Reaction of Five Forage Legumes to *Meloidogyne hapla*

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ABSTRACT

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Alfalfa, birdsfoot trefoil, crown vetch, red clover, and sainfoin are susceptible to the northern root-knot nematode, *Meloidogyne hapla*. Sainfoin is the most susceptible and crown vetch the least susceptible. In one test all sainfoin plants were killed within 108 days after inoculation with *M. hapla*, but no mortality was observed in the other legumes. Forage yields from alfalfa, red clover, and sainfoin were reduced significantly by *M. hapla* infestation. Red clover and alfalfa generally supported larger numbers of *M. hapla* than birdsfoot trefoil and may be responsible for increasing nematode numbers in crop rotations in eastern Canada.

The northern root-knot nematode, *Meloidogyne hapla* Chitwood, is one of the most prevalent species of nematodes associated with forage crops in eastern Canada (4,6). Townshend and Potter (2) determined that under greenhouse conditions, red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.) were good hosts and alfalfa (*Medicago sativa* L.) and birdsfoot trefoil (*Lotus corniculatus* L.) were only fair hosts for the northern root-knot nematode; yield losses, however, were not determined. In microplots under field conditions, these authors (3) showed that alfalfa, red clover, white clover, and birdsfoot trefoil yield and plant persistence were affected adversely by the northern root-knot nematode. Griffin (1) and Willis (5) showed that sainfoin (*Onobrychis viciaefolia* Scop.) was susceptible to *M. hapla*.

The present studies were undertaken to determine the relative susceptibility to *M. hapla* of a number of cultivars in five species of forage legumes. Yield effects and plant survival were also determined.

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MATERIALS AND METHODS

The *M. hapla* used in these studies originated from a red clover field in Prince Edward Island. The nematode was reared on red clover in a greenhouse, and inoculum was obtained by extracting nematodes from infested roots in a mistifier for 1 wk.

The cultivars included in the studies were: Alfa, Iroquois, Saranac, and Vernal alfalfa; Leo, Maitland, and Viking birdsfoot trefoil; Penngift crown vetch (*Coronilla varia* L.); Hungaropoli, Lakeland, Ottawa, and Reichersberger red clover; and Eski sainfoin. Twenty-five germinated seeds of each cultivar were

Table 1. Root-knot ratings and nematodes recovered from forage legumes 81 days after inoculation with *Meloidogyne hapla* (Test 1)

Legume Cultivar	Root-knot rating[y,z]	No. of *M. hapla* larvae[z] per gram of root	No. of *M. hapla* larvae[z] per plant
Alfalfa			
Alfa	2.58 ef	11,260 bc	1,010 cdef
Iroquois	2.09 g	6,000 c	520 ef
Saranac	2.40 f	9,370 bc	1,040 cde
Vernal	2.44 f	22,700 ab	2,560 b
Birdsfoot trefoil			
Leo	2.74 cde	3,070 d	260 g
Maitland	2.80 bcde	6,950 c	400 fg
Viking	2.89 abcd	8,120 c	580 def
Crown vetch			
Penngift	2.09 g	400 e	30 h
Red clover			
Hungaropoli	3.08 ab	34,400 ab	2,980 b
Lakeland	2.61 def	14,340 bc	1,360 bcd
Ottawa	2.42 f	9,300 c	900 cdef
Reichersberger	2.96 abc	20,270 bc	1,860 bc
Sainfoin			
Eski	3.12 a	48,900 a	7,680 a

[y] 1 = 0, 2 = 1–10, 3 = 11–100, 4 = > 100 galls per root system.
[z] Means in the same column followed by the same letter are not significantly different as determined by Duncan's multiple range test ($P = 0.05$).

Table 2. Root-knot ratings, nematode recovery, and plant mortality of forage legumes 108 days after inoculation with *Meloidogyne hapla* (Test 2)

Legume Cultivar	Root-knot rating[x,y]	*M. hapla* larvae		Plant mortality (%)
		No./g of root[y]	No. × 10^3/pot[y]	
Alfalfa				
Alfa	4.12 a	124,600 a	2,300 a	0
Iroquois	3.34 b	95,100 b	1,755 a	0
Birdsfoot trefoil				
Leo	1.85 c	44,200 c	595 b	0
Crown vetch				
Penngift	2.16 c	20,900 d	200 c	0
Red clover				
Hungaropoli	4.44 a	132,300 a	3,220 a	0
Ottawa	4.03 a	152,100 a	1,915 a	0
Sainfoin				
Eski[z]	...	...	...	100

[x] 0 = 0, 1 = 1–10, 2 = 11–25, 3 = 26–50, 4 = 51–100, 5 = > 100 galls per root system.
[y] Means in the same column followed by the same letter are not significantly different according to Duncan's multiple range test ($P = 0.05$).
[z] All plants had died and roots deteriorated.

Table 3. Effect of *Meloidogyne hapla* inoculation on foliage yields of forage legumes (Test 2)

Legume Cultivar	Relative yield[x] at cutting		
	1 (58)[y]	2 (87)	3 (118)
Alfalfa			
Alfa	98	100	80[z]
Iroquois	105	92	82[z]
Birdsfoot trefoil			
Leo	93	84[z]	80[z]
Crown vetch			
Penngift	99	94	77[z]
Red clover			
Hungaropoli	100	97	61[z]
Ottawa	99	83[z]	67[z]
Sainfoin			
Eski	96	50[z]	33[z]

[x] At each cutting, the yield of each cultivar (each inoculated with *M. hapla*) is proportional to the yield of its check cultivar (not inoculated). The yield of each check cultivar at each cutting equals 100.
[y] Days after seeding.
[z] Significantly different from the appropriate check at $P = 0.05$.

planted in 5-L pots containing 4.5 kg of fumigated Charlottetown fine sandy loam. All pots were maintained in a greenhouse at 18–24 C with a 16-hr photoperiod. Pots were watered to 100% field capacity of the soil and again when the moisture level in the soil reached 70% of field capacity.

Each cultivar was represented once in each of four randomized blocks in Test 1 and twice in each block in Test 2. Ten days after the germinated seeds were planted, 10,000 second-stage *M. hapla* larvae in water suspension were added to each pot in Test 1 and to half of the pots of each cultivar in each block in Test 2. This number of nematodes approximates the mean number found in fields infested with root-knot nematodes in eastern Canada (4).

The foliage on all plants was cut twice in Test 1 and three times in Test 2. Foliage yield data were determined for Test 2, only. At the end of the tests—81 days after inoculation for Test 1 and 108 days for Test 2—plants were carefully removed from the soil. After being washed, the root systems were rated for extent of root-knot galling. Nematodes were extracted from roots only in a mistifier for 1 wk in Test 1 and from roots in a mistifier and soil in modified Baermann pans in Test 2.

Nematode counts were calculated as the number per gram of dry rootlet, per root system, per kilogram of dry soil, or per pot. The data were analyzed and Duncan's multiple range test or LSD was used to determine differences.

RESULTS

All forage legumes and cultivars tested were susceptible to *M. hapla* (Tables 1 and 2). Root-knot ratings differed significantly among cultivars of alfalfa and red clover but not among cultivars of birdsfoot trefoil. There were also differences in size of galls among legumes. The galls were smallest on birdsfoot trefoil and largest on sainfoin.

The numbers of *M. hapla* larvae recovered from roots varied from few for crown vetch (Tables 1 and 2) to very many for sainfoin (Table 1). The numbers of larvae recovered from red clover cultivars were generally greater than from alfalfa and particularly from birdsfoot trefoil. All sainfoin plants in Test 2 inoculated with *M. hapla* were dead before the experiment ended 118 days after seeding (Table 2).

In Test 2, foliage yield was not affected by *M. hapla* infestation at the time of the first cutting, but was reduced significantly for Ottawa red clover, Leo birdsfoot trefoil, and Eski sainfoin at the second cutting (Table 3). Yields of all cultivars were reduced significantly by *M. hapla* at the third cutting.

DISCUSSION

The results of this study confirm those of Townshend and Potter (2) who reported that red clover was a better host for *M. hapla* than was birdsfoot trefoil or alfalfa. In my study there was little, if any, difference between red clover and alfalfa. This difference in results may reflect the different cultivars used or the different conditions under which the experiments were conducted.

Unlike Griffin's report (1) that sainfoin and alfalfa are similar in susceptibility to the northern root-knot nematode, my results show that sainfoin was more susceptible to *M. halpa* than was alfalfa. As in the present study, however, Griffin (1) reported that the galls on sainfoin roots are larger than those on alfalfa.

The detrimental effect of *M. hapla* on yield of forage legumes was similar to that reported for red clover and alfalfa in microplots in the field (3) and for alfalfa and sainfoin in a greenhouse study (1).

The mortality of sainfoin in comparison to alfalfa was greater here than reported by Griffin (1) and was due probably to differences in cultivars and environmental conditions in the two studies.

Three of the five legumes in this study, namely alfalfa, birdsfoot trefoil, and red clover, are recommended and grown throughout eastern Canada. Results of this study indicate that alfalfa and red clover are better hosts for *M. hapla* than is birdsfoot trefoil and may be responsible for increasing root-knot infestation levels in crop rotations. The use of sainfoin in areas infested by root-knot nematodes would likely result in crop failure and an undesirable buildup in nematode levels. In areas of *M. hapla* infestation, the use of crown vetch should decrease the likelihood of crop failure and result in less nematode buildup.

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