Frequency of Plant-Parasitic Nematodes Associated with Blue Grama and Western Wheatgrass in the Western Dakotas

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ABSTRACT

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Samples of western wheatgrass and blue grama were collected in 24 counties in western North Dakota and 28 counties in western South Dakota. Plant-parasitic nematodes occurred in 59% of the 3,101 soil samples analyzed. The most widely distributed plant-parasitic nematodes were *Helicotylenchus* spp., *Paratylenchus vexans, Xiphinema americanum*, and species of the Tylenchorhynchinae. *P. vexans* was the most common species in North Dakota and ranked second for South Dakota. *Helicotylenchus* was the most common genus in South Dakota and ranked second in North Dakota. *H. leiocephalus, H. glissus, H. exallus, H. pseudorobustus*, and *H. digonicus* were found in 46, 30, 13, 8, and 5 counties, respectively. *H. platyurus* was found in one county. There were no differences between the grass collections or between North Dakota and South Dakota for *X. americanum* and species of the Tylenchorhynchinae. *Tylenchorhynchus nudus, Quinisulcius acutoides, T. robustoides, T. maximus, Merlinius stegus*, and *T. canalis* were found in 26, 25, 10, 9, 7, and 4 counties, respectively. *T. pachys* was found in one county. *Criconemella xenoplax, Hoplolaimus galeatus, Pratylenchus* sp., and *Heterodera* sp. were found in less than 3% of the collections.

Western wheatgrass, *Agropyron smithii* Rydb. (Agsm), and blue grama, *Bouteloua gracilis* (Willd. ex H.B.K.) Lag. ex Griffiths (Bogr), are two of the predominant grasses in the short- and mixed-grass prairies of the northern Great Plains. A collection of these grasses was initiated in the western Dakotas to obtain germ plasm for breeding work. Soil samples associated with the collections were also obtained for extraction and identification of plant-parasitic nematodes.

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Occurrence of plant-parasitic nematodes in native prairies was studied previously in the north central region (7,10), and Thorne and Malek's study (14) documented nematodes associated with native grasses. There have been several previous reports of nematode distribution in North Dakota or South Dakota (3,5,8,9,11,13). The objective of this study was to determine which nematodes were most commonly associated with our germ plasm collection from the western Dakotas. A preliminary report has been made (1).

MATERIALS AND METHODS

Soil and root samples of western wheatgrass and blue grama were collected by Soil Conservation Service field personnel. Collections were made in 24 counties in western North Dakota and 28 counties in western South Dakota (Fig. 1). Sections 36 of alternate townships were chosen as collection sites because these were designated state school lands and a high proportion were in native range. Thus, collections were made in a grid pattern 19.3 km apart on uncultivated sites. The samples, with intact root systems, were dug with a soil-sampling spade. The root ball was trimmed to 10 cm^2 and 15 cm deep and placed in a plastic bag for transporting to Mandan, ND. Five samples of each grass were collected at each of 1,035 sites from late August to early October 1977. All samples were placed in a glasshouse and maintained to ensure plant growth. In May 1978, soil samples were processed for nematodes.

Of the 10,350 collections made, 3,101 were processed for nematodes: 942 Bogr samples and 855 Agsm samples from North Dakota (ND) and 666 Bogr samples and 638 Agsm samples from South Dakota (SD) (Table 1). After individual plants were taken from the collection samples, the soil fraction was passed through a 6-mm wire-mesh screen. Two 50-ml beakers of screened soil were placed in a plastic Ziploc bag and labeled. Soil samples were refrigerated at 6 ± 1 C for 12–72 hr before processing. Nematodes were extracted from the 100-cm^3 soil samples with a modified Baermann funnel technique (12). A 10-ml sample was taken from the funnel after 24 hr, the nematodes were allowed to settle for 30 min in test tubes, and the volume was reduced to 3 ml. Nematodes were heat-killed by placing the test tubes in a water bath at 58–60 C for 1 min. Six milliliters of a formalin-aceto-alcohol (FAA) solution (12) was added to the test tubes at a ratio of 2 FAA:1 water. After the contents of the test tube were stirred, the contents were poured into vials, sealed, and stored until the nematodes were identified. Permanent mounts for species identification were prepared with dehydrated glycerin.

RESULTS AND DISCUSSION

Fifty-nine percent of the 3,101 collections contained plant-parasitic nematodes. Plant-parasitic nematodes

occurred in 61% of the 942 Bogr-ND collections, 62% of the 855 Agsm-ND collections, 55% of the 666 Bogr-SD collections, and 56% of the 638 Agsm-SD collections. The most widely distributed plant-parasitic nematodes in the western Dakotas were *Helicotylenchus* spp., *Paratylenchus vexans* Thorne & Malek, *Xiphinema americanum* Cobb, and members of the Tylenchorhynchinae (Table 1). In North Dakota, *P. vexans, Helicotylenchus* spp., and members of the Tylenchorhynchinae were found in all counties where collections were taken, and *X. americanum* was found in all but one county. In South Dakota, *Helicotylenchus* spp. were found in 27 of the 28 counties. *P. vexans, X. americanum,* and species of the Tylenchorhynchinae were isolated from 26 of the 28 counties in South Dakota.

Helicotylenchus spp. and *P. vexans* were extracted from 27 and 26%, respectively, of the collections (Table 1). *Helicotylenchus* spp. were isolated from 34 and 33% of the Bogr and Agsm collections, respectively, in South Dakota and only 23% of the Bogr and Agsm collections in North Dakota. *P. vexans* was isolated from 34 and 32% of the Bogr and Agsm collections, respectively, in North Dakota and only 15 and 16% of the Bogr and Agsm collections, respectively, in South Dakota. Thus, *Helicotylenchus* spp. were the most common plant-parasitic nematodes isolated from collections in South Dakota, followed by *P. vexans*, whereas *P. vexans* was most commonly isolated from collections in North Dakota, followed by *Helicotylenchus* spp.

P. vexans was the only species present in the 54 slides containing *Paratylenchus*. The slides were prepared from samples collected from 24 counties in South Dakota and 15 counties in North Dakota.

Eight species of *Helicotylenchus* were identified in the 105 slides of *Helicotylenchus* spp. Slides were prepared from samples collected in 23 of 24 counties sampled in North Dakota and from samples collected in 27 of 28 counties in South Dakota. In the 50 counties from which samples were taken, *H. leiocephalus* Sher, *H. glissus* Thorne & Malek, *H. exallus* Sher, *H. pseudorobustus* (Steiner) Golden, and *H. digonicus* Perry et al were found in 46, 30, 13, 8, and 5 counties, respectively. *H. platyurus* Perry et al, was found in one county. All species except *H. glissus* are listed by Norton as being found in native prairies (6).

X. americanum and members of the Tylenchorhynchinae were isolated from 14 and 13%, respectively, of the collections containing plant-parasitic nematodes (Table 1). There were no apparent differences between the Bogr and Agsm collections or between North Dakota and South Dakota for *X. americanum* or Tylenchorhynchinae. *X. americanum* was the only dagger nematode present. Slides were prepared from samples collected in 27 of 28 counties sampled in South Dakota and from samples collected from all 24 counties sampled in North Dakota. This study confirmed that *X. americanum* exists in this area, which is in contrast to the statement by Lamberti and Bleve-Zacheo (4) that *X. americanum* is found only in the eastern United States. The *X. americanum* specimen found in the western Dakotas matches the description given by Lamberti and Bleve-Zacheo as the type specimen.

Seven species of Tylenchorhynchinae were identified. Slides were prepared from samples collected in 23 of 28

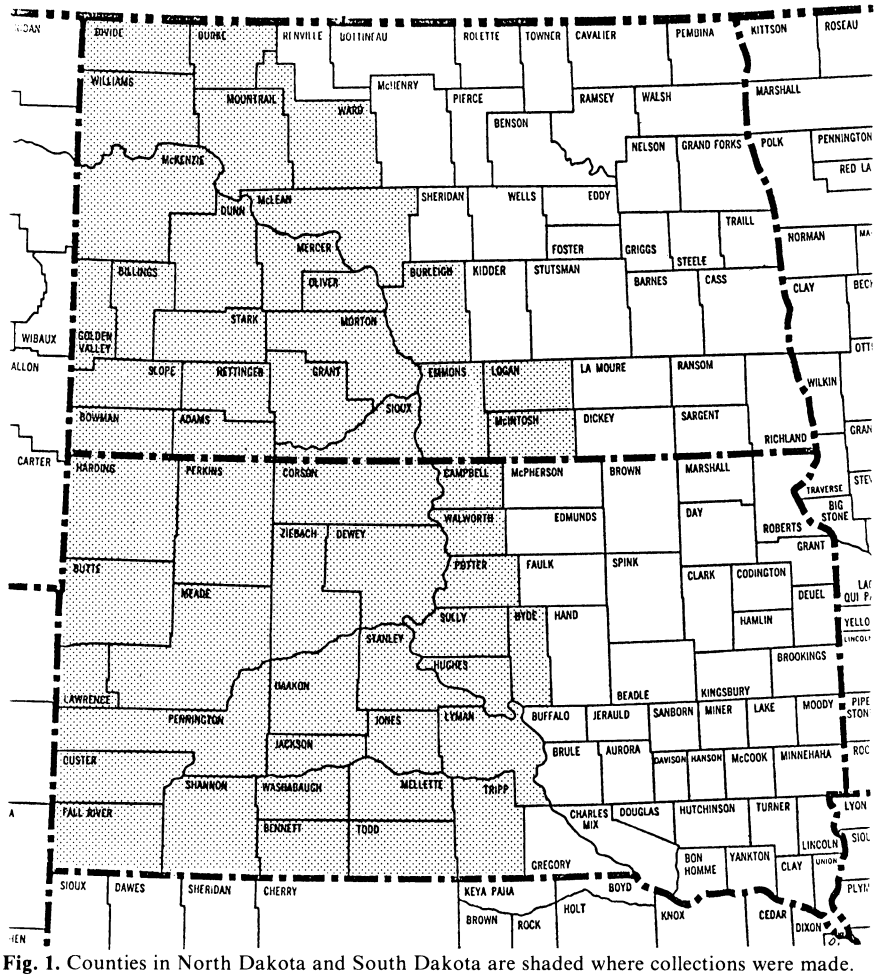

Fig. 1. Counties in North Dakota and South Dakota are shaded where collections were made.

Table 1. Frequency of samples containing plant-parasitic nematodes associated with blue grama (Bogr) and western wheatgrass (Agsm) in North Dakota and South Dakota

	North Dakota				South Dakota				Total (3,101)	
Nematodes isolated	Bogr (no.)	942[a] (%)	Agsm (no.)	855 (%)	Bogr (no.)	666 (%)	Agsm (no.)	638 (%)	No.	Percent
Helicotylenchus spp.	221	23	194	23	224	34	211	33	850	27
Paratylenchus vexans	320	34	273	32	99	15	103	16	795	26
Xiphinema americanum	125	13	132	15	67	10	99	16	423	14
Tylenchorhynchinae[b]	105	11	128	15	72	11	83	13	388	13
Hoplolaimus galeatus	14	1	11	1	2	0.3	3	0.5	30	1
Criconemella xenoplax	9	1	4	0.5	11	2	1	0.1	25	1
Pratylenchus sp.	2	0.2	7	1	1	0.1	2	0.3	12	0.4
Heterodera sp.	3	0.3	2	0.2	4	1	2	0.3	11	0.4

[a]Total number of samples processed for each of the four groups.
[b]Tylenchorhynchinae includes *Tylenchorhynchus*, *Merlinius*, and *Quinisulcius*.

counties sampled in South Dakota and from samples collected in 22 of 24 counties sampled in North Dakota. In the 45 counties from which samples were taken, *Tylenchorhynchus nudus* Allen, *Quinisulcius acutoides* (Thorne & Malek) Siddiqi, *T. robustoides* Thorne & Malek, *T. maximus* Allen, *Merlinius stegus* (Thorne & Malek) Siddiqi, and *T. canalis* Thorne & Malek, were found in 26, 25, 10, 9, 7, and 4 counties, respectively. *T. pachys* Thorne & Malek, was found in only one county. *T. nudus, T. maximus*, and *T. pachys* are listed by Norton as being found in native prairies (6).

Criconemella xenoplax (Raski) Luc & Raski, *Hoplolaimus galeatus* (Cobb) Filipjev, Schuurmans, & Stekhoven, *Pratylenchus* sp., and *Heterodera* sp. were recovered less frequently (Table 1). Of the 24 North Dakota counties, *C. xenoplax, H. galeatus, Pratylenchus* sp., and *Heterodera* sp. were only isolated from 7, 9, 7, and 4 counties, respectively. Of the 28 South Dakota counties, *C. xenoplax, H. galeatus, Pratylenchus* sp., and *Heterodera* sp. were isolated from 9, 5, 3, and 5 counties, respectively.

Overall, *Pratylenchus* sp., *C. xenoplax, H. galeatus*, and *Heterodera* sp. were found in less than 3% of the collections. *Pratylenchus* spp. were found in Divide, Burke, Mountrail, Ward, McKenzie, McLean, and Slope counties in North Dakota, and in Harding, Lawrence, and Mellette counties located in South Dakota. *Pratylenchus* sp. identification was impossible because only juvenile stages were found. The genus *Criconemella* was found in 16 counties: Divide, Ward, Dunn, Oliver, Burleigh, Morton, and Emmons in North Dakota; and Harding, Perkins, Carson, Meade, Dewey, Stanley, Jackson, Lyman, and Fall River in South Dakota. *C. xenoplax* was the only species present in the four slides of *Criconemella*. The genus *Hoplolaimus* was found in 14 counties: Ward, Golden Valley, Morton, Burleigh, Slope, Hettinger, Adams, Sioux, and Emmons in North Dakota; and Harding, Ziebach, Lawrence, Fall River, and Lyman in South Dakota. The one mature specimen, *H. galeatus*, was in Burleigh County, ND; it is the only species of *Hoplolaimus* ever identified from the northern Great Plains. The genus *Heterodera* was found in nine counties: Golden Valley, Dunn, Grant, and Emmons in North Dakota; and Harding, Meade, Lyman, Fall River, and Shannon in South Dakota. Because mounted nematodes were immature, no species identification was made for *Heterodera*. The low frequency of isolation of *Pratylenchus, C. xenoplax, Hoplolaimus*, and *Heterodera* make it difficult to establish definite distribution patterns.

Thorne believed that nematodes in the northern Great Plains were dispersed by buffalo (14). He speculated that a buffalo could easily have coated itself with 10–50 lb of soil, which eventually dried and dropped to the ground, and postulated that this was an excellent means of dispersal because the buffalo roamed from wallow to wallow (14). In light of recent work (2), we are finding more nematodes capable of anhydrobiosis. Survival of nematodes in anhydrobiosis in mud on buffalo fur may well have been a very common means of nematode dispersal. Our work has expanded the known distribution of plant-parasitic nematodes in the western Dakotas beyond Thorne and Malek's work (14), whereas many of the same nematodes were found by Willard while working on the Matador Project in Saskatchewan (15–17).

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