normal development of nodules was hindered in galled tissues. Moreover, heavily infected fruits were soft and dark. *M. incognita* infection deprived the developing seeds of nourishment through the vascular bundles which supply the ovules.

RIASSUNTO

Istologia di parti ipogee di Arachide infestata da Meloidogyne incognita.

È stata studiata l'istologia di noduli ginofori e frutti di Arachide infestati da *Meloidogyne incognita.* Cellule giganti sono state formate nei fasci vascolari di tutte le parti infestate. La normale formazione dei noduli radicali è stata bloccata nei tessuti con galle. Inoltre, i tessuti fortemente infestati erano molli e imbruniti. Gli attacchi di *M. incognita* hanno privato il seme in formazione della sostanza nutritiva che ad esso è convogliata dai fasci vascolari degli ovuli.

RÉSUMÉ

Histologie de parties hypogées d'Arachide infestée par Meloidogyne incognita.

L'histologie de nodules gynophores et des fruits d'Arachide ravagée par *Meloidogyne incognita* a été étudiée. Toutes les parties infestées présentent des cellules géantes dans les faisceaux vasculaires. La formation normale des nodules racinaires a été bloquée dans les tissus avec galles. De plus, les tissus trés infestés étaient noirs et remollis. L'infestation par *M. incognita* a privé la graine en germination de l'alimentation qui lui arrive à travers les faisceaux vasculaires des ovules.

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Accepted for publication on 20 June 1976.