Occurrence and Host Range of a New Root-Knot Nematode (*Meloidogyne chitwoodi*) in the Pacific Northwest

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ABSTRACT

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A new root-knot nematode (*Meloidogyne chitwoodi*) has been associated with potato, wheat, and corn in Washington, Idaho, and Oregon. A host range study showed that this nematode reproduces on potato, tomato, sugar beet, wheat, and corn. This is significant because wheat and corn are commonly grown in rotation with potatoes and sugar beets to reduce *Meloidogyne hapla* populations. Symptoms produced on tubers are similar to those produced by *M. hapla*. However, on potato and Red Cherry and Rutger tomato roots, *M. chitwoodi* causes no or only slight galling.

Root-knot nematodes are serious pests on irrigated crops, especially potatoes, in the Pacific Northwest (1). Approximately $9 million is spent annually to control root-knot nematodes on potatoes in Washington. The northern root-knot nematode (*Meloidogyne hapla* Chitwood) is widespread in Idaho, Oregon, and Washington, and the less common southern root-knot nematode (*M. incognita* (Kofoid and White) Chitwood) occurs in Oregon and Washington. A new species of root-knot nematode (the Columbia root-knot nematode, *M. chitwoodi* Golden et al) has been found infecting potato (*Solanum tuberosum* L.) in some commercial production areas of Idaho and Washington (2).

Examinations of potato tubers from production areas during 1977 to 1980 have revealed the presence of this new species from the lower, middle, and upper Columbia River Basin; other northwestern regions of Washington; and the lower, middle, and upper Snake River regions of Idaho (Fig. 1). It was also associated with wheat (*Triticum aestivum* L.) and corn (*Zea mays* L.) from Nyssa, OR, and potato from Hermiston, OR (Fig. 1). We think that because of the wide distribution, the nematode has been in the Northwest for some time but not detected or recognized as a new species.

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A test was conducted to compare the reproduction of *M. chitwoodi* and *M. hapla* on several hosts. Hosts used in the North Carolina differential host test were included to compare the host preference of *M. chitwoodi* to other *Meloidogyne* species (4).

MATERIALS AND METHODS

The nematodes were increased and maintained in a growth room on tomato (*Lycopersicon esculentum* Mill., 'Rutgers'). *M. chitwoodi* was originally isolated from Russet Burbank potato tubers and *M. hapla* from alfalfa (*Medicago sativa* L.). Nematode eggs for inoculum were extracted by vigorously shaking roots in 1% sodium hypochlorite (Clorox) for 4 min. Eggs were rinsed thoroughly and inoculations were made by pipetting 1,000 eggs into 25 ml of water and pouring them around the roots of the plants.

Hosts used in this experiment were potato cv. Russet Burbank, corn PX46 (Northrup King), wheat cv. Fielders Spring, barley (*Hordeum vulgare* L. 'Boyer'), oats (*Avena sativa* L. 'Park'), sugar beet (*Beta vulgaris* L.) U & I Hybrid 9, tomato cv. Rutgers, pepper (*Capsicum frutescens* L. 'California Wonder'), watermelon (*Citrullus vulgaris* Schrad 'Charleston Grey'), tobacco (*Nicotiana tabacum* L.) NC 95, peanut (*Arachis hypogaea* L. 'Florrunner'), cotton (*Gossypium hirsutum* L. 'Deltapine 16'), and alfalfa cv. Saranac. Seeds were planted in 10-cm-diameter clay pots containing sandy loam soil fumigated with methyl bromide. The pots were randomized on greenhouse benches with five replicates. Plants were inoculated 4 wk later. The ambient temperature in the

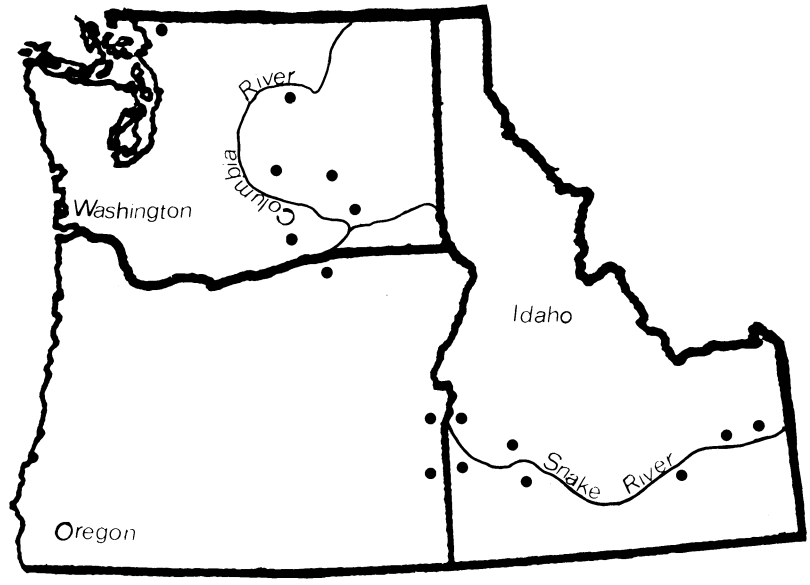

Fig. 1. Geographic distribution of *Meloidogyne chitwoodi* in the tri-state area.

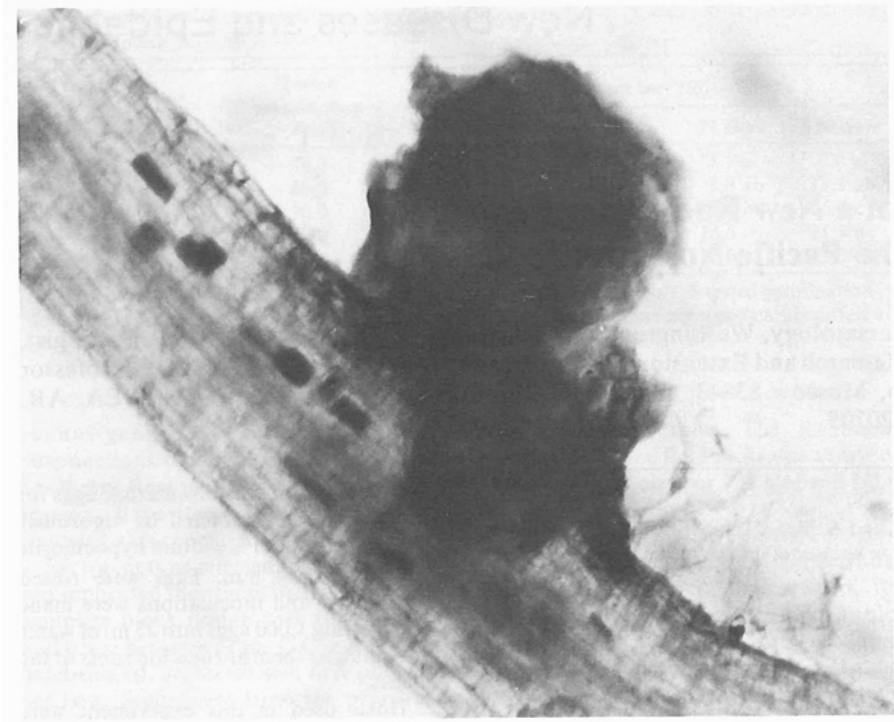

Fig. 2. Potato root infected with *Meloidogyne chitwoodi* showing large egg mass. Note absence of galling, which is characteristic of this nematode.

Table 1. Numbers of nematodes on several hosts 50 days after inoculation with 1,000 eggs of *Meloidogyne chitwoodi* and *M. hapla*

Host	*M. chitwoodi*[a]	*M. hapla*[a]
Potato, Russet Burbank	6,100*[b]	820
Corn, PX46	1,900**	0
Wheat, Fielders Spring	5,980**	1[c]
Barley, Boyer	1,100**	2
Oats, Park	2,300**	3[c]
Sugar beet, U & I Hybrid 9	840*	140
Tomato, Rutgers	3,800	4,400
Pepper, California Wonder	57**[c]	2,050
Watermelon, Charleston Grey	6	0
Tobacco, NC 95	1[c]	5
Peanut, Florrunner	0**	1,500
Cotton, Deltapine 16	0.4	14
Alfalfa, Saranac	15**	210

[a] Each value is a mean number of larvae extracted from soil and roots from five replicates.
[b] * Differs from *M. hapla* at $P = 0.05$; **differs at $P = 0.01$, by Duncan's multiple range test.
[c] No larvae recovered from roots.

glasshouse was maintained at 24 C. Plants were watered daily and fertilized with Hoagland's nutrient solution every week.

This experiment was terminated after 50 days. Nematodes from soil and roots were counted. Nematodes were extracted from soil by centrifugal flotation (3) and from roots by incubating infected tissue in polyethylene plastic bags for 7 days.

RESULTS AND DISCUSSION

The common hosts for *M. chitwoodi* and *M. hapla* were potato, sugar beet, and tomato (Table 1). *M. chitwoodi*, however, had a higher ($P = 0.05$) reproductive potential on potato and sugar beet than *M. hapla* (Table 1). In addition, *M. chitwoodi* reproduced on corn, wheat, barley, and oats but only slightly or not at all on pepper, watermelon, tobacco, peanut, cotton, or alfalfa. *M. hapla* reproduced on pepper, peanut, and alfalfa but not on corn, wheat, barley, oats, watermelon,tobacco, or cotton (Table 1). The host range of these nematodes becomes significant because wheat, corn, and alfalfa are commonly grown in rotation with potato. Wheat and corn can be used to reduce *M. hapla* populations and alfalfa for *M. chitwoodi*. Based on the North Carolina differential host test (4), *M. chitwoodi* can be separated from other root-knot species.

M. chitwoodi and *M. hapla* produce similar symptoms on potato tubers, ie, galls and swellings on the surface with internal brown spots. On potato roots, however, and on roots of Red Cherry and Rutger tomato, *M. chitwoodi* causes almost no galling, but *M. hapla* forms small but distinct galls. Tomato seedlings are commonly used as a bioassay for root-knot nematodes in soil (4), but because of only slight or no galling, roots must be examined with a dissecting microscope to determine the presence of *M. chitwoodi* (Fig. 2).

These preliminary experimental results and observations indicate that *M. chitwoodi*, in addition to *M. hapla*, may be a potentially serious problem for several crops, especially potatoes grown in the Pacific Northwest. More research is required. Studies are continuing to determine distribution, host range, life cycle, environmental adaptation, migration capabilities, pathogenicity, and control of this new root-knot nematode.

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