Some Monocotyledonous and Dicotyledonous Hosts of *Meloidogyne microtyla*

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ABSTRACT

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Meloidogyne microtyla reproduced on 62 of 87 plant species and cultivars tested in the greenhouse. Gramineous species were the best host, which causes concern because grasses are used as orchard cover crops. Among dicotyledonous vegetable species, garden pea, celery, and parsley were poor to intermediate hosts. They are not major crops within the known geographic distribution of the nematode. Dicotyledonous weed species were poor to intermediate hosts of *M. microtyla* but are capable of maintaining the nematode in its area of occurrence. A differential host-range test to distinguish *M. microtyla* from *M. chitwoodi, M. hapla,* and *M. incognita* is proposed using pepper, carrot, peanut, corn, and tall oat grass.

Meloidogyne microtyla Mulvey et al was described in 1975 (3) from turfgrasses in southwestern Ontario. With the description, a limited host range, primarily legumes and cereals, was presented. It was noted that this root-knot nematode was mainly restricted to the Grand River watershed. The nematode is primarily a problem in golf greens in southern Ontario. In infested golf greens, patches of turf turn yellow and die rapidly. *M. hapla* Chitwood, the only other root-knot nematode occurring in the field in Ontario, attacks vegetable crops but not grasses. The purpose of this investigation was to determine some of the monocotyledonous and dicotyledonous hosts of *M. microtyla.*

MATERIALS AND METHODS

M. microtyla for this study came from putting greens of the Delhi Golf Course in Norfolk County, Ontario, on the western edge of the Grand River watershed in 1979. Populations were increased on tomato (*Lycopersicon esculentum* Mill. 'Stakeless') in a greenhouse at the Vineland Research Station.

Wild grasses, dicotyledonous weeds, vegetables, and grass cover crops were tested as possible hosts of *M. microtyla.* Seeds were germinated in 128-cell (cells 4 × 4 cm) Styrofoam trays. Established seedlings were plugged into a sterile soil mix (Vineland silt loam, peat, and perlite; 4:2:1) in 12-cm clay pots inoculated with 50 ml of infested Vineland silt loam containing about 10,000 J_2 juveniles. Pots were plunged into sterile soil in a greenhouse ground bed maintained at 20–25 C. Treatments were randomized in a complete block design in three replicates.

Vegetable plants were harvested at 13 wk because of early maturing dates, and the wild grasses, dicotyledonous weeds, and grass cover crops were harvested at 17 wk. Soil in the pots was allowed to dry sufficiently for easy removal of roots. J_2 juveniles were extracted by Baermann pan (6) from one 50-g soil subsample per pot and from randomly selected portions of the feeder root system. Where available, 2 g or more of feeder roots was sampled per replicate. Weights of roots and soil from each pot were recorded. Data were recorded as the number of J_2/g fresh root and J_2/50 g soil and extrapolated as the number per pot (root system and soil). Presence of galls was also noted.

RESULTS

We considered a plant to be a host when juveniles were extracted from roots. Galls on roots were not considered conclusive evidence for a host; on many plants, such as the Gramineae, only exposed females and egg masses were observed.

Members of the Gramineae were favored hosts of *M. microtyla* (Table 1). Chess (*Bromus secalinus* L.), squirrel-tail grass (*Hordeum jubatum* L.), Italian ryegrass (*Lolium multiflorum* Lam.), wild oats (*Avena fatua* L.), redtop (*Agrostis alba* L.), Kentucky bluegrass (*Poa pratensis* L.), and Virginia wild rye (*Elymus virginicus* L.) supported the highest populations of J_2/g root and total numbers of J_2/pot (200,000/pot-roots + soil). Canary-grass (*Phalaris arundinacea* L.) and millet (*Panicum miliaceum* L.) were not hosts.

In several families, *M. microtyla* produced populations of intermediate size (10,000–200,000 J_2/pot) on at least one plant species (Table 1). Heal-all (*Prunella vulgaris* L., Labiatae), celery (*Apium graveolens* var. *dulce* Pres., Umbelliferae), and curled dock (*Rumex crispus* L., Polygonaceae) had populations of 14,190, 26,990, and 131,900 J_2/pot (roots + soil), respectively.

Many other plant species were considered poor hosts to nonhosts with only a few J_2/pot produced. The few J_2 recovered were active and did not appear starved. Galls were not prominent and were noted only on a few of the plant species that were hosts.

DISCUSSION

M. microtyla is primarily a parasite of grasses, based on final juvenile populations. This nematode, however, has a relatively broad host range because it also reproduced to some degree on one or more species in the 16 families studied. For several plant species, numerous juveniles were found in the soil but none were extracted from the roots, which indicates these species may be hosts of *M. microtyla.* Exposed females and egg masses could have been loosened when the soil was dried and stripped from the roots as they were separated from the soil. Original J_2 inoculum after 13–17 wk would be probably starved and noninfective (7).

The importance of *M. microtyla* as a parasite of grasses favored in golf-course management has been noted. Although Kentucky bluegrass (*Poa pratensis* L.) used in fairways is a better host than Colonial bentgrass (*Agrostis tenuis* Sibth.) used in putting greens, the latter is under much greater stress resulting from close clipping and is thus readily damaged when infested. Of concern are grasses used as orchard cover crops because recently, in the Georgian Bay area of Ontario, creeping red fescue (*Festuca rubra* L.) in an apple orchard was severely damaged by an infestation of *M. microtyla* (T. Olthof, *unpublished*). Two grasses under test at the time of this finding in Georgian Bay, Kentucky bluegrass and Italian ryegrass (*L. multiflorum*), are good to excellent hosts

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Table 1. Assessment of monocotyledonous and dicotyledonous plant species as hosts of *Meloidogyne microtyla*

Scientific name	Common name	Horticultural variety	Number of J_2		
			Per gram fresh root	Per 50 g soil	Per pot[a]
AMARANTHACEAE					
Amaranthus hybridus L.	Green pigweed	···	15	165	2,770
A. retroflexus L.	Red root pigweed	···	0	0	0
AMARYLLIDACEAE					
Allium cepa L.	Onion	Riverside Sweet Spanish	5*[b]	5	65
ASCLEPIADACEAE					
Asclepias syriaca L.	Common milkweed	···	0	2	25
CARYOPHYLLACEAE					
Cerastium vulgatum L.	Mouse-ear chickweed	···	170	40	236
Silene cucubalus Wibel	Bladder-campion	···	1*	25	334
CHENOPODIACEAE					
Beta vulgaris L.	Beet	Detroit Dark Red	38*	37	474
B. vulgaris var. *cicla* L.	Swiss chard	Fordhook Giant	66*	23	1,113
Chenopodium album L.	Lamb's-quarters		0	0	0
Spinacia oleracea L.	Spinach	America	145*	7	212
COMPOSITAE					
Cichorium endivia L.	Endive	Salad King	3*	10	167
Cirsium vulgare (Savi) Tenore	Bull Thistle	···	0	0	0
Erigeron canadensis L.	Canada Fleabane	···	0	5	67
Galinsoga ciliata (Raf.) Blake	Hairy galinsoga	···	590*	427	7,728
Hieracium aurantiacum L.	Orange Hawkweed	···	0	0	8
Lactuca scariola L.	Prickly lettuce	···	1*	8	121
Lactuca sativa L.	Lettuce	Mesa 659 M.I.	6*	2	38
L. sativa var. *longifolia* Lam.	Cos lettuce	Parris Island Cos	1*	5	97
Senecio vulgaris L.	Common groundsel	···	0	12	173
Taraxacum officinale Weber	Dandelion	···	0	2	21
CRUCIFERAE					
Barbarea vulgaris R.Br.	Yellow rocket	···	80*	205	3,729
Brassica oleracea var. *botrytis* L.	Cauliflower	Snowball-y	2*	0	9
B. oleracea var. *capitata* L.	Cabbage	Roundup	0	3	46
B. oleracea var. *gemmifera* Zenker	Brussel sprouts	Jade Cross	0	3	44
B. oleracea var. *italica* Plenck	Broccoli	Waltham 29	0	2	26
B. Napobrassica Mill.	Turnip	The Laurentian	0	10	108
Lepidium virginicum L.	Poor man's pepper	···	60*	20	636
Raphanus sativus L.	Radish	Comet	6	23	205
Sinapsis arvensis L.	Wild mustard	···	4*	83	1,187
Sisymbrium altissimum L.	Tumble mustard	···	0	2	20
CUCURBITACEAE					
Cucumis sativus L.	Cucumber	Windermoor Wonder	4	8	124
Cucurbita maxima Duchesne	Squash	Table King	0	0	0
C. pepo L.	Pumpkin	Small sugar	1	7	89
DIPSACACEAE					
Dipsacus sylvestris Huds.	Wild teasel	···	0	3	49
GRAMINEAE					
Agropyron repens (L.) Beauv.	Quack-grass	···	190	70	72,250
Agrostis alba L.	Redtop	···	160	387	366,800
A. tenuis Sibth.	Colonial bentgrass	···	850	100	102,100
Arrhenatherum elatius (L.) Mert. and Koch.	Tall oat-grass	···	290	0	2,280
Avena fatua L.	Wild oats	···	2,080	490	440,000
Briza maxima L.	Quaking grass	···	40	0	350
Bromus inermis Leyss.	Bromegrass	···	280	33	35,340
B. secalinus L.	Chess	···	6,550	793	797,560
B. tectorum L.	Downy brome-grass	···	330	17	19,890
Dactylis glomerata L.	Orchard-grass	···	70	0	1,270
Digitaria sanguinalis (L.) Scop.	Crabgrass	···	200	0	2,160
Echinochloa crusgalli (L.) Beau	Barnyard-grass	···	330	7	7,750
E. pungens (Poir.) Rydb. var. *Wiegandii* Gass.		···	440	0	3,700
Elymus virginicus L.	Virginia wild rye	···	850	147	207,460
Eragrostis pectinacea (Michx.) Nees	Love-grass	···	200	117	95,240
Glyceria striata (Lam.) Hitch	Fowl-meadow grass	···	30	0	130
Hordeum jubatum L.	Squirrel-tail grass	···	1,660	550	488,570
Hystrix patula Moench	Bottle-brush grass	···	330	65	35,990
Leersia oryzoides (L.) Sw.	Rice cutgrass	···	1,700	7	22,090
Lolium multiflorum Lam.	Italian ryegrass	···	1,660	525	484,140
Panicum capillare L.	Old-witch grass	···	270	113	91,140
P. miliaceum L.	Millet	···	0	3	60
Phalaris arundinacea L.	Reed canary-grass	···	320	0	10,980
P. canariensis L.	Canary-grass	···	0	0	0

(*continued*)

Table 1. (*continued from preceding page*)

Scientific name	Common name	Horticultural variety	Number J_2		
			Per gram fresh root	Per 50 g soil	Per pot[a]
Phleum pratense L.	Timothy	···	190	3	5,970
Poa pratensis L.	Kentucky bluegrass	···	2,330	133	227,960
Setaria glauca (L.) Beauv.	Yellow foxtail	···	20	3	3,130
S. viridis (L.) Beauv.	Green foxtail	···	5	10	9,040
Triticum aestivum L.	Wheat	Stewart	80	0	190
Zea mays var. *saccharata* Bailey	Sweet corn	Seneca Chief	7	20	457
GUTTIFERAE					
Hypericum punctatum Lam.	Spotted St. John's-wort	···	0	2	20
LABIATAE					
Leonurus cardiaca L.	Motherwort	···	15*	33	5,030
Nepeta cataria L.	Catnip	···	1*	60	1,218
Prunella vulgaris L.	Heal-all	···	1,460	178	14,187
LEGUMINOSAE					
Glycine max Merr.	Soybean	Fiskeby V	0	0	0
Medicago lupulina L.	Black medick	···	610	335	7,479
Phaseolus vulgaris var. *humilis* Alef.	Green bush bean	Del Rey	0	2	22
P. vulgaris L.	Navy bean	White Marrow	4	7	98
Pisum sativum L.	Pea	Improved Laxton's Progress	855*	120	1,764
MALVACEAE					
Malva neglecta Wallr.	Common mallow	···	0	13	258
ONAGRACEAE					
Oenothera biennis L.	Common evening-primrose	···	0	2	22
PLANTAGINACEAE					
Plantago lanceolata L.	Ribgrass	···	0	0	0
P. major L.	Common plantain	···	230	28	2,780
POLYGONACEAE					
Rumex crispus L.	Curled dock	···	910	60	131,911
ROSACEAE					
Potentilla norvegica L.	Rough cinquefoil	···	780*	15	5,844
SCROPHULARIACEAE					
Verbascum thapsus L.	Common mullein	···	3	3	64
SOLANACEAE					
Datura stramonium L.	Jimsonweed	···	3	32	493
Nicotiana tabacum L.	Tobacco	Harrow Velvet	7	22	446
Solanum dulcamara L.	Bittersweet nightshade	···	70	123	2,094
S. melongena var. *esculentum* Nees.	Common eggplant	Imperial Black Beauty	0	7	129
UMBELLIFERAE					
Apium graveolens var. *dulce* Pers.	Celery	Utah	97.0	68	26,993
Daucus carota L.	Wild carrot	···	0	0	0
Petroselinum crispum Nym.	Parsley	Curlina	36*	32	1,157

[a] Extrapolation including all juveniles from the soil and root system.
[b] * = Galls observed.

of *M. microtyla*. The status of other orchard grass cover crops as hosts should be determined.

The weed host range of *M. microtyla* is of such diversity that it represents a potential for geographically widespread maintenance of this nematode. Many weed hosts do not support large numbers of *M. microtyla* but their potential as reservoirs within an orchard cover is of some concern.

Of the cultivated vegetables, garden pea, celery, and parsley were the best hosts of *M. microtyla* although none were as good as the grasses in terms of numbers of juveniles extracted. Although these vegetables are not major crops within the known geographic area of occurrence of the nematode, it is important to know their host status.

In addition to *M. microtyla*, two other species of root-knot nematodes are found in greenhouses and field soils in Ontario.

Table 2. Proposed differential hosts of four species of *Meloidogyne*

Root-knot species	Differential host plants[a]				
	Vinedale pepper	Gold Pak carrot	Spanish peanut	Pride 137 corn	Tall oat-grass
M. microtyla	–[b]	–	–	–	+
M. chitwoodi	–	+	–	+	–
M. hapla	+	+	+	–	–
M. incognita	+	+	–	+	+

[a] Seed of the differential hosts pepper, carrot, and peanut were obtained from Stokes Seed Ltd., St. Catharines, Ont., and corn from King Grain Ltd., Chatham, Ont., and seed of tall oat-grass was collected in the Niagara Peninsula.
[b] – = No larvae extractable from roots, + = larvae extractable from roots.

In the original description of *M. microtyla*, the need for a differential host range to be used in conjunction with perineal pattern examination was expressed. This differential host range is presented (Table 2) for *M. microtyla, M. chitwoodi* Golden et al, *M. hapla*, and *M. incognita* (Kofoid & White) Chitwood, based on our results and those from the literature (3–5). *M. naasi* Franklin, which occurs in Illinois (southwest of southern Ontario), was not included because the literature (2) did not reveal any differentiating hosts. *M. incognita* was included in this group of temperate zone nematodes because of its common occurrence in Ontario greenhouses and its ability to survive on transplants (1) during the summer in southern Ontario fields. Pepper (*Capsicum annuum* L.)

separates *M. microtyla* and *M. chitwoodi* from *M. hapla* and *M. incognita* (Table 2). Gold Pak carrot (*Daucus carota* L.) separates *M. microtyla* from *M. chitwoodi* whereas peanut (*Arachis hypogaea* L.) separates *M. hapla* from *M. incognita*. Tall oat grass (*Arrhenatherum elatius* (L.) Mert. & Koch) and field corn (*Zea mays* L.), respectively, provide reciprocal confirmation for the carrot and peanut differentiation.

Galls of *M. microtyla* on tomato are very small (1–2 mm), most closely resembling those of *M. chitwoodi*; galls of *M. hapla* are intermediate in size and galls of *M. incognita* are the largest (2). These gall characteristics on tomato would be a useful supplement to the differential host test.

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