Comparative Relationship between *Meloidogyne chitwoodi* and *M. hapla* Population Densities and Growth of Sugarbeet Seedlings[1]

G. D. GRIFFIN[2], R. N. INSERRA[3] AND M. DI VITO[3]

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The Columbia root-knot nematode, *Meloidogyne chitwoodi* Golden et al., and the northern root-knot nematode, *M. hapla* Chitwood, are widely distributed in the Pacific Northwest (1,5). Although *M. chitwoodi* appears to be more widely distributed on potato (*Solanum tuberosum* L.) than *M. hapla* (3), both species are able to infect and reproduce on sugarbeet (*Beta vulgaris* L.) (4,5). There is, however, a lack of information on the effect of initial

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[2]Nematologist, USDA ARS, Crops Research Laboratory, Logan, UT, 84322.

[3]Nematologist, Istituto Nematologia Agraria del Consiglio Nazionale delle Ricerche, 70126, Bari, Italy.

Fig. 1. TEM photomicrographs of transverse sections cut through eggs of *Orrina phyllobia* containing larvae in the process of moulting. A) Oblique section through part of a larvae at the commencement of moulting. The L_2 cuticle (C_2) is starting to form under the cuticle of the L_1 (C_1); the somatic muscle is shown cut obliquely and adjacent to part of a nucleus (n); part of the shell (s) is also visible. B) Transverse section through the anterior part of a larva after moulting, showing the L_2 cuticle (C_2), the shed L_1 cuticle (C_1), and part of the egg shell (s). C) Transverse section through the posterior part of a larva after moulting, showing the L_2 cuticle (C_2) and the moulted cuticle of the previous L_1 (C_1). D) High-powered photomicrograph showing part of an oblique section cut through the L_1 cuticle (C_1), the L_2 cuticle (C_2) in the initial stages of its formation, and the underlying hypodermis (hyp). E) High-powered photomicrograph showing part of a transverse section cut through the L_2 cuticle (C_2) and the moulted and partially reabsorbed L_1 cuticle (C_1).

population densities of *M. chitwoodi* and *M. hapla* on sugarbeet yields. A study was initiated to determine the relationship between population densities of *M. chitwoodi* and *M. hapla* and their effect on yields of sugarbeet.

A *M. chitwoodi* population obtained from a potato field at Ft. Hall, Idaho, and a *M. hapla* population from a lettuce (*Lactuca sativa* L.) field at Ogden, Utah, were separately cultured on tomato (*Lycopersicon esculentum* Mill. cv. Cal Pack) plants under greenhouse conditions.

Plastic pots (6 cm) containing sandy loam soil (72% sand, 18% silt, and 10% clay) fumigated with methyl bromide were inoculated with a geometric progression of either *M. chitwoodi* and *M. hapla* eggs and/or second-stage juveniles (0, 0.125, 0.25, 0.5, ... 512/cm³ of soil). The inoculum was obtained from tomato roots using a 0.8% sodium hypochlorite solution (2). A single 15-day-old sugarbeet seedling (AH-14) was planted in each pot. Treatments (inoculum densities) were randomized on greenhouse benches and replicated six times. The ambient temperature in the greenhouse was maintained at 25 ± 3 C, under a 19-h day with supplemental high-output flourescent lamps. At harvest (65 days after transplanting) fresh tap root and top weights were recorded. Nematode reproduction was determined by counting the eggs and second-stage juveniles of the eggs masses present in the roots by using the sodium hypochlorite extraction method (2).

The relation between sugarbeet tap root weights at harvest and initial nematode population density is shown in Fig. 1. Both the curves fit the equation $y = m + (1-m)z^{P-T}$ (eq. i.) for $P \geq T$ and $y = 1$ for $P \leq T$ (where y = relative yield, m = relative minimum yield; $z \leq 1$, P = initial nematode density and $z^{-T} = 1.05$) (6). The curves show a tolerance limit (T) of sugarbeet to *M. chitwoodi* and *M. hapla* of 2.8 and 0.6 eggs and/or second-stage juveniles per cm³ of soil, respectively. The relative minimum yield (m) was similar for *M. chitwoodi* and *M. hapla*, resulting in a 60 and 65% reduction in fresh tap root weight. Since the minimum yield increases as plants age (7), lower minimum yields would be

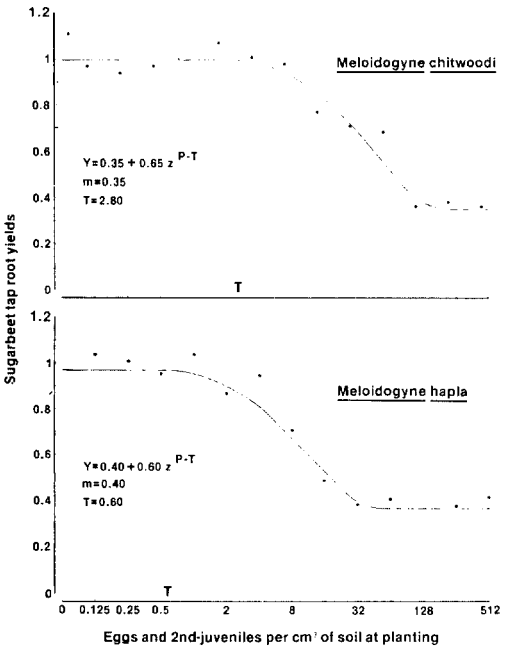

Fig. 1. Relationship between initial population densities of *Meloidogyne chitwoodi* and *M. hapla* on the tap root growth of 15-day-old sugarbeet (*Beta vulgaris L.* cv. AH-14) transplants grown in the greenhouse after 65 days. (The sugarbeet tap root yields are expressed as values of the percentage increase or decrease of inoculated plants as compared to uninoculated controls. 1 = 100%; m = relative minimum yield; T = tolerance limit).

expected if pregerminated seeds were used instead of sugarbeet seedlings.

Top growth of the sugarbeet plants was not significantly affected by nematodes, except at the largest initial population density of *M. chitwoodi*, where growth was 32% less than the control ($P = 0.05$).

Reproduction of *M. hapla* on sugarbeet was significantly greater than that of *M. chitwoodi* at all initial population densities except at 0.25 eggs and/or second-stage juveniles per cm³ of soil (Table 1).

Although both *M. chitwoodi* and *M. hapla* reduced tap root growth in this experiment, sugarbeet is a better host for *M. hapla* than for *M. chitwoodi*, as indicated by the greater nematode reproduction and the lower T value for *M. hapla*. Since the detectable soil population densities of these two nematode species are rarely more than 1 nematode per cm³ of soil at time of planting in the Intermountain or Pacific Northwest areas of the United States, it appears

Table 1. Reproduction of *Meloidogyne chitwoodi* and *M. hapla* on 15-day-old sugarbeet (*Beta vulgaris* L. cv. AH-14) transplants grown in the greenhouse after 65 days.

Inoculum density (Eggs + second-stage juveniles/cm³ soil)	Eggs + second-stage juveniles/plant	
	M. chitwoodi	*M. hapla*
0.125	50	895*
0.25	168	468
0.5	243	1,772*
1	511	2,013*
2	394	1,875*
4	3,252	11,136*
8	13,786	39,083*
16	15,489	78,208*
32	26,092	232,250*
64	18,945	199,083*
128	51,388	211,875*
256	29,364	173,241*
512	38,040	missed

Asterisks indicate significant ($P = 0.05$) differences in reproduction between *M. chitwoodi* and *M. hapla*.

that *M. hapla* may be more pathogenic than *M. chitwoodi* under field conditions.

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