

Phytoparasitic Nematode Surveys of Arkansas Wheat Fields, 1986-88¹

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Abstract: In Arkansas wheat is commonly grown either in rotation or double cropped with soybean. Surveys from 1986 to 1988 identified 18 phytoparasitic nematode species in Arkansas wheat fields. The frequency of occurrence, as a percentage of the total number of samples (199), for the following nematodes was *Heterodera glycines* 43%, *Quinisulcius acutus* 40%, *Pratylenchus scribneri* 37%, *Helicotylenchus pseudorobustus* 15%, *Xiphinema americanum* 14%, *Paratylenchus tenuicaudatus* 13%, *Pratylenchus alleni* 10%, *Merlinius brevidens* 8%, *Tylenchorhynchus ewingi* 7%, *Paratrichodorus minor* 5%, *T. martini* 4%, and *Hoplolaimus magnistylus*, *Paratylenchus projectus*, and juveniles of *Meloidogyne* spp. 2%. *Helicotylenchus dihystra*, *Paratylenchus elachistus*, and *Tylenchorhynchus claytoni* were each found in one wheat field.

Key words: Arkansas, crop loss estimate, *Helicotylenchus pseudorobustus*, *Heterodera glycines*, *Hoplolaimus magnistylus*, *Meloidogyne* spp., *Merlinius brevidens*, infestation estimate, *Paratrichodorus minor*, *Paratylenchus projectus*, *P. tenuicaudatus*, *Pratylenchus alleni*, *P. scribneri*, *P. zaeae*, *Quinisulcius acutus*, survey, *Triticum aestivum*, *Tylenchorhynchus ewingi*, *T. martini*, wheat, *Xiphinema americanum*.

Estimations of crop losses due to phytoparasitic nematodes are difficult to obtain (2,3). Major difficulties in estimating losses for a large area, such as a state, include estimation of the infested hectareage, identification of the nematode species present, estimation of the infestation level of each nematode species, and estimation of the extent of damage caused by each nematode species.

Several authors report the association of certain nematodes with wheat (*Triticum aestivum* L.) but do not indicate yield losses due to a specific nematode (2-4,7,8,10,11). *Merlinius brevidens* (Allen) Siddiqi (5), *Paratrichodorus minor* (Colbran) Siddiqi (19), and *Pratylenchus thornei* Sher & Allen (13) are associated with yield losses to wheat in North America, whereas *Heterodera avenae* Wollenweber causes significant yield losses to wheat in Australia (6).

The Arkansas Agricultural Statistics Service (AASS) annually estimates the statewide wheat yield by randomly sampling 75 wheat fields. Because of the randomness of the sampling method, various soil types, soil fertility levels, moisture

levels, wheat cultivars, and management systems are included. In 1986 a joint survey project (10) was initiated between the AASS and the Arkansas Nematode Assay and Diagnostic Lab (ANL). The objectives of the project were to determine the phytoparasitic nematode species present, to estimate the level of infestation by each species, and to estimate the proportion of the wheat production area infested.

MATERIALS AND METHODS

An average of 66 nematode samples taken each year by AASS personnel in late April to early May consisted of soil samples from two prescribed locations in a field (1). The procedures used in nematode sampling, extraction, and species identification have been reported (9).

RESULTS

The number of hectares of wheat planted in Arkansas was 358,200 in 1986, 376,400 in 1987, and 453,300 in 1988 with 329,800, 339,900, and 433,000 hectares harvested in the respective years (Table 1). Planted hectareage with phytoparasitic nematodes were 89.3% in 1986, 77.5% in 1987, and 90.3% in 1988 (16). Numbers of hectares infested by *H. glycines*, *Pratylenchus* spp., *Tylenchorhynchus* spp., *Merlinius brevidens*-*Quinisulcius acutus* (Allen) Siddiqi, *Hoplolaimus* spp., and *Meloidogyne* spp. were highest in 1988. *Paratrichodorus minor*

Received for publication 23 January 1989.

¹ Published with approval of the director of the Arkansas Agricultural Experiment Station.

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and *Xiphinema americanum* Cobb numbers were highest in 1986. *Helicotylenchus* spp. and *Paratylenchus* spp. were highest in 1987 (Table 1).

For this survey nematode infestation densities in each field were divided into five ranges; 0 (none), 1–24 (trace), 25–99 (low), 100–499 (moderate), and 500 or more/500 cm³ soil (high) (Table 2). The percentage of fields with each infestation level is given for *H. glycines*, *Pratylenchus* spp., *Tylenchorhynchus* spp.–*M. brevidens*–*Q. acutus*, *Helicotylenchus* spp., *Hoplolaimus* spp., *X. americanum*, and *Paratylenchus* spp. (Table 2). In approximately half of the samples, the nematode infestations were within the trace range. *Heterodera glycines*, *Tylenchorhynchus* spp.–*M. brevidens*–*Q. acutus*, and *Pratylenchus* spp. were found in ca. 40–50% of the samples; however, high numbers were found in less than 8% of these samples. *Paratylenchus* spp. were found in ca. 25% of the fields with ca. 3% having high numbers; *Helicotylenchus* spp. in ca. 15%, only rarely in high numbers; *Hoplolaimus* spp. and *Paratrichodorus minor* in 6% and 5%, respectively, only as trace numbers; and *Meloidogyne* spp. in ca. 2%, only in trace numbers.

During the sampling period the most frequently encountered nematodes on wheat were *Q. acutus* and *Pratylenchus scribneri* Steiner in Sherbakoff & Stanley (ca. 25 fields per year) (Table 3). More than 25 wheat fields each year were infested with *H. glycines*. *Helicotylenchus pseudorobustus* (Steiner) Golden was found in ca. 10 wheat fields per year; *Pratylenchus alleni* V. Ferris, *X. americanum*, *Paratylenchus tenuicaudatus* Wu, and *M. brevidens* in five or more wheat fields per year; *P. minor*, *Tylenchorhynchus ewingi* Hopper, *T. martini* Fielding, *Paratylenchus projectus* Jenkins, *Pratylenchus zaeae* Graham, and *Hoplolaimus magnistylus* Robbins were found, on the average, in one wheat field per year. Juveniles of unidentified species of *Paratylenchus* were in approximately seven fields per year, and of *Meloidogyne* spp. in approximately one field per year. *Helicotylenchus dihystra* (Cobb) Sher, *Paratylenchus elachistus* Steiner, and

TABLE 1. Estimated annual hectares (× 1,000) of wheat planted, harvested, and infested by any of several phytoparasitic nematodes in Arkansas, 1986–88.

	1986	1987	1988
Planted	358.2	376.4	453.3
Harvested	329.8	339.9	433.0
With nematodes	319.8	291.6	409.2
<i>Heterodera glycines</i>	179.1	194.9	218.6
<i>Pratylenchus</i> spp.	179.1	169.6	188.9
<i>Tylenchorhynchus</i> spp., <i>Merlinius brevidens</i> , and <i>Quinisulcius acutus</i>	198.3	190.9	207.8
<i>Helicotylenchus</i> spp.	70.4	79.5	63.0
<i>Hoplolaimus</i> spp.	70.4	26.5	75.6
<i>Paratrichodorus minor</i>	12.8	10.6	12.6
<i>Xiphinema americanum</i>	32.0	10.6	25.2
<i>Paratylenchus</i> spp.	83.2	111.3	107.0
<i>Meloidogyne</i> spp.	0.0	5.3	18.9

Tylenchorhynchus claytoni Steiner were found in only one field during the survey.

DISCUSSION

During the 1970s the wheat hectareage planted in Arkansas ranged from a low of 123,400 in 1973 to a high of 333,900 in 1977 (14). The harvested hectareage varied from a low of 87,800 in 1973 to a high of 267,800 in 1977 (14). Approximately 67% of the planted hectares were harvested during the 1970s. Since 1980 the largest hectareage planted was 809,000 in 1982 and the smallest 263,100 in 1985 (15,17). Approximately 92% of the wheat planted was harvested during this period. Some possible reasons for the increase in the percentage of wheat harvested during the 1980s are better weather conditions at harvest, fewer marginal fields plowed up to produce soybean, better weed control, and the need for cash income because of the poor farm economy. The large fluctuations in the area planted in the 1980s were probably due largely to unfavorable weather at planting and unfavorable price expectations.

Phytoparasitic nematodes were found in ca. 78–90% of the samples taken during the 3-year sampling period. Only about 16% of the samples during the sampling period had 500 or more of any nematode.

TABLE 2. Number of wheat fields sampled, percentage of fields with the indicated plant-parasitic nematodes, and percentage of each indicated nematode group within each density range† in Arkansas, 1986–88.

	Fields sampled (No.)	With nematodes (%)	Trace (n = 1–24)	Low (n = 25–99)	Moderate (n = 100–499)	High (n = 500+)
<i>Heterodera glycines</i>						
1986	56	50.0	26.8	5.4	10.7	7.1
1987	71	40.8	25.4	9.9	5.6	0.0
1988	72	37.5	9.7	8.3	16.7	2.8
Mean		42.8	20.6	7.8	11.0	3.3
<i>Pratylenchus</i> spp.						
1986	56	50.0	8.9	16.1	12.5	12.5
1987	71	45.1	22.5	15.5	5.6	1.4
1988	72	41.7	8.3	16.7	12.5	4.2
Mean		45.6	13.3	16.1	10.2	6.0
<i>Tylenchorhynchus</i> spp., <i>Merlinius brevidens</i> , <i>Quinisolcius acutus</i>						
1986	56	55.4	14.3	7.1	23.2	10.7
1987	71	50.7	25.4	16.9	8.5	0.0
1988	72	45.8	16.7	9.7	8.3	11.1
Mean		50.6	18.8	11.3	13.3	7.3
<i>Helicotylenchus</i> spp.						
1986	56	19.6	17.9	1.8	0.0	0.0
1987	71	21.1	12.7	4.2	4.2	0.0
1988	72	12.5	8.3	4.2	0.0	0.0
Mean		17.8	13.0	3.4	1.4	0.0
<i>Hoplolaimus</i> spp.						
1986	56	3.6	3.6	0.0	0.0	0.0
1987	71	2.8	2.8	0.0	0.0	0.0
1988	72	2.8	1.4	0.0	1.4	0.0
Mean		3.1	2.6	0.0	0.5	0.0
<i>Paratrichodorus minor</i>						
1986	56	8.9	3.6	3.6	1.8	0.0
1987	71	2.8	1.4	1.4	0.0	0.0
1988	72	5.6	0.0	4.2	0.0	1.4
Mean		5.8	1.7	3.0	0.6	0.5
<i>Xiphinema americanum</i>						
1986	56	19.6	12.5	3.6	1.8	1.8
1987	71	7.0	1.4	4.2	1.4	0.0
1988	72	16.7	11.1	2.8	2.8	0.0
Mean		14.5	8.3	3.5	2.0	0.6
<i>Paratylenchus</i> spp.						
1986	56	23.2	7.1	7.1	3.6	5.4
1987	71	29.6	18.3	5.6	5.6	0.0
1988	72	23.6	8.3	1.4	9.7	4.2
Mean		25.5	11.3	4.7	6.3	3.2
<i>Meloidogyne</i> spp.						
1986	56	0.0	0.0	0.0	0.0	0.0
1987	71	1.4	1.4	0.0	0.0	0.0
1988	72	4.2	4.2	0.0	0.0	0.0
Mean		1.9	1.9	0.0	0.0	0.0

† Density range = n/500 cm³ soil.

TABLE 3. Wheat fields (number) in Arkansas from which various phytoparasitic nematodes were identified, 1986-88.

	1986	1987	1988	Total	Average
<i>Heterodera glycines</i>	28	29	27	84	28.0
<i>Pratylenchus</i> spp.	28	30	32	90	30.0
<i>P. alleni</i>	5	7	7	19	6.3
<i>P. scribneri</i>	26	26	22	74	24.7
<i>P. zeae</i>	3	5	3	11	3.7
<i>Tylenchorhynchus</i> spp., <i>Merlinius</i> spp., <i>Quimissulcius</i> spp.	31	36	33	100	33.3
<i>T. claytoni</i>	0	0	1	1	0.3
<i>T. ewingi</i>	5	9	0	14	4.7
<i>T. martini</i>	1	2	5	8	2.7
<i>M. brevidens</i>	2	6	8	16	5.3
<i>Q. acutus</i>	26	25	28	79	26.3
<i>Helicotylenchus</i> spp.	11	15	9	35	11.7
<i>H. dihystra</i>	0	1	0	1	0.3
<i>H. pseudorobustus</i>	10	12	9	31	10.3
<i>Hoplolaimus</i> spp.	2	2	2	6	2.0
<i>H. magnistylus</i>	2	0	2	4	1.3
<i>Paratrichodorus</i> spp.	5	2	4	11	3.7
<i>P. minor</i> (<i>P. christiei</i>)	5	2	4	11	3.7
<i>Xiphinema</i> spp.	11	5	12	28	9.3
<i>X. americanum</i>	11	5	12	28	9.3
<i>Paratylenchus</i> spp.	13	21	17	51	17.0
<i>P. elachistus</i>	0	0	1	1	0.3
<i>P. projectus</i>	1	3	0	4	1.3
<i>P. tenuicaudatus</i>	7	9	9	25	8.3
<i>Meloidogyne</i> spp.	0	1	3	4	1.3
Total fields sampled	56	71	72	199	66.3

The nematodes with 500 or more found more than once were *Q. acutus* (12 times), *P. scribneri* (9 times), *P. tenuicaudatus* (7 times), *M. brevidens* (3 times), and *Heterodera glycines* (6 times). Of these nematodes only *M. brevidens* was reported to cause significant loss of yield to wheat (5).

Heterodera avenae is not known to occur in Arkansas, whereas *Punctodera punctata* (Thorne) Mulvey & Stone was found occasionally on turfgrasses (18). Though no field symptoms of these nematodes were observed, in future assays samples containing 100 or more Heteroderidae juveniles will be placed on differential hosts for specific identification.

Of the nematodes found in the Arkansas wheat survey, none is believed to cause significant yield losses to wheat. The low number of wheat samples with 500 or more nematodes proven to be phytoparasitic to wheat is given in support of this statement.

Several of the nematodes encountered in these samples are probably the remnants of populations on previous crops. The presence of *H. glycines* in ca. 43% of the samples probably is due to the practice of double cropping wheat and soybean.

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