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Effect of Three Plant Species on Population Densities of *Xiphinema americanum* and *X. rivesi*[1]

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Abstract: A taxonomic revision of the *Xiphinema americanum* species complex has necessitated a reexamination of the host range of species in the complex before recommendations can be made with confidence on the likelihood that specific crops will be damaged. Toward this end, populations of *X. americanum* and *X. rivesi* collected from apple orchards in eastern and western New York state were evaluated after 3 months in pots planted with cucumber, apple, or dandelion seedlings. Eastern and western New York populations of both nematode species declined on cucumber but increased to similar final densities on apple and dandelion.

Key words: apple, cucumber, *Cucumis sativus*, dandelion, *Malus domestica*, *Taraxacum officinale*, *Xiphinema americanum*, *X. rivesi*.

Xiphinema americanum and related species are economically important parasites of plants and vectors of plant viruses (6–9,11). A taxonomic revision of this species complex (6) has necessitated a reexamination of their host ranges as part of a reassessment of their potential to damage crops. Because these species are morphologically very similar, studies of such biological attributes as host range might also reveal a means of identifying the species. Alternatively, if such studies consistently fail to uncover biological differences, they could provide a basis for resynonymization. The present study was undertaken to compare the effects of three plant species on the density of populations of two species in the complex, *X. americanum* and *X. rivesi*.

Materials and Methods

Four populations of *X. americanum* and *X. rivesi* were collected in soil from apple orchards in eastern (populations F and G) and western (populations E and C) New York. Populations F and C were identified as *X. americanum*, population E was identified as *X. rivesi*, and population G was identified as a mixed population of 30% *X. americanum* and 70% *X. rivesi*.

Seedlings of apple (*Malus domestica* Borkh. cv. Northern Spy), dandelion (*Taraxacum officinale* Weber), or cucumber (*Cucumis sativus* L. cv. Marketer) were transplanted into infested soil. Dandelion and cucumber seed were obtained from Park Seed, Greenwood, South Carolina, and Stokes Seed, Buffalo, New York; apple seed were obtained from the Cornell University Pomology Department. Stratified apple seed were planted 2 weeks, cucumber 1 week, and dandelion 2–4 weeks before transplanting in each experiment. Each treatment was replicated eight times in each of two coldframe experiments (experiments 1, 2) and five times in each of two greenhouse experiments (experiments 3, 4). A fallow treatment was included in experiments 1–3. In experiments 1 and 2, plants were grown in 2.5 liters of infested soil in black plastic pots; in experiments 3 and 4, the plants were grown in 1.5 liters of infested soil in clay pots. The greenhouse was maintained at 24 ± 2 C, and supplemental fluorescent lighting (12-hour photoperiod) was provided in experiments 3 and 4. Plants in all experiments were fertilized weekly with a complete (20-20-20, N-P-K) soluble fertilizer.

Pots were randomized within blocks of each nematode population. This experimental design was deliberately confounded to reduce the risk of contamination, since differences in initial nematode densities and in soil types would have invalidated statistical comparison of the four populations.

After 2.5–3 months, plants were removed, the soil from each pot was mixed, and a 100-cm^3 soil sample was taken.

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TABLE 1. Densities of *Xiphinema* spp. from four New York apple orchards initially and after 3 months in pot tests of host suitability of three plant species.

	No. of reps.	*Xiphinema* spp./100 cm³ soil			
		F	G	E	C
		Experiment 1			
Pi	3	129.5			
Pf					
Apple	8	117.0 a			
Dandelion	8	99.4 a			
Cucumber	8	21.5 b			
Fallow	8	0.4 b			
		Experiment 2			
Pi	3	27.7	35.3	25.0	
Pf					
Apple	8	14.9 b	6.9 c	0.1 d	
Dandelion	8	22.4 a	9.4 c	0.4 d	
Cucumber	8	2.2 d	1.5 d	0.0 d	
Fallow	8	0.2	0	0	
		Experiment 3			
Pi	2	11.0	10.5	22.0	
Pf					
Apple	5	34.8 a*	35.2 a**	13.8 b	
Dandelion	5	39.2 a*	41.6 a**	5.4 b	
Cucumber	5	7.0 b	5.8 b	9.4 b	
Fallow	5	0	0	0	
		Experiment 4			
Pi	4	14.5	36.8	27.2	18.0
Pf					
Apple	5	11.8 cd	77.8 a**	11.8 cd	12.0 cd
Dandelion	5	24.8 c*	46.6 b	11.0 cd	23.2 c
Cucumber	5	1.6 d	4.0 d	1.4 d	2.4 d

Experiments 1 and 2 were conducted in a cold frame; experiments 3 and 4, in a 24 ± 2 C greenhouse under fluorescent lamps.

Analysis of experiment 2 was performed after square-root transformation.

Within an experiment, means followed by the same letter were not significantly different at the 5% level in Newman-Keuls sequential range tests.

*, **: Pf significantly greater than Pi at $\alpha = 0.05$ and $\alpha = 0.005$, respectively, in two-sample t-tests.

Nematodes were extracted from the samples by sugar flotation centrifugation (10), and *Xiphinema* spp. were counted. Final population densities (Pf) were subjected to the Burr-Foster Q-test for homogeneity of variance (2) and to analysis of variance. In the event of a significant Q-test statistic, an appropriate transformation was applied, e.g., a square-root transformation if data means were proportional to their variances (2), and the data were retested to ascertain that the variances had been stabilized by the transformation. Newman-Keuls sequential range tests and contrasts were used to compare means within blocks (populations).

RESULTS AND DISCUSSION

In experiments 1 and 2 in the coldframe, densities of three populations of *Xiphinema* spp. declined on all three plant species (Table 1). This decline may reflect normal summer decline of *Xiphinema* spp. (4,11) or greater difficulties in controlling soil water and temperature outdoors. *X. americanum* sensu lato is known to be sensitive to temperature and moisture fluctuations (1,8).

All populations declined on cucumber in

TABLE 2. Effect of three plant species on population density of *Xiphinema* spp. in soils from New York apple orchards in pot experiments lasting 3 months each.

Experiment	Population	Test statistic
		Plant species
1		$F(3,28) = 35.05$ ($P < 0.005$)
2		$F(2,63) = 40.17$ ($P < 0.005$)
3		$F(2,36) = 33.28$ ($P < 0.005$)
4		$F(2,48) = 68.64$ ($P < 0.005$)
		Block (population) × plant species interaction
2		$F(4,63) = 10.16$ ($P < 0.005$)
3		$F(4,36) = 9.42$ ($P < 0.005$)
4		$F(6,48) = 22.11$ ($P < 0.005$)
		Cucumber vs. fallow
1	F	$t(28) = 1.540$, ns
		Apple vs. dandelion
1	F	$t(28) = 1.285$, ns
2	F	$t(63) = -2.286$ ($P < 0.05$)
	G	$t(63) = -1.015$, ns
	E	$t(63) = -0.452$, ns
3	F	$t(36) = -0.857$, ns
	G	$t(36) = -1.246$, ns
	E	$t(36) = 1.636$, ns
4	F	$t(48) = -2.630$ ($P < 0.025$)
	G	$t(48) = 6.311$ ($P < 0.001$)
	E	$t(48) = 0.162$, ns
	C	$t(48) = -2.266$ ($P < 0.05$)
		Apple and dandelion vs. cucumber
1	F	$t(28) = 7.321$ ($P < 0.001$)
2	F	$t(63) = 9.452$ ($P < 0.001$)
	G	$t(63) = 4.989$ ($P < 0.001$)
	E	$t(63) = 0.632$, ns
3	F	$t(36) = 6.747$ ($P < 0.001$)
	G	$t(36) = 7.332$ ($P < 0.001$)
	E	$t(36) = 0.045$, ns
4	F	$t(48) = 3.378$ ($P < 0.005$)
	G	$t(48) = 13.938$ ($P < 0.001$)
	E	$t(48) = 2.336$ ($P < 0.05$)
	C	$t(48) = 3.550$ ($P < 0.005$)

Analysis of experiment 2 was performed after square-root transformation.

all four experiments. In experiment 1, the final density of *X. americanum* (population F) on cucumber was not significantly different from fallow (Tables 1, 2). Similar comparisons were not made in experiments 2–4 because the fallow data was excluded from the analyses of experiments 2 and 3 and the fallow treatment was eliminated in experiment 4 (see below). This confirms earlier reports (7,9) that cucumber is a poor host for *X. americanum* and indicates that it is also a poor host for *X. rivesi*. The *X. rivesi* of population E decreased on all three plant species in all experiments (Table 1). Drainage and plant growth were poor in this soil, which may account for the poor survival. *X. americanum* (population F) and the mixed population (G) increased significantly on apple and dandelion in the greenhouse (Table 1; experiments 3, 4). In experiment 4, final densities of *X. americanum* (F, C) were higher on dandelion than on apple, whereas the final density of the mixed population (G) was higher on apple than on dandelion, according to tests of contrasts between means (Table 2). The proportion of *X. rivesi* in the population increased to 94% on apple versus 88% on dandelion, based on a sample of preserved first-stage juveniles and adult females. These percentages are not significantly different, however. The more conservative multiple-range test failed to detect differences between apple and dandelion except for the mixed population (G) in this experiment and *X. americanum* (F) in experiment 2 (Table 1). The apparent species difference in host suitability was not observed in experiment 3.

The fallow treatment reduced populations of *Xiphinema* spp. to zero or nearly zero in experiments 1–3 (Table 1). Results of this treatment were excluded from the analyses of experiments 2 and 3 to satisfy the requirement of homogeneity of variance. Water relations in these pots were so unlike water relations in pots in which plants were growing that their appropriateness as controls was questionable. For these reasons, the fallow treatment was omitted altogether in experiment 4.

Since other longidorid species require 4 months or more to complete a life cycle (3,5), the present 3-month experiments were rather short. They were long enough, however, to show a significant negative effect of cucumber on the *Xiphinema* spp. populations when compared with the effect of apple or dandelion, which occasionally supported significant population increases in spite of the short experimental period. The poor performance of the populations

on cucumber and in fallow soil suggests that these increases cannot be attributed solely to the hatching of eggs already present in the infested soils. The results suggest that apple and dandelion were hosts, i.e., supported development and reproduction, and cucumber was a nonhost for these New York populations of *X. americanum* and *X. rivesi.* No consistent differences were found between the two species in their response to the three plant species studied. The morphological continuity between the two species can make them difficult to distinguish; the failure thus far to find major biological differences between them provides no practical reason for doing so.

Literature Cited

1. Addoh, P. G. 1965. Biological study of *Xiphinema americanum.* Dissertation Abstracts 26(4):1853.

2. Anderson, V. L., and R. A. McLean. 1974. Design of experiments. New York: Marcel Dekker.

3. Cohn, E., and M. Mordechai. 1969. Investigations on the life cycles and host preference of some species of *Xiphinema* and *Longidorus* under controlled conditions. Nematologica 15:295–302.

4. Griffin, G. D., and H. M. Darling. 1964. An ecological study of *Xiphinema americanum* Cobb in an ornamental spruce nursery. Nematologica 10:471–479.

5. Griffiths, B. S., and D. L. Trudgill. 1983. A comparison of the generation times of and gall formation by *Xiphinema diversicaudatum* and *Longidorus elongatus* on a good and a poor host. Nematologica 29:78–87.

6. Lamberti, F., and T. Bleve-Zacheo. 1979. Studies on *Xiphinema americanum sensu lato* with descriptions of fifteen new species (Nematoda, Longidoridae). Nematologia Mediterranea 7:51–106.

7. Lownsbery, B. F. 1964. Effects of cropping on population levels of *Xiphinema americanum* and *Criconemoides xenoplax.* Plant Disease Reporter 48:218–221.

8. Lownsbery, B. F., and A. R. Maggenti. 1963. Some effects of soil temperature and soil moisture on population levels of *Xiphinema americanum.* Phytopathology 53:667–668.

9. Miller, P. M. 1980. Reproduction and survival of *Xiphinema americanum* on selected woody plants, crops, and weeds. Plant Disease 64:174–175.

10. Miller, P. M. 1957. A method for the quick separation of nematodes from soil samples. Plant Disease Reporter 41:194.

11. Wallace, M. K., and D. H. MacDonald. 1979. Plant-parasitic nematodes in Minnesota apple orchards. Plant Disease Reporter 63:1063–1067.