Reproduction and Pathogenicity of Three Isolates of Meloidogyne hapla Race A on Concord Grapes[1]

G. S. Santo and R. W. Hackney[2]

The northern root-knot nematode, *Meloidogyne hapla* Chitwood, 1949, parasitizes a number of important crops in Washington (1). *M. hapla* is widespread on Concord grapes (*Vitis labrusca* L.), and heavy infestations have been associated with vines with poor growth. All the same, a greenhouse pathogenicity study with an isolate of *M. hapla* from alfalfa (*Medicago sativum* L.) showed that Concord grape was a poor host. Those observations indicated that at least two populations of *M. hapla* were present. Pathotypes are common in species of *Meloidogyne* (4, 5, 6), and five pathotypes of *M. hapla* are known from the Pacific northwestern United States (5). Pathotypes are generally differentiated by host range, pathogenicity, and mode of reproduction (6, 8). Chromosome numbers have recently been used to identify field populations of *Meloidogyne* spp. (2). There are at least two known races of *M. hapla* distinguished by type of chromosome reproduction (8).

This study was done to measure the variation in reproduction, pathogenicity, and chromosome number of three Washington State field isolates of *M. hapla* on Concord grapes.

Dormant three-node grape cuttings were rooted in peat moss in a greenhouse. Rooted cuttings were transplanted into methyl-bromide-fumigated sandy loam soil (72.4% sand, 22.6% silt, 5% clay) in 10-cm-diam plastic pots. After 10 weeks, established plants were transplanted into 7.5-liter plastic pots and inoculated with nematodes. Isolates of *M. hapla* taken from alfalfa, red currant (*Ribes rubrum* L.), and Concord grape in the field were increased and maintained separately on tomato (*Lycopersicon esculentum* Mill. 'Tiny Tim') in a growth room. Second-stage larvae of *M. hapla* were extracted by placing roots under mist for 48-72 h. Inoculations were made by pouring 50 ml of water containing 1,000 *M. hapla* second-stage larvae around the grape roots. Uninoculated plants received 50 ml water. Each treatment was replicated 10 times, and pots were arranged in randomized blocks on a greenhouse bench. Soil temperatures ranged from 18 to 24 C. Plants were watered with tap water and fertilized every 2 weeks with Hoagland's nutrient solution. After 6 months, fresh weights of roots were determined, and nematode counts were made from soil and roots. Nematodes were extracted from the soil by centrifugal-flotation (3), and from the roots by placing 1-cm root segments on screens under mist for 7 days.

Nematodes were obtained for chromosome analysis by dissecting young egg-laying females from root-gall tissue. Chromosome analyses were performed by the method developed by Triantaphyllou (7) and Triantaphyllou and Hirschmann (9). At least 10 chromosome counts were performed per field isolate. Perineal patterns were cut from the empty cuticles to confirm the identity of *M. hapla*.

Pathogenicity: Concord grape roots parasitized by the Concord grape isolate weighed less ($P = 0.01$) than uninoculated controls or grape roots parasitized by the alfalfa and red currant isolates. No reduction in grape root weight followed parasitism by the alfalfa and red currant isolates (Table 1).

Reproduction: The Concord grape and red currant isolates reproduced better ($P = 0.01$) than the alfalfa isolate (Table 1). Differences between the final populations of the Concord grape and red currant isolates were not statistically significant.

Chromosome counts: The three isolates of *M. hapla* were race A. The isolates from alfalfa and red currant contained chromosomal populations with 15 and 17 chromosomes, whereas the isolate from Concord grape had chromosomal populations with 15 and 16 chromosomes.

In conclusion, the alfalfa isolate differed from the Concord grape and red currant

Received for publication 11 April 1979.

[1]Washington State University College of Agriculture Research Center, Pullman, Project 1491.

[2]Respectively Assistant Plant Pathologist-Nematologist and Assistant Professor of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, Washington 99350; and Plant Nematologist, California Department of Food and Agriculture, Sacramento, California 95814.

TABLE 1. Reproduction and pathogenicity of three isolates of *Meloidogyne hapla* Race A on Concord grape after 6 months, and chromosomal analysis of the isolates.

Source of *M. hapla* isolate[a]	Fresh root weight (g)[b]	Final no. of larvae/pot[b] (in 1,000's)	Chromosomal populations present in isolates[c]		
			15	16	17
No nematodes	195.4 x	—	−	−	−
Alfalfa	206.6 x	1.9 y	+	−	+
Red currant	183.1 x	15.0 x	+	−	+
Concord grape	122.7 y	20.7 x	+	+	−

[a]Initial population, 1,000 nematodes/pot.
[b]Average of 10 replicates. Values in each column not followed by the same letter differ significantly ($P = 0.01$) according to Duncan's multiple-range test.
[c]+ = chromosomal population present. − = none present.

isolates in reproduction on Concord grape. The Concord grape isolate differed from the other two isolates in pathogenicity and chromosome number. Although the alfalfa and red currant isolates both contained chromosomal populations of *M. hapla* race A, they differed in their ability to reproduce on Concord grapes. These results indicate that field populations of *M. hapla* vary in ability to parasitize Concord grapes.

LITERATURE CITED

1. FAULKNER, L. R., and F. D. McELROY. 1964. Host range of northern root-knot nematode on irrigated crop plants and weeds in Washington. Plant Dis. Rep. 48:190-193.

2. HACKNEY, R. W. 1977. Identification of field populations of Meloidogyne spp. by chromosome number. J. Nematol. 9:248-249.

3. JENKINS, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Dis. Rep. 48:692.

4. MICHELL, R. E., R. B. MALEK, D. P. TAYLOR, and D. I. EDWARDS. 1973. Races of the barley root-knot nematode, Meloidogyne naasi. I. Characterization by host preference. J. Nematol. 5:41-44.

5. OGBUJI, R. O., and H. J. JENSEN. 1974. Two pacific northwest biotypes of Meloidogyne hapla reproduce on corn and oat. Plant Dis. Rep. 58:128-129.

6. STURHAN, D. 1971. Biological Races. *In:* Plant parasitic nematodes, Vol. II. (B. M. Zuckerman, W. F. Mai and R. A. Rhode, eds.), pp. 51-71. Academic Press, New York.

7. TRIANTAPHYLLOU, A. C. 1963. Polyploidy and parthenogenesis in the root-knot nematode, Meloidogyne arenaria, J. Morphol. 113:489-499.

8. TRIANTAPHYLLOU, A. C. 1966. Polyploidy and reproductive patterns in the root-knot nematode Meloidogyne hapla. J. Morphol. 118:403-414.

9. TRIANTAPHYLLOU, A. C., and HEDWIG HIRSCHMANN. 1966. Gametogenesis and reproduction in the wheat nematode, Anguina tritici. Nematologica 12:437-442.