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STUDIES OF PLANT AND SOIL NEMATODES

2. QUEENSLAND HOST RECORDS OF ROOT-KNOT NEMATODES (*MELOIDOGYNE* SPECIES)

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SUMMARY.

Meloidogyne species which have been found in Queensland are *M. javanica* (Treub) Chitwood, *M. arenaria* (Neal) Chitwood, *M. hapla* Chitwood, and *M. incognita* (Kofoid and White) Chitwood. Within these species there are distinct physiological races.

The records are presented in two sections. In the first the hosts are arranged in alphabetical order with data on nematode parasite, maximum severity of infestation observed, locality, and susceptibility of test plants; in the second the relevant hosts are listed under each of the Meloidogyne species.

The host list includes 269 species in 62 botanical families. Many of these are new records.

I. INTRODUCTION.

In 1949 Chitwood separated the root-knot nematodes from the genus *Heterodera* in which they were considered a single species, *H. marioni* (Cornu) Goodey, and transferred them to the genus *Meloidogyne*. He redescribed *M. exigua* Goeldi, *M. javanica* Treub, *M. incognita* Kofoid and White and *M. arenaria* Neal, and described *M. hapla* and *M. incognita acrita*. The main character on which Chitwood (1949) based the separation of species was the pattern of the striations in the perineal region of adult females.

Earlier, several workers, including Christie and Albin (1944), Christie (1946) and Christie and Havis (1948), had demonstrated that different root-knot nematode populations varied in their plant-host reactions.

Since 1949 the following species and subspecies have been described:—*M. arenaria thamesi* Chitwood 1952, *M. brevicauda* Loos 1953, *M. inornata* Lordello 1956, *M. javanica bauruensis* Lordello 1956, and *M. acronea* Coetzee 1956.

Sasser (1954) studied the host-parasite relationships of populations of *M. javanica*, *M. arenaria*, *M. hapla*, *M. incognita incognita* and *M. incognita acrita*, and proposed that these species could be separated by testing their effects on *Arachis hypogaea* L. (peanut, Spanish); *Citrullus vulgaris* Schrad. (watermelon, Dixie Queen); *Triticum aestivum* L. (wheat, Coastal), *Hordeum vulgare* L. (barley, Moore), or *Zea mays* L. (corn, Golden Cross Bantam); *Capsicum frutescens* L. (red pepper, California Wonder); and *Lycopersicon peruvianum* (L.) Mill. He concluded that peanuts are susceptible to *Meloidogyne hapla* and *M. arenaria* but resistant to the other nematode species; watermelon, wheat, barley and corn are susceptible to *M. arenaria* but resistant or immune to *M. hapla*; red pepper is resistant to *M. javanica*; and *Lycopersicon peruvianum* is susceptible to *M. incognita acrita* but resistant to *M. incognita incognita*.

Subsequently several workers, including Sasser and Nusbaum (1955), Colbran (1955), Linde (1956) and Sauer and Giles (1957), reported nematode populations which differed in plant-host reactions from those originally studied by Sasser (1954). The presence of physiological races within the species makes host testing necessary before resistant crops can be recommended for rotations.

Root-knot nematodes have been proved of considerable economic importance in Queensland, being pests of a number of cultivated crop plants, including tobacco (*Nicotiana tabacum* L.), tomato (*Lycopersicon esculentum* Mill.), pineapple (*Ananas comosus* (L.) Merr.), banana (*Musa* spp.), strawberry (*Fragaria X ananassa* Duch.), carrot (*Daucus carota* L.) and beetroot (*Beta vulgaris* L.).

This paper follows an investigation to determine the species of *Meloidogyne* present in Queensland and their host plants.

II. MATERIAL AND METHODS.

Roots infested with *Meloidogyne* species were preserved in 5 per cent. formalin prior to examination. Mature females were dissected from the roots and the perineal regions removed and trimmed with an oculist's scalpel on a perspex block before being mounted in lactophenol.

Selected *Meloidogyne* populations were increased on tomatoes and tested under glasshouse conditions against the following plants—barley (*Hordeum vulgare* L.), beetroot (*Beta vulgaris* L.), cabbage (*Brassica oleracea* L. var. *capitata* L.) capsicum (*Capsicum frutescens* L.), carrot (*Daucus carota* L.), cauliflower (*Brassica oleracea* L. var. *botrytis* L.), cotton (*Gossypium barbadense* L.), cowpea (*Vigna sinensis* (L.) Endl. ex Hassk.), cucumber (*Cucumis sativus* L.), endive (*Cichorium endivia* L.), French bean (*Phaseolus vulgaris* L.), lettuce (*Lactuca sativa* L.), linseed (*Linum usitatissimum* L.), mung bean (*Phaseolus mungo* L.), oats (*Avena sativa* L.), onion (*Allium cepa* L.), pea (*Pisum sativum* L.), peanut (*Arachis hypogaea* L.), pigeon pea (*Cajanus cajan* (L.) Millsp.), pumpkin (*Cucurbita maxima* Duch.), Rhodes grass (*Chloris gayana* Kunth), rye (*Secale cereale* L.), salsify (*Tragopogon porrifolius* L.), strawberry

(*Fragaria X ananassa* Duch.), sweet corn (*Zea mays* L.), soybean (*Glycine max* (L.) Merr.), tobacco (*Nicotiana tabacum* L.), tomato (*Lycopersicon esculentum* Mill.), watermelon (*Citrullus vulgaris* Schrad.), wheat (*Triticum aestivum* L.), and white clover (*Trifolium repens* L.).

III. SPECIES OF *MELOIDOGYNE* PRESENT IN QUEENSLAND.

The following species have been found in Queensland—*M. javanica*, *M. arenaria*, *M. hapla* and *M. incognita*. Some of these co-exist, particularly in areas where plants are frequently introduced, such as small-crop farms, home gardens and parks.



Fig. 1.

Left, Healthy strawberry root system. Right, Strawberry root system infected with *Meloidogyne hapla*.

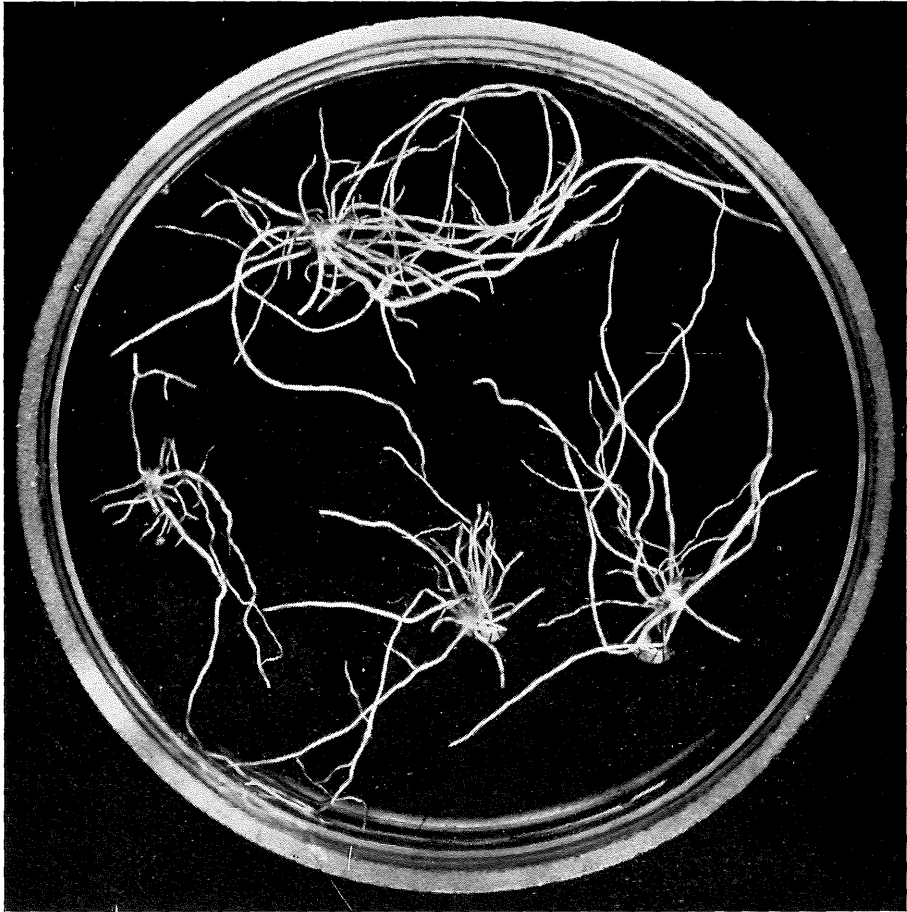


Fig. 2.

Galls from peanut roots inoculated with *Meloidogyne hapla*.

M. javanica, the Javanese root-knot nematode, is the most widely distributed species in Queensland. Crops in which severe root-knot has been recorded include tobacco, pineapple, tomato, banana, carrot and beetroot. The majority of the populations of *M. javanica* studied by the author did not reproduce on red pepper, but several exceptions have been noted.

M. arenaria has been found in a number of localities in the coastal area south of Rockhampton. The most severe infestations occurred on tomato crops. Populations of *M. arenaria* studied in glasshouse tests did not reproduce on peanuts.

M. hapla, the strawberry root-knot nematode, occurs in south-eastern Queensland as a major pest of strawberries. The galls formed by this species are characteristic, being small with radiating lateral rootlets which give the

root system a matted appearance (Fig. 1). The spread of *M. hapla* has been facilitated by the use of infested strawberry runners. Repeated glasshouse tests have shown that peanuts and red pepper are resistant to populations of *M. hapla* infesting strawberries in Queensland. The few galls observed in these tests were typical of those normally formed by this species (Fig. 2).

M. incognita occurs in coastal Queensland, principally in the southern and central districts, where it causes serious galling on lettuce, French bean and tomato. This species is common on tobacco in the Inglewood district. The majority of the populations of *M. incognita* tested did not reproduce on *Lycopersicon peruvianum* (L.) Mill. No populations produced more than a few galls on cotton.

IV. PRESENTATION OF DATA.

The host list is restricted to plants on which mature females and eggs of *Meloidogyne* species were found, and is presented in two parts.

In Section I the hosts are arranged in alphabetical order. The number given in parentheses after each species refers to the botanical family (see Appendix: Key to Botanical Families). An asterisk before the plant name indicates that the species was not recorded as a host by Goodey and Franklin (1956). The nematode species attacking the host are recorded with locality—an X indicates that the infestation was observed only in the glasshouse; maximum infestation as light, moderate or heavy; and the effect of the population, if tested, on selected plants in glasshouse tests. The ratings are 0 no infestation, 1 very light, 2 light, 3 moderate, 4 heavy.

In Section II the plant species are arranged in alphabetical order for each species of *Meloidogyne*.

SECTION I.

HOST-NEMATODE LIST.

**Abutilon oxycarpum* F. Muell. ex Benth. forma *acutatum* Benth.

M. incognita Light. Gayndah.

**Acacia cunninghamii* Hook. (34). Brisbane black wattle.

M. javanica. Moderate. Brisbane.

**Acacia glaucocarpa* Maid. & Blakely (34).

M. incognita. Moderate. Benarkin.

**Acacia myrtifolia* (Sm.) Willd. (34).

M. javanica. Moderate. Beerwah.

**Acacia pugioniformis* Wendl. (34).

M. arenaria. Heavy. The Blunder (Brisbane).

(This population did not reproduce on peanuts.)

- **Ageratum houstonianum* Mill. (18). Blue billygoat weed.
M. javanica. Moderate. Wetheron (Gayndah district).
- **Alternanthera denticulata* R.Br. (3). Lesser joyweed.
M. javanica. Heavy. Capalaba.
- **Alternanthera ficoidea* (L.) R. & S. (3).
M. javanica. Heavy. Woodstock.
- **Alternanthera nana* R.Br. (3). Hairy joyweed.
M. incognita. Light. Gayndah.



Fig. 3.

Pineapple Infested with *Meloidogyne javanica*.

- Alternanthera repens* (L.) Steud. (3). Khaki weed.
M. incognita. Heavy. Gurgeena Plateau (Gayndah district).
- Amaranthus paniculatus* L. (3). Redshank.
M. incognita. Moderate. Gurgeena Plateau.
- Amaranthus tricolor* L. (3).
M. incognita. Moderate. Brisbane.
- Amaranthus viridis* L. (3). Green amaranth.
M. javanica. Heavy. Brisbane.

Anagallis arvensis L. (48). Scarlet pimpernel.

M. incognita. Light. Stanthorpe.

Ananas comosus (L.) Merr. (12). Pineapple (Fig. 3).

M. javanica. Heavy. Coastal Queensland; Mareeba.

Antirrhinum majus L. (53). Snapdragon.

M. javanica. Heavy. Brisbane.

Apium graveolens L. (59). Celery.

M. javanica. Heavy. Brisbane.

**Apium leptophyllum* (DC.) F. Muell. (59). Slender celery.

M. javanica. Moderate. Ormiston.

Arachis hypogaea L. (34). Peanut.

M. hapla. Light. X.

No reproduction has been observed in the field on Red Spanish peanuts. Several small galls were found in the course of repeated inoculation tests with populations of *M. hapla* obtained from strawberries. (Fig. 2.)

**Argemone mexicana* L. (43). Mexican poppy.

M. javanica. Light. Claredale.

**Artanema fimbriatum* Don (53).

M. incognita. Light. Benarkin.

**Asclepias curassavica* L. (7). Red-head cotton bush.

M. javanica. Heavy. Coastal areas south of Gympie.

M. javanica (Mt. Tamborine): beetroot 1, cucumber 4, French bean 2, linseed 0, watermelon 3.

**Asclepias fruticosa* L. (7). Narrow-leaf cotton bush.

M. javanica. Heavy. Coastal areas south of Gympie.

**Aster subulatus* Michx. (18). Bushy starwort.

M. javanica. Moderate. Brisbane.

**Astrophytum myriostigma* Lem. (13).

Meloidogyne sp. Moderate. Brisbane.

**Astrophytum ornatum* (DC.) Weber (13).

Meloidogyne sp. Moderate. Brisbane.

Avena sativa L. (29). Oats.

M. incognita. Light. X.

M. javanica. Light. X.

B

Begonia semperflorens Link & Otto (9). Begonia.

M. incognita. Heavy. Botanic Gardens, Brisbane.

Beta vulgaris L. var. *vulgaris* (17). Beetroot.

M. incognita. Heavy. Brisbane.

M. javanica. Heavy. Coastal Queensland.

Beta vulgaris L. var. *cicla* L. (17). Silver beet.

M. incognita. Heavy. Brisbane; Charleville; Rockhampton.

M. incognita (Brisbane): capsicum 0, cotton 0, cowpea 4, *Lycopersicon peruvianum* 1, okra 4, peanut 0, tomato 4, watermelon 4.

M. incognita (Charleville): *Lycopersicon peruvianum* 0, tomato 4.

M. javanica. Heavy. Coastal Queensland.

Bidens pilosa L. (18). Cobbler's pegs.

M. javanica. Light. Brisbane, Ormiston.

**Borreria brachystema* (R.Br. ex Benth.) Val. (50).

M. javanica. Heavy. Middle Barrata (Ayr district).

**Brachiaria miliiformis* (Presl.) Chase. (29). Green summer grass.

M. javanica. Light. Claredale.

Brassica actinophylla F. Muell. (6). Umbrella tree.

M. incognita. Heavy. Brisbane.

Brassica napus L. var. *napobrassica* (L.) Rehb. (21). Swede turnip.

M. javanica. Moderate. Ormiston.

Brassica oleracea L. var. *botrytis* L. (21). Cauliflower.

M. hapla. Light. X.

M. incognita. Light. X.

Brassica oleracea L. var. *capitata* L. (21). Cabbage.

M. hapla. Light. X.

M. incognita. Moderate. Stanthorpe.

M. javanica. Moderate. Ormiston, Mt. Isa.

M. javanica (Ormiston): capsicum 0, *Lycopersicon peruvianum* 2, peanut 0, sweet corn 1, tomato 4, watermelon 2.

No infestations of economic importance have been recorded from this host.

Cajanus cajan (L.) Millsp. (34). Pigeon pea.

M. incognita. Heavy. Brisbane.

M. javanica. Heavy. Widespread.

Cajanus cajan is resistant to some populations of *M. javanica*.

- Calendula officinalis* L. (18). Calendula.
M. arenaria. Moderate. Wetheron (Gayndah district).
- **Calotis dentex* R.Br. (18). White burr daisy.
M. incognita. Moderate. Benarkin.
- Capsicum frutescens* L. (54). Capsicum.
M. arenaria. Moderate. X.
M. hapla. Light. X.
M. incognita. Heavy. X.
M. javanica. Moderate. Ormiston.
- Capsicum frutescens* is resistant to most races of *M. javanica* and to some races of *M. incognita*.
- Carica papaya* L. (15). Papaw.
M. javanica. Heavy. Coastal Queensland.
M. javanica (Rochedale): *Lycopersicon peruvianum* 2, peanut 0, sweet corn 0, tomato 4.
- Cassia mimosoides* L. (34).
M. incognita. Moderate. Brisbane.
M. javanica. Light. Mareeba.
- Celosia argentea* L. var. *argentea* (3). Cockscomb.
M. javanica and *M. arenaria*. Heavy. Brisbane.
- Celosia argentea* L. var. *cristata* Kuntze (3).
M. javanica. Heavy. Brisbane.
- **Centratherum muticum* Less. (18).
M. incognita. Moderate. Moggill, Benarkin.
- **Cephalocereus senilis* (Haw.) Pfeiff. (13).
M. incognita. Moderate. Brisbane.
- **Cereus peruvianus* (L.) Mill. (13).
M. incognita. Moderate. Brisbane.
- Chenopodium album* L. (17). Fat hen.
M. incognita. Moderate. Stanthorpe.
- **Chenopodium carinatum* R.Br. (17). Keeled goosefoot.
M. incognita. Light. Stanthorpe.
- **Chenopodium trigonon* R. & S. (17). Fishweed.
M. incognita. Light. Gayndah.

Chrysanthemum frutescens L. (18). Marguerite daisy.

M. javanica and *M. incognita*. Heavy. Brisbane.

Chrysanthemum maximum Ram. (18). Shasta daisy.

M. incognita. Heavy. Brisbane.

Chrysanthemum spp. (18). Chrysanthemum.

M. incognita. Moderate. Brisbane.

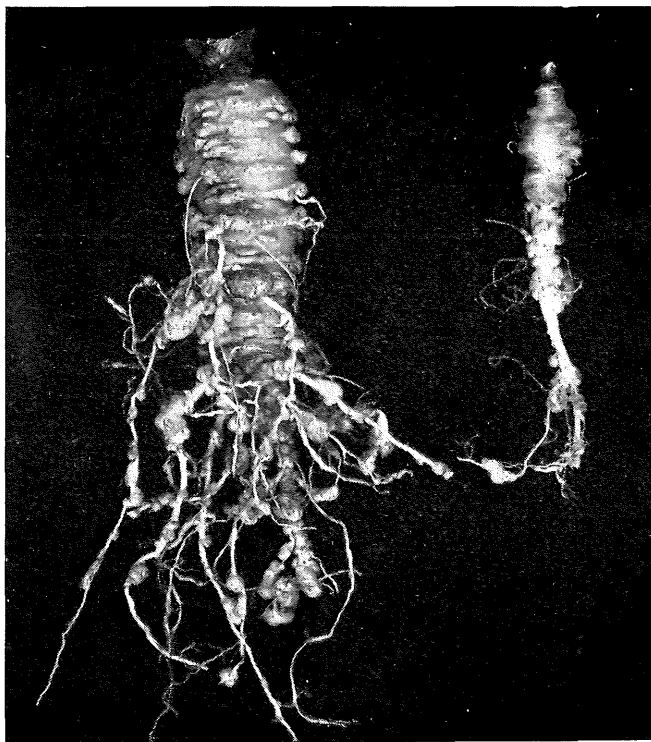


Fig. 4.

Carrot roots infested with *Meloidogyne javanica*.

Cichorium endivia L. (18). Endive.

M. arenaria. Moderate. Warwick.

M. hapla. Moderate. X.

Citrullus vulgaris Schrad. (22). Watermelon.

M. arenaria. Heavy. X.

M. hapla. Light. X.

M. incognita. Heavy. X.

M. javanica. Heavy. X.

Citrus sp. (51). Orange.

M. incognita. Heavy. Wynnun: capsicum 3, cotton 0, cowpea 4,
Lycopersicon peruvianum 1, okra 4, peanut 0, strawberry 0, tomato 4.

Only one tree has been found severely infested. The variety was Washington Navel and the rootstock sweet orange or citronelle. In glasshouse tests the population produced terminal swellings on *Poncirus trifoliata* (L.) Raff. but no egg masses were observed.

**Cleistocactus strausii* (Heese) Bckbg. (13).

M. incognita. Moderate. Brisbane.

**Cleome aculeata* L. (14).

M. javanica. Light. Kamerunga.

Clerodendrum ugandense Prain (60). Blue Butterfly bush.

M. incognita. Heavy. Brisbane.

**Clitoria ternatea* L. (34). Butterfly pea.

M. javanica. Moderate. Ayr.

Coleus blumei Benth. (33). Coleus.

M. incognita. Heavy. South-eastern Queensland.

M. incognita (Brisbane): capsicum 0, linseed 1, *Lycopersicon peruvianum*
1, tomato 4.

**Corchorus acutangulus* Lam. (57).

M. javanica. Light. Ayr.

**Coronopus didymus* (L.) Sm. (21). Bittercress or lesser swinecress.

M. incognita. Light. Benarkin, Brisbane.

**Crassocephalum crepidioides* (Benth.) S. Moore (18). Thickhead.

M. incognita. Moderate. Moggill.

**Crassula acutifolia* Lam. (20).

M. incognita. Heavy. Brisbane.

**Crassula multicava* L. (20).

M. incognita. Moderate. Brisbane.

**Crassula tetragona* L. (20).

M. incognita. Heavy. Brisbane.

**Crotalaria mucronata* Desv. (34). Streaked rattlepod.

M. hapla. Light. Ormiston.

Cucumis sativus L. (22). Cucumber.

M. hapla. Moderate. X.

M. incognita. Heavy. Brisbane.

M. incognita (Brisbane): capsicum 3, cotton 0, cowpea 3, okra 3, peanut 0, pigeon pea 3, tomato 4.

M. javanica. Heavy. Coastal Queensland.

Cucurbita maxima Duch. (22). Pumpkin.

M. arenaria. Heavy. Tiaro.

M. hapla. Moderate. X.

M. incognita. Heavy. Petrie district.

M. incognita (Lawnton): barley 1, beetroot 0, cabbage 0, capsicum 0, carrot 4, cotton 0, cucumber 3, endive 0, French bean 3, lettuce 2, *Lycopersicon peruvianum* 1, oats 1, onion 0, pea 4, peanut 0, Rhodes grass 0, soybean 2, Sudan grass 0, sweet corn 1, tobacco 4, watermelon 1, wheat 1.

M. javanica. Heavy. South-eastern Queensland.

Cucurbita pepo L. var. *medullosa* Alef. (22). Marrow.

M. arenaria. Heavy. Rockhampton.

**Cyperus brevifolius* (Rottb.) Hassk. (23).

M. incognita. Light. X.

Cyperus rotundus L. (23). Nut grass.

M. javanica. Moderate. Ayr district.

The galls on nut grass are small, and have external egg masses.

Dahlia sp. (18). Dahlia.

M. arenaria. Light. Sunnybank.

M. javanica. Heavy. South-eastern Queensland.

Daucus carota L. (59). Carrot (Fig. 4).

M. hapla. Heavy. Ormiston.

M. incognita. Heavy. Petrie district; Brisbane.

M. javanica. Heavy. Widespread.

M. javanica (Mt. Tamborine): capsicum 0, *Lycopersicon peruvianum* 2, peanut 0, tomato 4, watermelon 4.

**Desmodium muelleri* Benth. (34).

M. javanica. Light. Ayr district.

**Desmodium nemorosum* F. Muell. (34).

M. javanica. Moderate. Atherton Tableland.

- **Desmodium rhytidophyllum* F. Muell. ex Benth. (34).
M. incognita. Heavy. Brisbane.
M. incognita (Brisbane): capsicum 3, cotton 0, peanut 0, tomato 4.
- **Desmodium trichocaulon* DC. (34).
M. incognita. Moderate. Brisbane.
- Desmodium triflorum* (L.) DC. (34). Creeping tick trefoil.
M. javanica. Moderate. Kamerunga.
- **Desmodium uncinatum* DC. (34).
M. javanica. Moderate. Ormiston.
- **Dianella caerulea* Sims (35). Blue flax lily.
M. javanica. Moderate. Palm Beach (South Coast).
- **Dianella revoluta* R.Br. (35). A blue berry lily.
M. javanica. Moderate. Eight Mile Plains (Brisbane district).
- Dianthus caryophyllus* L. (16). Carnation.
M. javanica. Heavy. South-eastern Queensland.
 Varietal differences in susceptibility have been observed.
- **Digitaria adscendens* (H.B.K.) Henrard (29). Summer grass.
M. javanica. Light. Claredale.
- **Digitaria orbata* Hughes (29).
M. arenaria. Moderate. The Blunder (Brisbane).
- Digitaria violascens* Link (29).
Meloidogyne sp. Light. Beerwah.
- Duboisia leichhardtii* F. Muell. (54).
M. javanica. Heavy. Nambour.
- Duboisia myoporoides* R.Br. (54).
M. javanica. Heavy. Nambour.
- Echinochloa crus-galli* (L.) Beauv. (29). Barnyard millet.
M. javanica. Light. Claredale.
- **Echinopsis eyriesii* (Turp.) Zucc. (13).
M. incognita. Moderate. Brisbane.
- **Echinopsis multiplex* (Pfeiff.) Zucc. (13).
M. incognita. Moderate. Brisbane.

- Eclipta alba* (L.) Hassk. (18). White twin heads.
M. javanica. Heavy. Woodstock.
- Eleusine indica* (L.) Gaertn. (29). Crowsfoot grass.
M. arenaria. Light. Tiaro.
M. javanica. Light. Claredale, Cooroy.
- **Emex australis* Steinh. (46). Spiny emex
M. incognita. Light. Gayndah.
- Emilia sonchifolia* DC. (18). Purple sowthistle.
M. javanica. Light. Ayr.
- **Epaltes australis* Less. (18).
M. arenaria. Light. The Blunder (Brisbane).
- **Eragrostis elongata* (Willd.) Jacq. (29). Love grass.
M. arenaria. Moderate. The Blunder (Brisbane).
- **Erechtites atkinsoniae* F. Muell. (18). Commonwealth weed.
M. incognita. Moderate. Benarkin.
- Erechtites quadridentata* (Labill.) DC. (18). Cotton fireweed.
M. incognita. Moderate. Benarkin.
- Erechtites valerianifolia* (Wolf) DC. (18). Brazilian fireweed.
M. javanica. Heavy. Mossman.
- **Eriocereus adscendens* (Gurke) Berger (13).
M. incognita. Moderate. Brisbane.
- Euphorbia geniculata* Orteg. (26).
M. javanica. Heavy. Ormiston.
- **Euphorbia officinarum* L. (26).
M. incognita. Heavy. Brisbane.
- Euphorbia prostrata* Ait. (26). Red caustic creeper.
M. javanica. Moderate. Brisbane.
- Ficus carica* L. (39). Cultivated fig.
M. incognita. Heavy. Ormiston.
M. javanica. Moderate. Kuraby.
- Ficus pumila* L. (39). Creeping fig.
M. incognita. Heavy. Brisbane.
- **Fimbristylis pauciflora* R.Br. (23).
M. incognita. Moderate. Coolum.

Fragaria X ananassa Duch. (49). Strawberry.

M. hapla. Heavy. South-eastern Queensland.

M. hapla (Ormiston): barley 0, beetroot 1, cabbage 1, capsicum 1, cauliflower 1, cotton 0, cowpea 1, cucumber 0, *Datura stramonium* 0, endive 2, French bean 2, lettuce 3, *Lycopersicon peruvianum* 1, maize 0, mung bean 3, oats 0, onion 0, pea 4, peanut 0, pumpkin 4, Rhodes grass 0, rye 0, salsify 0, sorghum 0, Sudan grass 0, tobacco 4, tomato 3, watermelon 1, white clover 4.

**Fuchsia hybrida* Voss. (41).

M. hapla. Heavy. Ipswich.

Galinsoga parviflora Cav. (18). Potato weed.

M. hapla. Moderate. Redland Bay.

Gerbera jamesoni Bolus (18). Gerbera.

M. incognita. Heavy. South-eastern Queensland.

Gladiolus spp. (31.) Gladiolus.

M. hapla. Moderate. Brisbane.

M. incognita Moderate. Kenmore.

Glycine max (L.) Merr. (34). Soybean.

M. hapla. Moderate. X.

M. incognita. Moderate. X.

**Gnaphalium indicum* L. (18). Cudweed.

M. javanica Light. Eight Mile Plains (Brisbane).

**Gnaphalium japonicum* Thunb. (18).

M. incognita. Moderate. Moggill.

Gomphrena globosa L. (3). Bachelor's buttons.

M. javanica. Heavy. Brisbane.

**Goodenia rotundifolia* R.Br. (28).

M. incognita. Moderate. Benarkin, Moggill.

Gossypium barbadense L. (38). Cotton.

M. incognita. Light. X.

No infestations of root-knot in field cotton have been recorded.

**Graptophyllum pictum* (L.) Griff. (1).

M. javanica. Heavy. Torquay.

**Haworthia tuberculata* Poelln. (35).

Meloidogyne sp. Heavy. Brisbane.

- Helianthus annuus* L. (18). Sunflower.
M. javanica. Moderate. Brisbane.
- **Hibbertia linearis* R.Br. var. *obtusifolia* (DC.) Benth. (24).
M. incognita. Light. Benarkin.
- Hibiscus esculentus* L. (38). Okra.
M. arenaria. Heavy. X.
M. incognita var. *acrita*. Heavy. X.
M. incognita. Heavy. X.
M. javanica. Heavy. Ormiston.
- Hibiscus sabdariffa* L. (38). Rosella.
M. javanica. Moderate. Palmwoods.
- Hordeum vulgare* L. (29). Barley.
M. incognita. Light. X.
- **Hovea acutifolia* A. Cunn. ex G. Don (34). Hovea.
M. javanica. Light. Beerwah.
- **Hypericum gramineum* Forst. (30). Small St. John's wort.
M. incognita. Moderate. Brisbane.
- Hypochoeris radicata* L. (18). Catsear, dandelion, flatweed.
M. incognita. Heavy. Stanthorpe.
- **Hyptis capitata* Jacq. (33).
M. javanica. Light. Innisfail.
- Impatiens balsamina* L. (8). Balsam.
M. incognita. Heavy. Brisbane.
M. incognita and *M. javanica*. Heavy. Buderim.
- **Indigofera australis* Willd. (34). Australian indigo.
M. arenaria. Light. Etty Bay (Innisfail).
M. javanica. Heavy. Ormiston.
- Indigofera endecaphylla* Jacq. (34).
M. javanica. Moderate. Brisbane.
- Indigofera hirsuta* L. (34). Hairy indigo.
M. javanica. Light. Ormiston.
- Ipomoea pes-caprae* (L.) Sweet (19). Goatsfoot convolvulus.
M. incognita. Moderate. Palm Beach (South Coast).
- **Ipomoea polymorpha* R. & S. (19).
M. javanica. Heavy. Ayr.

Iresine herbstii Hook. f. var. *aureo-reticulata* Hort. (3).

M. incognita. Heavy. Brisbane.

M. incognita (Brisbane) : capsicum 3, *Lycopersicon peruvianum* 1, peanut 0, tomato 4.

Iris germanica L. (31). Bearded flag iris.

M. javanica. Heavy. Darra.

**Jacksonia scoparia* R.Br. (34). Dogwood.

M. incognita. Moderate. Moggill.

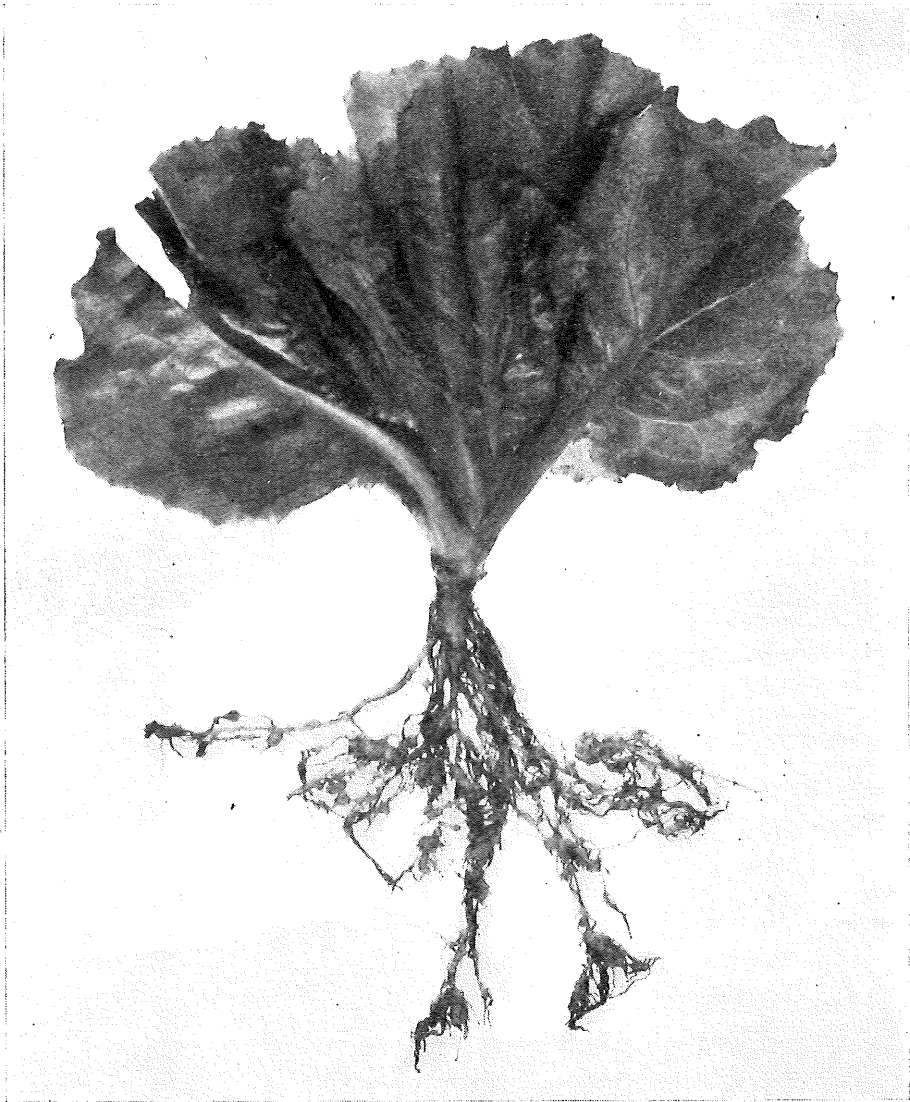


Fig. 5.

Lettuce roots infested with *Meloidogyne incognita*.

- **Juncus polyanthemos* Buchen. (32). Common rush.
M. arenaria. Moderate. The Blunder (Brisbane).
- **Jussiaea villosa* Lam. (41). Water primrose.
M. incognita. Heavy. Mourilyan.
- **Kleinia repens* (L.) Haw. (18).
M. javanica. Light. Brisbane.
- Lactuca sativa* L. (18). Lettuce (Fig. 5).
M. hapla. Heavy. X.
M. incognita. Heavy. Brisbane.
M. javanica. Heavy. Brisbane.
- Lactuca serriola* L. (18). Prickly lettuce.
M. incognita. Light. Lawes.
- Lantana camara* L. (60). Lantana.
M. javanica. Heavy. Yarwun, Dalrymple Heights (Mackay district).
M. javanica (Dalrymple Heights): *Lycopersicon peruvianum* 0, sweet corn 0, tomato 4, watermelon 4.
- **Lantana montevidensis* (Spreng.) Briq. (60). Creeping lantana.
M. incognita. Moderate. Moggill.
- **Lepidium hyssopifolium* Desv. (21). Pepperercress.
M. incognita. Light. Gayndah.
- Lepidium sativum* L. (21). Cress.
M. incognita. Heavy. Brisbane.
M. javanica. Heavy. Ormiston.
- **Leucas linifolia* Spreng. (33).
M. javanica. Moderate. Kamerunga.
- Linum usitatissimum* L. (36). Linseed.
M. incognita. Light. X.
- **Lobelia purpurascens* R.Br. (37). White-root.
M. incognita. Moderate. Benarkin.
- Lupinus angustifolius* L. (34). New Zealand blue lupin.
M. incognita. Heavy. Stanthorpe.
M. javanica. Heavy. Ormiston.
- Lycopersicon esculentum* Mill. (54). Tomato.
M. arenaria. Heavy. Brisbane, Rockhampton.
M. hapla. Moderate. Redland Bay.

- M. incognita*. Heavy. South-east Queensland; Rockhampton.
M. incognita (Lawes): capsicum 4, cotton 0, *Lycopersicon peruvianum* 1, okra 4, peanut 0, strawberry 0, sweet corn 1.
M. javanica. Heavy. Widespread.
M. javanica (Ormiston): capsicum 0, *Lycopersicon peruvianum* 1, peanut 0, sweet corn 1, watermelon 3.
M. javanica (Howard): beetroot 4, capsicum 0, carrot 3, cotton 0, cucumber 4, *Lycopersicon peruvianum* 2, peanut 0, pumpkin 4, watermelon 3.
M. javanica (Rochedale): capsicum 0, *Lycopersicon peruvianum* 1, peanut 0, sweet corn 1, watermelon 3.

Lycopersicon peruvianum (L.) Mill. (54).

- M. arenaria*. Heavy. X.
M. hapla. Moderate. Ormiston.
M. incognita. Moderate. X.
M. javanica. Moderate. Ormiston.

Some but not all populations of *M. incognita* failed to reproduce on this plant.

**Macarthuria neocambrica* F. Muell. (2).

M. incognita. Moderate. Coolum.

**Malvastrum spicatum* (L.) A. Gray (38). Malvastrum.

M. incognita. Moderate. Gayndah.

**Mammillaria gracilis* Pfeiff. (13).

M. incognita. Moderate. Brisbane.

Medicago hispida Gaertn. (34). Burr medic.

M. incognita. Heavy. Lawes.

Medicago sativa L. (34). Lucerne.

M. javanica. Moderate. Moggill, Tivoli (Ipswich district).

The infestations recorded here occurred on light sandy alluvial soil adjacent to the Brisbane River.

**Medicago scutellata* (L.) Mill. (34). Snail medic.

M. javanica. Moderate. D'Aguilar.

**Medicago tribuloides* Desr. (34). Barrel medic.

M. incognita. Heavy. Lawes.

**Melochia pyramidata* L. (55).

M. javanica. Light. Ayr.

Mimosa invisa Mart. (34).

M. javanica. Moderate. Innisfail.

**Moghania parviflora* (Benth.) O.K. (34).

M. hapla. Moderate. Tinana Creek.

**Monstera deliciosa* Liebm. (5). Monstera.

M. incognita. Heavy. Brisbane.

This population formed distinct swellings along the roots accompanied by splitting of the outer tissues.

Morus alba L. (39). Mulberry.

M. javanica. Moderate. Charters Towers.

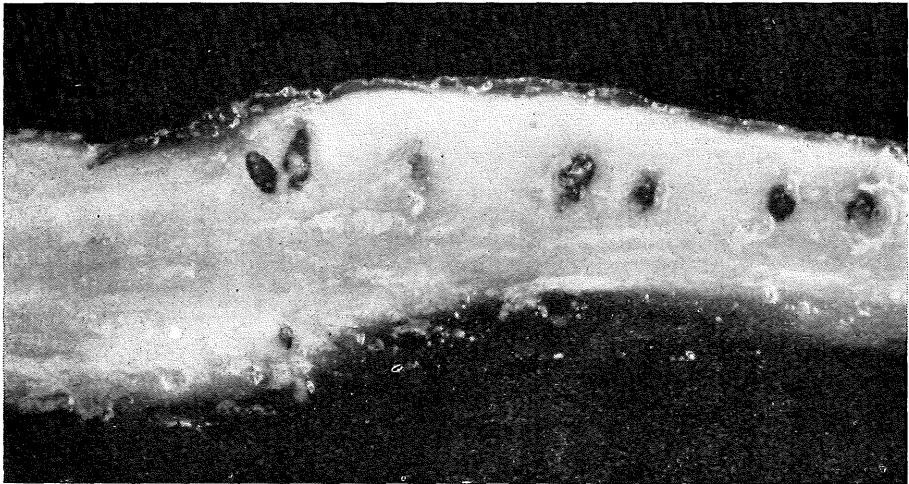


Fig. 6.

Females and egg masses of *Meloidogyne javanica* in a banana root.

Musa spp. (40). Cultivated banana.

M. javanica. Heavy. Coastal Queensland.

M. arenaria. Moderate. Ormiston.

The roots do not always show external swellings but a longitudinal section will reveal numerous adults and egg masses in the cortex (Fig. 6). When large populations are present the roots from the corm remain short with terminal galls.

Nicandra physaloides (L.) Gaertn. (54). Apple of Peru.

M. javanica. Light. Ormiston, Mt. Tamborine.

M. arenaria. Moderate. Tiaro.

Nicotiana glauca Graham (54). Tree tobacco.

M. javanica. Moderate. Claredale.

Nicotiana glutinosa L. (54).

M. javanica. Moderate. X.

Nicotiana tabacum L. (54). Tobacco.

M. arenaria. Heavy. X.

M. hapla. Heavy. X.

M. incognita. Heavy. Inglewood, Tinana Creek.

M. incognita (Inglewood): capsicum 1, cotton 0, *Lycopersicon peruvianum* 1, mung bean 4, okra 4, peanut 0, sweet corn 2, tomato 4.

M. javanica. Heavy. Ayr, Bundaberg, Inglewood, Mareeba.

M. javanica (Ayr.): capsicum 0, cowpea 3, *Lycopersicon peruvianum* 1, peanut 0, sweet corn 2, tomato 4.

**Notocactus ottonis* (Link and Otto) Berg. (13).

M. incognita. Heavy. Brisbane.

**Oenothera longiflora* L. (41). Long-flowered evening primrose.

M. incognita. Light. Stanthorpe.

**Oplismenus imbecillis* R. & S. (29).

M. javanica. Light. X.

The galls were small and had well-filled external egg masses.

**Opuntia elata* Link and Otto ex Salm-Dyck (13).

M. incognita. Moderate. Brisbane.

Oxalis martiana Zucc. (42). Shamrock.

M. javanica. Moderate. Brisbane.

**Pandorea jasminoides* (Lindl.) K.Sch. (10).

M. hapla. Light. Brisbane.

Papaver rhoeas L. (43).

M. incognita. Moderate. Brisbane.

**Parsonsia straminea* (R.Br.) F. Muell. (4). Monkey rope.

M. incognita. Moderate. Moggill.

Passiflora caerulea L. (44).

M. javanica. Moderate. Sunnybank, Ormiston.

Passiflora edulis Sims forma *edulis* (44). Passionfruit.

M. arenaria. Heavy. Rockhampton.

M. incognita. Heavy. Sunnybank.

M. javanica. Heavy. Coastal Queensland.

**Passiflora edulis* Sims forma *flavicarpa* Degener (44).

M. javanica. Light. Ormiston.

This form, which is used as a rootstock for *P. edulis*, shows greater resistance to *M. javanica* than *P. edulis*.

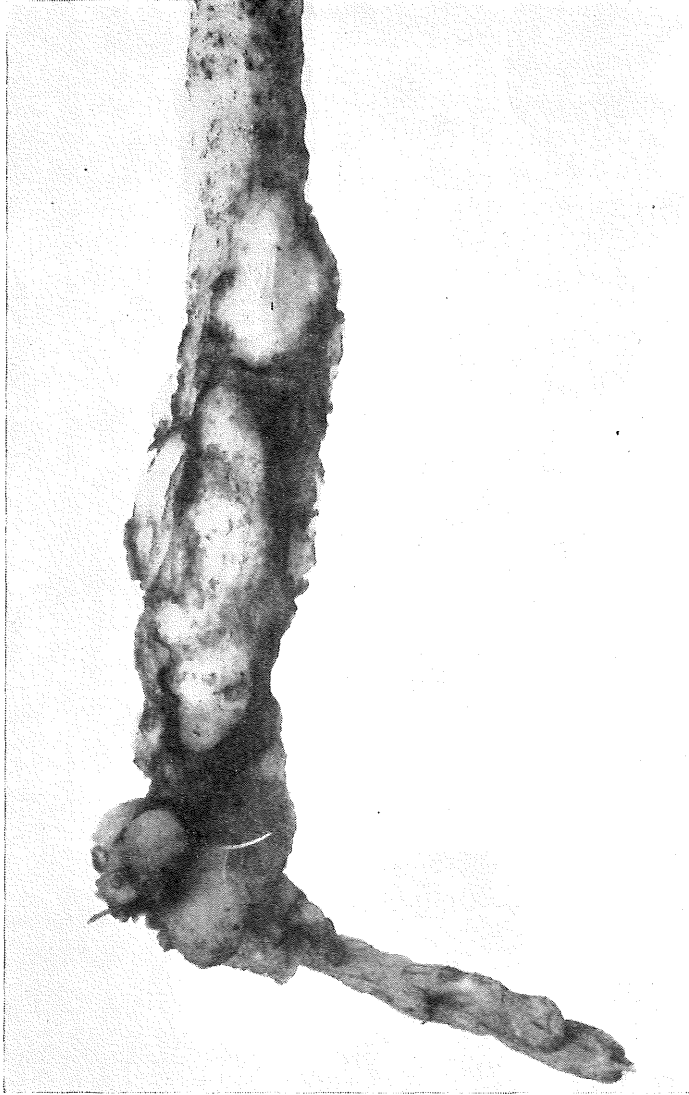


Fig. 7.

Stem galls of *Meloidogyne incognita* on French bean.

**Passiflora maliformis* L. (44).

M. javanica. Moderate. Ormiston.

Passiflora quadrangularis L. (44). Granadilla.

M. javanica. Moderate. Cairns.

**Passiflora suberosa* L. (44). Corky passion-flower.

M. javanica. Moderate. South-eastern Queensland.

Pastinaca sativa L. (59). Parsnip.

M. javanica. Heavy. South-eastern Queensland.

Petroselinum crispum Nym. (59). Parsley.

M. javanica. Moderate. Brisbane.

Petunia hybrida Vilm. (54). Petunia.

M. incognita. Light. Brisbane.

Phaseolus lathyroides L. (34). Phasey bean.

M. incognita. Heavy. Lawes, Beerwah, Coolum.

M. incognita (Coolum): Capsicum 0, cotton 0, French bean 1, *Lycopersicon peruvianum* 1, okra 4, pigeon pea 0, soybean 0, tomato 4.

M. javanica. Heavy. Central Queensland.

Phaseolus mungo L. (34). Mung bean.

M. arenaria. Heavy. X.

M. hapla. Heavy. X.

M. incognita. Heavy. X.

M. javanica. Heavy. Ormiston.

Phaseolus vulgaris L. (34). French bean (Fig. 7).

M. hapla. Moderate. X.

M. incognita. Heavy. Brisbane, Redland Bay, Nambour.

M. incognita (Nambour): capsicum 0, cotton 0, cucumber 4, *Lycopersicon peruvianum* 1, okra 4, peanut 0, pigeon pea 2, sweet corn 0, tomato 4, watermelon 2.

Usually French beans are not adversely affected by root knot although occasional plantings become heavily infested. Stem galls are frequently present for several inches above the crown (Plate 7).

M. javanica. Heavy. Ormiston.

**Phytolacca minima* L. (54). Wild gooseberry.

M. incognita. Moderate. Claredale.

M. javanica. Moderate. Gayndah.

Phytolacca peruviana L. (54). Cape gooseberry.

M. javanica. Heavy. Nambour.

Phytolacca octandra L. (45). Inkweed.

M. arenaria and *M. incognita*. Heavy. Brisbane.

**Pimelea pauciflora* R.Br. (56). Poison pimelea.

M. incognita. Moderate. Benarkin.

Pisum sativum L. (34). Pea.

M. hapla. Heavy. X.

M. incognita. Heavy. X.

No field infestations have been recorded.

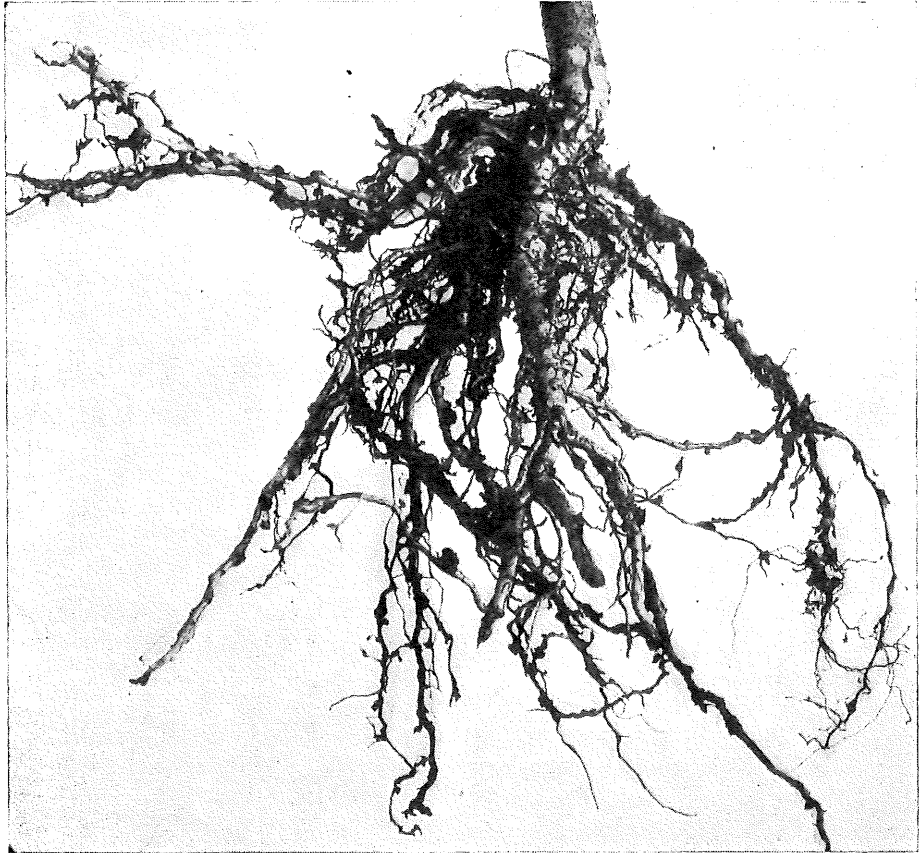


Fig. 8.

Peach roots infested with *Meloidogyne javanica*.

**Plectranthus australis* R.Br. (33).

M. incognita. Heavy. Moggill.

Podranea ricasoliana (Tanf.) Sprague (10).

M. javanica. Moderate. Brisbane.

Polygonum lapathifolium L. (46). A smartweed.

M. javanica. Moderate. Capalaba.

**Polygonum plebeium* R.Br. (46). Small knotweed.

M. incognita. Light. Stanthorpe.

- **Pomax umbellata* Soland. ex Gaertn. (50).
M. incognita. Heavy. Moggill.
- Portulaca oleracea* L. (47). Pigweed.
M. incognita. Moderate. Brisbane.
- Primula obconica* Hance (48). Primula.
M. arenaria. Light. Brisbane.
- Prunus persica* (L.) Batsch (49). Peach.
M. javanica. Heavy (Fig. 8). Stanthorpe district.
- Prunus* sp. (49). Blood plum.
M. incognita. Heavy. Stanthorpe.
- **Pseuderanthemum variabile* (R.Br.) Radlk. (1). Love flower.
M. incognita. Heavy. Moggill.
- **Psychotria daphnoides* A.Cunn. ex Hook. (50).
M. incognita. Moderate. Benarkin.
- **Pterocaulon glandulosum* F. Muell. (18).
M. javanica. Light. Magnetic Island.
- Pterocaulon redolens* (Willd.) F. Muell. (18).
M. javanica. Moderate. Claredale.
- **Pultenaea villosa* Willd. (34).
M. arenaria. Moderate. The Blunder (Brisbane).
M. incognita. Moderate. Moggill.
M. javanica. Moderate. Beerwah.
- Raphanus sativus* L. (21). Radish.
M. javanica. Moderate. Rita Island (Ayr district).
- **Rhynchelytrum repens* (Willd.) C. E. Hubbard (29). Red Natal grass.
M. arenaria. Light. The Blunder (Brisbane).
- Richardia brasiliensis* (Moq.) Gomez (50). Mexican clover.
M. javanica. Moderate. Eight Mile Plains, Beerwah.
- Rosa* sp. (49). Rose.
M. javanica. Moderate. Brisbane.
- **Rubus rosifolius* Sm. (49). Native raspberry.
M. incognita. Heavy. Benarkin.
- Rumex acetosella* L. (46). Sorrel.
M. incognita. Moderate. Stanthorpe.

**Russelia equisetiformis* Schlecht. & Cham. (53). Russelia.

M. incognita. Light. Brisbane.

Saccharum officinarum L. (29). Sugar cane.

M. incognita. Moderate. Bundaberg.

M. javanica. Moderate. Coastal Queensland.

Usually sugar cane is not affected by root-knot nematodes, although damage has occasionally been reported from sandy soils.

Salix alba L. var. *coerulea* (Sm.) Sm. (52). Willow.

M. javanica. Moderate. Ormiston.

Salvia splendens Sello (33). Red salvia.

M. javanica. Light. Brisbane.

Scabiosa caucasica Bieb. (25). Perennial scabious.

M. incognita. Moderate. Brisbane.

Scoparia dulcis L. (53). Scoparia.

M. incognita. Light. Brisbane.

Sechium edule Sw. (22). Choko.

M. javanica. Moderate. Brisbane.

**Sedum rubrotinctum* Clausen (20). Jelly beans.

M. incognita. Heavy. Palm Beach (South Coast).

Senecio cruentus DC. (18). Cineraria.

M. javanica. Light. Brisbane.

Sesbania aculeata Pers. (34). Sesbania pea.

M. incognita. Heavy. Coolum.

M. incognita (Coolum): capsicum 0, *Lycopersicon peruvianum* 1, sweet corn 1.

**Sida cordifolia* L. (38). Flannel weed.

M. arenaria. Moderate. Brisbane.

Sida rhombifolia L. (38). Common sida.

M. javanica. Heavy. South-eastern Queensland.

M. javanica (Ormiston): capsicum 0, *Lycopersicon peruvianum* 1, sweet corn 1, tomato 4, watermelon 3.

Sigesbeckia orientalis L. (18). Indian weed.

M. incognita. Moderate. Moggill, Benarkin.

Sinningia speciosa B. & H. (27). Gloxinia.

M. arenaria. Light. Brisbane.

Solanum auriculatum Ait. (54). Wild tobacco tree.

M. javanica. Moderate. Brisbane.

**Solanum densivestitum* F. Muell. (54).

M. incognita. Moderate. Benarkin.

Solanum melongena L. (54). Egg fruit.

M. javanica. Heavy. Rita Island (Ayr district).

Solanum nigrum L. (54). Blackberry nightshade.

M. incognita. Heavy. Lawes.

M. javanica. Moderate. Coastal Queensland.

**Solanum seforthianum* Andr. (54). Brazilian nightshade.

M. javanica. Light. Kamerunga.

Solanum stelligerum Sm. (54). Devil's needles.

M. incognita. Moderate. Moggill; Gayndah.

Solanum tuberosum L. (54). Potato.

M. incognita. Heavy. Lawnton.

M. javanica. Heavy. South-eastern Queensland.

(Infested potato tubers have a pimply appearance).

Sonchus oleraceus L. (18). Common sow thistle or milk thistle.

M. arenaria. Moderate. Sunnybank.

M. hapla. Moderate. Ormiston.

M. incognita. Moderate. Stanthorpe.

Stachys arvensis L. (33). Stagger weed.

M. hapla. Moderate. Ormiston.

Stizolobium spp. (34). Velvet beans.

(Varieties: Mucuna, Smith, Somerset, White Stringless, Black Mauritius, Marbilee, Jubilack, White Mauritius).

M. javanica. Light. Ormiston.

**Stylosanthes sundaica* Taub. (34). Townsville lucerne.

M. javanica. Light. Ayr.

**Symphytum peregrinum* Ledeb. (11). Russian Comfrey.

M. javanica. Moderate. Ormiston.

Tagetes erecta L. (18). African marigold.

M. javanica. Light. Brisbane.

Tephrosia candida (Roxb.) DC. (34).

M. javanica. Moderate. Ormiston.

Tragopogon porrifolius L. (18). Salsify.

M. javanica. Moderate. X.

**Trichocereus spachianus* (Lem.) Riccobono (13).

M. incognita. Moderate. Brisbane.

**Trichodiadema barbatum* (L.) Schwantes (2).

M. incognita. Heavy. Brisbane.

Trifolium dubium Sibth. (34). Yellow suckling clover.

M. incognita. Heavy. Kybong (Gympie district).

Trifolium pratense L. (34). Red clover.

M. incognita. Heavy. Gympie, Coolum.

M. incognita (Gympie): capsicum 3, cotton 0, cowpea 4, *Lycopersicon peruvianum* 1, okra 2, peanut 0, tomato 4, watermelon 4.

M. javanica. Heavy. Gympie.

Trifolium repens L. (34). White clover.

M. hapla. Heavy. X.

M. javanica. Heavy. Widespread.

Trifolium subterraneum L. (34). Subterranean clover.

No infestations have been reported from Queensland. Specimens submitted for examinations from Armidale, northern New South Wales, were heavily infested by *M. hapla*.

Triticum aestivum L. (29). Wheat.

M. incognita. Light. X.

**Triumfetta repens* (Bl.) Merr. & Rolfe (57).

M. javanica. Light. Yeppoon.

Tropaeolum majus L. (58). Nasturtium.

M. javanica. Moderate. Brisbane.

Urena lobata L. (38). Urena or pink-flowered Chinese burr.

M. javanica. Moderate. Mossman, Kamerunga.

**Vandasia retusa* (Benth.) Domin (34).

M. javanica. Moderate. Mossman.

**Velleia spathulata* R.Br. (28).

M. javanica. Moderate. Caboolture.



Fig. 9.

Black cowpea infested with *Meloidogyne javanica*.

Verbena bonariensis L. (60). Purple top.

M. arenaria. Moderate. Eight Mile Plains.

M. arenaria (Eight Mile Plains): capsicum 0, okra 4, peanut 0, pigeon pea 0, tomato 4, watermelon 0.

M. incognita. Moderate. Inglewood.

Verbena officinalis L. (60). Common verbena.

M. incognita. Heavy. Lawes.

Vernonia cinerea (L.) Less. (18). Vernonia.

M. incognita. Moderate. Moggill.

M. javanica. Light. X.

Vicia faba L. (34). Broad bean.

M. incognita. Light. Brisbane.

Vigna sinensis (L.) Endl. ex Hassk. (34). (Fig. 9).

M. hapla. Moderate. X.

M. incognita. Heavy. X.

M. javanica. Heavy. Widespread.

Vitis vinifera L. (61). Grape.

M. incognita. Light. Rockhampton, Glen Aplin.

Zea mays L. (29). Maize.

M. incognita. Light. X.

M. javanica. Light. Cooroy.

**Zieria minutiflora* (F. Muell.) Domin (51).

M. incognita. Moderate. Beerwah.

Zingiber officinale Rosc. (62). Ginger.

M. incognita. Moderate. Nambour.

Zinnia elegans Jacq. (18). Zinnia.

M. javanica. Light. Brisbane.

SECTION II.

NEMATODE-HOST LIST.

Meloidogyne arenaria.

<i>Acacia pugioniformis</i>	<i>Lycopersicon esculentum</i>
<i>Calendula officinalis</i>	<i>Lycopersicon peruvianum</i>
<i>Capsicum frutescens</i>	<i>Musa</i> spp.
<i>Celosia argentea</i> var. <i>argentea</i>	<i>Nicandra physaloides</i>
<i>Cichorium endivia</i>	<i>Nicotiana tabacum</i>
<i>Citrullus vulgaris</i>	<i>Passiflora edulis</i> forma <i>edulis</i>
<i>Cucurbita maxima</i>	<i>Phaseolus mungo</i>
<i>Cucurbita pepo</i> var. <i>medullosa</i>	<i>Phytolacca octandra</i>
<i>Dahlia</i> sp.	<i>Primula obconica</i>
<i>Digitaria orbata</i>	<i>Pultenaea villosa</i>
<i>Eleusine indica</i>	<i>Rhynchelytrum repens</i>
<i>Epaltes australis</i>	<i>Sida cordifolia</i>
<i>Eragrostis elongata</i>	<i>Sinningia speciosa</i>
<i>Hibiscus esculentus</i>	<i>Sonchus oleraceus</i>
<i>Indigofera australis</i>	<i>Verbena bonariensis</i>
<i>Juncus polyanthemus</i>	

M. hapla.

<i>Arachis hypogaea</i>	<i>Lactuca sativa</i>
<i>Brassica oleracea</i> var. <i>botrytis</i>	<i>Lycopersicon esculentum</i>
<i>Brassica oleracea</i> var. <i>capitata</i>	<i>Lycopersicon peruvianum</i>
<i>Capsicum frutescens</i>	<i>Moghania parviflora</i>
<i>Cichorium endivia</i>	<i>Nicotiana tabacum</i>
<i>Citrullus vulgaris</i>	<i>Pandorea jasminoides</i>
<i>Crotalaria mucronata</i>	<i>Phaseolus mungo</i>
<i>Cucumis sativus</i>	<i>Phaseolus vulgaris</i>
<i>Cucurbita maxima</i>	<i>Pisum sativum</i>
<i>Daucus carota</i>	<i>Sonchus oleraceus</i>
<i>Fragaria</i> X <i>ananassa</i>	<i>Stachys arvensis</i>
<i>Fuchsia hybrida</i>	<i>Trifolium repens</i>
<i>Galinsoga parviflora</i>	<i>Trifolium subterraneum</i>
<i>Gladiolus</i> spp.	<i>Vigna sinensis</i>
<i>Glycine max</i>	

M. incognita.

<i>Acacia glaucocarpa</i>	<i>Anagallis arvensis</i>
<i>Alternanthera nana</i>	<i>Artanema fimbriatum</i>
<i>Alternanthera repens</i>	<i>Avena sativa</i>
<i>Amaranthus paniculatus</i>	<i>Beta vulgaris</i> var. <i>vulgaris</i>
<i>Amaranthus tricolor</i>	<i>Beta vulgaris</i> var. <i>cicla</i> .

- Begonia semperflorens*
Brassaia actinophylla
Brassica oleracea var. *botrytis*
Brassica oleracea var. *capitata*
Cajanus cajan
Calotis dentex
Capsicum frutescens
Cassia mimosoides
Centratherum muticum
Cephalocereus senilis
Cereus peruvianus
Chenopodium album
Chenopodium carinatum
Chenopodium trigonum
Chrysanthemum frutescens
Chrysanthemum maximum
Chrysanthemum species
Citrullus vulgaris
Citrus sp.
Cleistocactus strausii
Clerodendrum ugandense
Coleus blumei
Coronopus didymus
Crassocephalum crepidioides
Crassula acutifolia
Crassula multicava
Crassula tetragona
Cucumis sativus
Cucurbita maxima
Cyperus brevifolius
Daucus carota
Desmodium rhytidophyllum
Desmodium trichocaulon
Echinopsis eyriesii
Echinopsis multiplex
Emex australis
Erechtites atkinsoniae
Erechtites quadridentata
Eriocereus adscendens
Euphorbia officinarum
Ficus carica
Ficus pumila
Fimbristylis pauciflora
Gerbera jamesoni
Gladiolus spp.
Glycine max
Gnaphalium japonicum
Goodenia rotundifolia
Gossypium barbadense
Hibbertia linears var. *obtusifolia*
Hibiscus esculentus
Hordeum vulgare
Hypericum gramineum
Hypochæris radicata
Impatiens balsamina
Ipomoea pes-caprae
Iresine herbstii var. *aureo reticulata*
Jacksonia scoparia
Jussiaea villosa
Lactuca sativa
Lactuca serriola
Lantana montevidensis
Lepidium hyssopifolium
Lepidium sativum
Linum usitatissimum
Lobelia purpurascens
Lupinus angustifolius
Lycopersicon esculentum
Lycopersicon peruvianum
Macarthuria neocambrica
Malvastrum spicatum
Mammillaria gracilis
Medicago hispida
Medicago tribuloides
Monstera deliciosa
Nicotiana tabacum
Notocactus ottonis
Oenothera longiflora
Opuntia elata
Papaver rhoeas
Parsonsia straminea
Passiflora edulis
Petunia hybrida
Phaseolus lathyroides
Phaseolus mungo
Phaseolus vulgaris
Physalis minima
Phytolacca octandra
Pimelea pauciflora
Pisum sativum
Plectranthus australis
Polygonum plebeium

<i>Pomax umbellata</i>	<i>Solanum stelligerum</i>
<i>Portulaca oleracea</i>	<i>Solanum tuberosum</i>
<i>Prunus</i> sp.	<i>Sonchus oleraceus</i>
<i>Pseuderanthemum variabile</i>	<i>Trichocereus spachianus</i>
<i>Psychotria daphnoides</i>	<i>Trichodiadema barbatum</i>
<i>Pultenaea villosa</i>	<i>Trifolium dubium</i>
<i>Rubus rosifolius</i>	<i>Trifolium pratense</i>
<i>Rumex acetosella</i>	<i>Triticum aestivum</i>
<i>Russelia equisetiformis</i>	<i>Verbena bonariensis</i>
<i>Saccharum officinarum</i>	<i>Verbena officinalis</i>
<i>Scabiosa caucasica</i>	<i>Vernonia cinerea</i>
<i>Scoparia dulcis</i>	<i>Vicia faba</i>
<i>Sedum rubrotinctum</i>	<i>Vigna sinensis</i>
<i>Sesbania aculeata</i>	<i>Vitis vinifera</i>
<i>Sigesbeckia orientalis</i>	<i>Zea mays</i>
<i>Solanum densivestitum</i>	<i>Zieria minutiflora</i>
<i>Solanum nigrum</i>	<i>Zingiber officinale</i>

M. javanica.

<i>Acacia cunninghamii</i>	<i>Cassia mimosoides</i>
<i>Acacia myrtifolia</i>	<i>Celosia argentea</i> var. <i>argentea</i>
<i>Ageratum houstonianum</i>	<i>Celosia argentea</i> var. <i>cristata</i>
<i>Alternanthera denticulata</i>	<i>Chrysanthemum frutescens</i>
<i>Alternanthera ficoidea</i>	<i>Citrullus vulgaris</i>
<i>Amaranthus viridis</i>	<i>Cleome aculeata</i>
<i>Ananas comosus</i>	<i>Clitoria ternatea</i>
<i>Antirrhinum majus</i>	<i>Corchorus acutangulus</i>
<i>Apium graveolens</i>	<i>Cucumis sativus</i>
<i>Apium leptophyllum</i>	<i>Cucurbita maxima</i>
<i>Argemone mexicana</i>	<i>Cyperus rotundus</i>
<i>Asclepias curassavica</i>	<i>Dahlia</i> sp.
<i>Asclepias fruticosa</i>	<i>Daucus carota</i>
<i>Aster subulatus</i>	<i>Desmodium muelleri</i>
<i>Avena sativa</i>	<i>Desmodium nemorosum</i>
<i>Beta vulgaris</i> var. <i>vulgaris</i>	<i>Desmodium triflorum</i>
<i>Beta vulgaris</i> var. <i>cicla</i>	<i>Desmodium uncinatum</i>
<i>Bidens pilosa</i>	<i>Dianella caerulea</i>
<i>Borreria brachystema</i>	<i>Dianella revoluta</i>
<i>Brachiaria miliiformis</i>	<i>Dianthus caryophyllus</i>
<i>Brassica oleracea</i> var. <i>capitata</i>	<i>Digitaria adscendens</i>
<i>Brassica napus</i> var. <i>napobrassica</i>	<i>Duboisia leichhardtii</i>
<i>Cajanus cajan</i>	<i>Duboisia myopopoides</i>
<i>Capsicum frutescens</i>	<i>Echinochloa crus-galli</i>
<i>Carica papaya</i>	<i>Eclipta alba</i>

- Eleusine indica*
Emilia sonchifolia
Erechtites valerianifolia
Euphorbia geniculata
Euphorbia prostrata
Ficus carica
Gnaphalium indicum
Gomphrena globosa
Graptophyllum pictum
Helianthus annuus
Hibiscus esculentus
Hibiscus sabdariffa
Hovea acutifolia
Hyptis capitata
Impatiens balsamina
Indigofera australis
Indigofera endecaphylla
Indigofera hirsuta
Ipomoea polymorpha
Iris germanica
Kleinia repens
Lactuca sativa
Lantana camara
Lepidium sativum
Leucas linifolia
Lupinus angustifolius
Lycopersicon esculentum
Lycopersicon peruvianum
Medicago sativa
Medicago scutellata
Melochia pyramidata
Mimosa invisa
Morus alba
Musa spp.
Nicandra physaloides
Nicotiana glauca
Nicotiana glutinosa
Nicotiana tabacum
Oplismenus imbecillis
Oxalis martiana
Passiflora caerulea
Passiflora edulis forma edulis
Passiflora edulis forma flavicarpa
Passiflora maliformis
Passiflora quadrangularis
Passiflora suberosa
Pastinaca sativa
Petroselinum crispum
Phaseolus lathyroides
Phaseolus mungo
Phaseolus vulgaris
Physalis minima
Physalis peruviana
Podranea ricasoliana
Polygonum lapathifolium
Prunus persica
Pterocaulon glandulosum
Pterocaulon redolens
Pultenaea villosa
Raphanus sativus
Richardia brasiliensis
Rosa sp.
Saccharum officinarum
Salix alba var. coerulea
Salvia splendens
Sechium edule
Senecio cruentus
Sida rhombifolia
Solanum auriculatum
Solanum melongena
Solanum nigrum
Solanum seaforthianum
Solanum tuberosum
Stizolobium spp.
Stylosanthes sundaica
Symphytum peregrinum
Tagetes erecta
Tephrosia candida
Tragopogon porrifolius
Trifolium pratense
Trifolium repens
Triumfetta repens
Tropaeolum majus
Urena lobata
Vandasia retusa
Velleia spathulata
Vernonia cinerea
Vigna sinensis
Zea mays
Zinnia elegans

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APPENDIX.

Key to Botanical Families.

1. Acanthaceae
 2. Aizoaceae
 3. Amaranthaceae
 4. Apocynaceae
 5. Araceae
 6. Araliaceae
 7. Asclepiadaceae
 8. Balsaminaceae
 9. Begoniaceae
 10. Bignoniaceae
 11. Boraginaceae
 12. Bromeliaceae
 13. Cactaceae
 14. Cappariaceae
 15. Caricaceae
 16. Caryophyllaceae
 17. Chenopodiaceae
 18. Compositae
 19. Convolvulaceae
 20. Crassulaceae
 21. Cruciferae
 22. Cucurbitaceae
 23. Cyperaceae
 24. Dilleniaceae
 25. Dipsacaceae
 26. Euphorbiaceae
 27. Gesneriaceae
 28. Goodeniaceae
 29. Gramineae
 30. Hypericaceae
 31. Iridaceae
 32. Juncaceae
 33. Labiatae
 34. Leguminosae
 35. Liliaceae
 36. Linaceae
 37. Lobeliaceae
 38. Malvaceae
 39. Moraceae
 40. Musaceae
 41. Onagraceae
 42. Oxalidaceae
 43. Papaveraceae
 44. Passifloraceae
 45. Phytolaccaceae
 46. Polygonaceae
 47. Portulacaceae
 48. Primulaceae
 49. Rosaceae
 50. Rubiaceae
 51. Rutaceae
 52. Salicaceae
 53. Scrophulariaceae
 54. Solanaceae
 55. Sterculiaceae
 56. Thymeliaceae
 57. Tiliaceae
 58. Tropaeolaceae
 59. Umbelliferae
 60. Verbenaceae
 61. Vitaceae
 62. Zingiberaceae
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