NEMATODES ASSOCIATED WITH FORAGE LEGUME CROPS IN NOVA SCOTIA[1]

C.B. Willis,[2] A.L. Henderson. D.J. Hough, and J.D. Seoord [3]

Abstract

Nematodes belonging to the genera Pratylenchus, Meloidogyne, Heterodera, Parafylenchus, Tylenchorhynchus, Helicot lenchus, and Criconemoides were isolated from field soil and from rootlet: of birdsfoot trefoil, red clover and alfalfa in Nova Scotia in 1970. Pratylenchus had the widest distribution, followed by Paratylenchus, Helicotylenchus, and Meloidogyne. Xiphenema was isolated only from soil seeded to alfalfa. A positive correlation was observed between forage legume rootlet color and Pratylenchus population density.

Introduction

Red clover (Trifolium pratense L.), alfalfa (Medicago sativa L.) and birdsfoot trefoil (Lotus corniculatus L.) are the principal forage legume crops grown in Nova Scotia; where they are seeded in mixtures with grasses. A survey of forage growing areas in the province was carried out to determine the occurrence and population density of plant-parasitic nematodes. This paper summarizes the results of a preliminary survey of nematodes in red clover, alfalfa, and birdsfoot trefoil fields in Nova Scotia.

Materials and methods

Soil and root samples were collected in September, October, and November 1970 from 36 fields on 20 farms located in Annapolis, Colchester, Cumberland, Hants, Kings, Lunenburg, and Pictou counties. Farms and fields were chosen without prior knowledge of nematode problems, The soils ranged from a gravelly loam to a clay loam with drainage rated from excellent to poor.

From each field, 20 soil cores (2.54 x 15.0 cm) and a minimum of 10 root systems were taken. Only the predominant forage legume was sampled in each field. Soil samples were passed through a 2 mm screen to remove rocks and larger roots. Nematodes from two 50 g subsamples from each soil sample were extracted by the modified cottonwool filter method (9). Root samples were washed and the rootlet portion was rated visually for discoloration. Rootlet color was rated as light or medium-dark (light for little or no discoloration, medium-dark for extensive brown to black discoloration). The rootlets were then trimmed from the tap roots and larger secondary roots and were cut into short pieces; a maximum of 10 g of rootlets from each root sample were extracted for 7 days by the funnel-spray method (6). Nematodes were identified visually-to genus under a dissecting microscope and counts were recorded as the number of nematodes per 0.45 kg of soil (oven dry weight) and per g dry weight of rootlet. The data were compiled according to forage legume crop and to the year in which the crop was seeded.

Results

Frequency of occurrence

Root-lesion (Pratylenchus), root-knot (Meloidogyne), pin (Paratylenchus), cyst (Heterodera), spiral (Helicotylenchus), stunt (Tylenchorhynchus), ring (Criconemoides), and dagger (Xiphinema) nematodes were isolated (Tables 1 and 2). Root-lesion nematodes were isolated from 89% of the root samples and from 92% of the soil samples. Root-knot larvae were obtained from 36% and 33% of the root and soil samples, respectively. There were no great differences in the incidence of either nematode among the three forage legumes or among the three seeding years. Pin nematodes were the second and spiral nematodes the third most frequently recovered nematodes. Cyst nematode larvae, stunt nematodes, and ring nematodes were recovered less frequently. The dagger nematode was recovered from only 6% of the soil samples and all of these were seeded to alfafla.

Population density

The population density of root-lesion nematodes was high in infested rootlet samples (Table 1) but was highest in soil samples (Table 1 and 2). However, the root-knot nematode was more abundant in infested rootlets, with an overall mean of 4,266 nematodes/g of rootlets, than in soil

[1] Contribution No. 239, Research Station, Canada Department of Agriculture, Charlottetown, Prince Edward Island.

[2] Plant Pathologist, Research Station, Canada Department of Agriculture, Charlottetown, Prince Edward Island.

[3] Field Crop Specialists, Nova Scotia Department of Aqriculture and Marketing.

Table 1. Population density of root-lesion and root-knot nematodes in infested samples of rootlets and soil from 36 fields of forage legumes

Forage legume and year seeded	Root-lesion nematode						Root-knot nematode					
	Roots			Soil			Roots			Soil		
	No. of samples	Range*	Mean*	No. of samples	Range†	Mean†	No. of samples	Range*	Mean*	No. of samples	Range†	Mean†
Birdsfoot trefoil	9	9-20,663	4,346	9	534-6,003	2,021	4	9- 1,333	346	4	68-1,556	530
Red clover	7	44-11,771	3,473	7	178-8,271	2,141	3	73-11,142	4,168	3	435- 631	503
Alfalfa	16	18-21,049	1,887	17	140-9,706	2,912	6	424-33.425	6,929	5	68-4,742	1,553
All legumes												
1968 or earlier	12	18-14,780	2,866	12	140-9,706	4,416	5	73- 4,728	1,593	5	442-4,742	1,765
1969	9	9- 2,575	891	10	328-8,271	1,716	5	9-33,425	9,179	4	68- 631	328
1970	11	44-21.049	4,654	11	178-3,876	1,139	3	12- 1,163	553	3	68- 869	418
All legumes from all seeding years	32	9-21,049	2,925	33	140-9,706	2,505	13	9-33,425	4,266	12	68-4,742	949

* Range and mean number of nematodes/g rootlets.

† Range and mean number of nematodes/0.45 kg soil.

Table 2. Population density of five nematode types in infested samples of soil from 36 fields of forage legumes

Forage legume and year seeded	Pin nematode			Cyst nematode			Stunt nematode			Spiral nematode			Ring nematode		
	No. of samples	Range*	Mean*	No. of samples	Range*	Mean*	No. of samples	Range*	Mean*	No. of samples	Range*	Mean*	No. of samples	Range*	Mean*
Birdsfoot trefoil	7	213-5524	2495	2	113-1281	697	1		219	7	34-1095	361	4	35-119	111
Red clover	5	104-1415	409	3	104-2321	1153	1		103	5	104-1197	425	1		218
Alfalfa	15	69-5569	925	4	69-1195	569	6	310-619	461	7	33-1100	475	3	107-548	356
All legumes															
1968 or earlier	9	69-5114	1398	3	69-2321	995	3	310-550	433	6	104-1100	424	4	112-548	318
1969	9	105-5569	1763	2	113-1281	697	3	219-619	463	8	33-1197	504	3	35-218	117
1970	9	69-2006	549	4	104-1195	687	2	103-301	202	5	34- 536	212	1		107
All legumes from all seeding years	27	69-5569	1237	9	69-2321	792	8	103-619	386	19	33-1197	402	8	35-548	216

* Range and mean number of nematodes/0.45 kg soil.

samples, which contained a mean of 949/0.45 kg soil. Mean numbers of root-lesion nematodes recovered from rootlet samples were lowest from alfalfa and highest from birdsfoot trefoil. Mean numbers of root-lesion nematodes recovered from soil samples were lowest from fields seeded in 1970 and highest from fields seeded in 1968 or earlier. Recovery of root-knot nematodes was greatest from alfalfa rootlets. The pin nematode had the second highest population mean from infested soil samples: cyst, stunt, spiral, and ring nematodes had lower means (Table 2).

The color of forage legume rootlets ranged from little or no discoloration to very dark brown or black; rootlets in the latter category were rotting and were difficult to recover in the field. The mean number of root-lesion nematodes recovered/g rootlets from samples that were classified medium-dark was much higher than from samples classified light (Table 3). More than 5X the number of root-lesion nematodes were recovered from soils from which medium-dark rootlets were recovered.

Discussion

It is recognized that several factors contribute to the often observed depletion of the legume component in legume-grass mixtures. The root rot complex is one such factor that has been identified in the Maritime Provinces (7), and root-lesion nematodes have also been associated with forage legumes (11).

The frequency of occurrence of root-lesion nematodes in this study was similar to that reported from strawberry fields in Nova Scotia (10), but was much greater than that reported from red clover and alfalfa fields in North Carolina (2). A high population density coupled with the high frequency of occurrence and the previous demonstration (8) of forage yield reductions indicate that

Table 3. Relationship of forage legume rootlet color and number of root-lesion nematodes (Pratylenchus) isolated from rootlet and soil samples

Rootlet color	No. of samples	Mean number of nematodes per sample: Rootlets (no./g)	Mean number of nematodes per sample: Soil (no./0.45 kg)
Light	22	1524 (± 946)*	883 (±136)
Medium-dark	14	4291 (±1770)	4520 (±869)

* Figures in brackets are standard errors of the means.

root-lesion nematodes are economically important in forage production in Nova Scotia.

No root-knot nematodes were recovered from Nova Scotia strawberry fields (10) but they were recovered from 33% and 25% of the root and soil samples, respectively, of the fields sampled in this study. The hoot-hot nematode has also been shown to have detrimental effects on forage legumes (5), and, since it had the greatest population density in infested root samples in this study, this nematode could also be considered economically important.

Pin nematodes occurred more frequently and stunt and dagger nematodes less frequently in the present study than in the strawberry and forage surveys referred to above (2, 10). No cyst nematodes were recovered from the Nova Scotia strawberry fields (10), but were isolated from fields of each forage legume in this survey. Of these nematodes, the cyst nematode has reduced forage yields of red clover in the field (4); the stunt nematode had no effect on yield of alfalfa or red clover in greenhouse studies (1); and the dagger nematode, which was recovered from only 2 alfalfa fields in this study, has been reported to reduce alfalfa yields (3).

The positive correlation ($r = 0.6609^{**}$) observed in this study between the color of forage legume rootlets and the recovery of root-lesion nematodes from soils suggests that these nematodes are involved in the frequently observed root rot complex (7). A similar relationship between rootlet color and the prevalence of other nematode species was not observed.

The frequency of occurrence and population densities of endo- and ecto-parasitic nematodes associated with forage legume crops in Nova Scotia indicated a definite need for further research on host-parasite relationships, as well as on the economic importance of nematode infestations, and on the relationships of nematodes to the root rot disease complex.

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