Influence of Tillage Methods on *Pratylenchus* spp. in Two Soil Types

G. B. BERGESON, Associate Professor, Department of Botany and Plant Pathology, and J. M. FERRIS, Professor, Department of Entomology, Purdue University, West Lafayette, IN 47907

ABSTRACT

Bergeson, G. B., and Ferris, J. M. 1986. Influence of tillage methods on *Pratylenchus* spp. in two soil types. Plant Disease 70: 326-328.

A 4-yr study conducted on two soil types showed that lesion nematode numbers were significantly higher in the roots of field corn grown in moldboard-plowed plots than in nontilled plots. The population increase in chisel-plowed plots was intermediate between those in moldboard-plowed and nontilled plots.

Conversion from conventional moldboard plowing to chisel plowing or no tillage introduces major changes in quantitative and qualitative aspects of some disease, weed, and insect problems (2,6–8,11). Reports on the impact of these changes on plant-parasitic nematodes do not agree, perhaps because tillage method does not affect all nematode species in the same way (6). Corbett and Webb (5) reported wheat grown in plowed ground generally had more plant-parasitic nematodes than wheat in unplowed ground. Caveness (4) reported *Meloidogyne incognita* and *Helicotylenchus pseudorobustus* were more plentiful in nontilled plots but that *Pratylenchus* sp. were more than twice as numerous in tilled plots. Smittle and Johnson (10) found no differences between moldboard plowing and subsoil tillage in numbers of *M. incognita* juveniles or root gall indices. Alby (1) found different tillage regimes maintained over a 3-yr period did not result in marked differences in the nematode community of a field soil planted to soybeans for the same 3-yr period. Thomas (12), however, found lesion nematodes in maize increased more in nontilled ridge plots than in plowed plots. This paper reports our observations on the effect of no-till, fall chisel-plowing, and fall moldboard-plowing treatments on populations of *Pratylenchus* spp.

Present address of first author: 7924 N. Sarazen Road, Citrus Springs, FL 32630.

Paper 8985 of the Journal Series of the Purdue University Agricultural Experiment Station.

Accepted for publication 27 September 1985 (submitted for electronic processing).

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

MATERIALS AND METHODS

Experiments were conducted in 1979, 1980, 1983, and 1984 in field plots at the Purdue Agronomy Farm on a Treaty silt loam soil (15% sand, 58% silt, and 27% clay) and at the Pinney Purdue Farm on a Tracy sandy loam soil (56% sand, 34% silt, and 10% clay). The predominant lesion nematode species was *Pratylenchus hexincisus* Taylor & Jenkins. The 1979 and 1980 tillage treatments included fall moldboard plowing (20 cm deep), fall chisel plowing (straight shanks spaced 25

Table 1. Effects of three tillage regimes on population levels of *Pratylenchus hexincisus* in corn roots

Location	Tillage	1979 Nematode numbers			1980 Nematode numbers		
		Preplant soil[a]	Early season[b]	Midseason[b]	Preplant soil[a]	Early season[b]	Midseason[b]
Agronomy[c]	Moldboard plow	7.2	566	694	2.6	552	1,385
	Chisel plow	7.2	390	158	3.0	228	992
	No tillage	7.2	464	141	11.4	82	624
Pinney[d]	Moldboard plow	11.9	2,382	4,854	16.2	4,636	7,143
	Chisel plow	11.9	780	2,760	4.8	2,395	3,963
	No tillage	11.9	684	197	12.3	790	1,214

[a] *Pratylenchus* per 50 cm.
[b] *Pratylenchus* per gram dry root.
[c] Agronomy Farm, 7 mi. northwest of Lafayette, IN.
[d] Pinney Purdue Agricultural Center, 3 mi. northwest of Wanatah, IN.

Table 2. Effects of two tillage regimes at the Purdue Agronomy Farm on population levels of *Pratylenchus hexincisus* in corn roots

Tillage	1983 Nematode numbers			1984 Nematode numbers		
	Preplant soil[a]	Early season[b]	Midseason[b]	Preplant soil[a]	Early season[b]	Midseason[b]
Moldboard plow	2.8	1,211	2,983	36	1,457	2,686
No tillage	14.5	300	320	26	442	553

[a] *Pratylenchus* per 50 cm.
[b] *Pratylenchus* per gram dry root.

cm apart), and no tillage. Each tillage treatment consisted of an eight-row main plot (75-cm spacing between rows) 45.7 m long. Four replicates of each tillage treatment were arranged in a randomized block design. Each main plot was divided into six subplots 7.6 m long. Subplot treatments included two inoculation levels of *Colletotricum graminicola* (cause of anthracnose leaf blight) and three insecticide/nematicide treatments in all possible combinations. In 1979 and 1980, the maize cultivar B73 × Mo17 was planted in early May. For each location and year, preplant soil samples consisted of 10 randomly selected cores (2.5 × 20 cm) per subplot. Cores from each subplot were combined and mixed, then a 50-cm sample was placed in a 9-cm-diameter Baermann funnel for 48 hr. Extracted nematodes were counted on a Peter's eelworm-counting slide. Postplant samples, collected in June and again in late July or early August, consisted of roots from six randomly selected corn plants from each subplot. Representative portions of about equal amounts of each root system were combined and placed in a mist chamber for 1 wk. Emerged lesion nematodes were counted, roots dried, and nematodes per gram of dry root computed.

Experiments in 1983 and 1984 followed the same procedures, except 1) only the Purdue Agronomy Farm site was used, 2) moldboard plowing and no tillage were the only tillage treatments, 3) there were three subplot treatments consisting of three weed management levels, and 4) the corn cultivar used was DeKalb XL72AA.

The W test, developed by Shapiro and Wilk (9), was used to determine normality of the error terms for both early and midseason counts of *P. hexincisus* from roots at each location. Only the midseason 1979–1980 data satisfied this normality assumption. However, the test suggested a transformation of the other data (early season 1979–1980 and early and midseason 1983–1984) using natural log (ln) of root counts, which then satisfied the assumption of normality. Bartlett's Box F was run on the transformed data to test for homogeneity of variance, which was satisfied. The BMDP8V analysis of variance (ANOVA) program was used to test main effects and interactions.

Table 3. ANOVA table for 1979–1980 early-season raw data for three tillage (T) regimes, two locations (L), two years (Y), and three nematicide (C) treatments

Source	df	Mean square	*F*	Probability
T	2	18.07231	8.89	0.0043
L	1	96.44492	72.39	0.0001
Y	1	0.32405	0.17	0.6958
C	2	8.86544	10.01	0.0028
YT	2	1.58394	0.78	0.4806
LT	2	4.56330	4.08	0.0445
TC	4	3.18041	0.72	0.5854
YLT	2	1.06762	0.95	0.4124
YTC	4	5.20106	1.18	0.3444
LTC	4	2.38694	1.56	0.2172

RESULTS AND DISCUSSION

During all growing seasons, lesion nematode numbers in the roots of maize grown in plots tilled with moldboad plow were consistently higher than those from nontilled plots (Tables 1 and 2). At the Agronomy and Pinney locations (Table 1), fungus levels had no effect on lesion nematode counts. Thus the ANOVA tested for main effects of tillage, location, year, and chemical treatment, and interactions, for the years 1979–1980 (Tables 3 and 4). Although tillage was significantly different for both early and midseason root counts (P = 0.0043 and 0.0018, respectively), there was an interaction between tillage and location. This interaction occurred because both early and midseason population levels of *P. hexincisus* in maize roots were not significantly different for no tillage and moldboard plowing at the Agronomy location, but they were different at the Pinney location (Table 1). For the 1983–1984 data (Table 2), there were no interactions between tillage and either location, year, or weed management levels (Tables 5 and 6). Transformed means for the two tillage methods (early = 6.84 and 5.66 for plowing and no tillage, respectively; midseason = 7.54 and 5.71 for plowing and no tillage, respectively) were significantly different for both early (P = 0.0072, Table 5) and midseason (P = 0.0007, Table 6) counts of *P. hexincisus* in maize roots, indicating that raw data means were also different (Table 2).

Reasons for lower populations in nontilled plots versus plots tilled with moldboard plow are not known. However, we observed that soil in nontilled plots was more compacted. Thus, plowing appeared to improve soil structure and aeration, which would favor root development and facilitate nematode movement. Barber (3) demonstrated increased maize root growth and production of finer roots

Table 4. ANOVA table for 1979–1980 midseason transformed (ln) data for three tillage (T) regimes, two locations (L), two years (Y), three nematicide (N), and two fungal (F) treatments

Source	df	Mean square	*F*	Probability
T	2	212,588,733	11.15	0.0018
L	1	520,848,571	7.97	0.0302
Y	1	84,959,958	1.45	0.2739
N	2	78,382,891	8.00	0.0062
F	1	93,302,353	2.47	0.1667
LT	2	129,062,894	5.56	0.0195
YT	2	3,366,370	0.18	0.8402
TN	4	10,685,407	0.85	0.5054
TF	2	27,678,652	1.91	0.1910
LYT	2	2,674,275	0.12	0.8921
LTN	4	11,594,709	0.93	0.4653
YTN	4	11,026,388	0.88	0.4900
LTF	2	14,998,245	0.87	0.4423
YTF	2	4,366,689	0.30	0.7457
TNF	4	16,637,965	0.89	0.4860
LYTN	4	16,906,680	1.35	0.2805
LYTF	2	5,325,367	0.31	0.7390
LTNF	4	14,318,329	0.77	0.5562
YTNF	4	9,157,947	0.49	0.7438
LYTNF	4	8,206,463	0.44	0.7781

Table 5. ANOVA table for 1983–1984 early-season transformed (ln) data for two tillage (T) regimes, two years (Y), and three weed management (W) levels

Source	df	Mean square	*F*	Probability
T	1	16.567	15.95	0.0072
Y	1	1.342	1.68	0.2430
W	2	3.266	4.43	0.0363
TY	1	0.008	0.01	0.9313
TW	2	0.578	1.28	0.3125
TYW	2	0.177	0.39	0.6836

Table 6. ANOVA table for 1983–1984 midseason transformed (ln) data for two tillage (T) regimes, two years (Y), and three weed management (W) levels

Source	df	Mean square	*F*	Probability
T	1	40.328	40.87	0.0007
Y	1	0.255	0.09	0.7742
W	2	1.048	7.99	0.0062
TY	1	1.246	1.26	0.3040
TW	2	0.382	0.49	0.6222
TYW	2	0.099	0.13	0.8809

in tilled versus nontilled plots.

Our results agree with those of Caveness (4) and Corbett and Webb (5) but conflict with those of Thomas (12). However, Thomas found a significant increase only in nontilled ridged plots and not in nontilled flat plots, which would more closely correspond to our no-till treatment. Lack of agreement in reports on the effects of different tillage treatments might also reflect the possibility that nematode response may vary with soil type and climatic factors.

ACKNOWLEDGEMENTS

We wish to thank R. L. Nicholson, D. H. Scott, and F. T. Turpin for consultation and field plot arrangement. We also thank F. P. Degennaro and L. R. Sisco for their help in processing samples and T. M. Kimes and B. A. Zook, Statistical Consulting Services, Purdue University, for statistical analysis. Research was supported by the USDA, SEA, under Grant No. 89-106 and USDA, RRS, Special IPM Systems Research Grant: An Integrated Pest Management System for Crop Production in the Eastern Corn Belt Region.

LITERATURE CITED

1. Alby, T. 1980. Dynamics of selected nematodes associated with soybeans. Ph.D. thesis. Purdue University, West Lafayette, IN. 109 pp.
2. All, J. N., and Gallaher, R. N. 1976. Insect infestation in no-tillage corn cropping systems. Ga. Agric. Res. 17:17-19.
3. Barber, S. A. 1971. Effect of tillage practice on corn (*Zea mays* L.) root distribution and morphology. Agron. J. 63:724-726.
4. Caveness, F. E. 1975. Plant-parasitic nematode population differences under no-tillage and tillage soil regimes in western Nigeria. (Abstr.) J. Nematol. 6:138.
5. Corbett, D. C. M., and Webb, R. M. 1970. Plant and soil nematode population changes in wheat grown continuously in ploughed and in unploughed soil. Ann. Appl. Biol. 65(2):327-335.
6. Fortnum, B. A., and Karlen, D. L. 1985. Effect of tillage system and irrigation on population densities of plant nematodes in field corn. J. Nematol. 17:25-28.
7. Gregory, W. W., and Musick, G. J. 1976. Insect management in reduced tillage systems. Bull. Entomol. Soc. Am. 22:302-304.
8. Jordan, T. N., Baumann, T. T., and Williams, J. L., Jr. 1979. Weed problems in reduced and no-till production. Weed Sci. Publ. Purdue Univ. Coop. Ext. Ser. Publ. BP 10-11. 4 pp.
9. Shapiro, S. S., and Wilk, M. B. 1965. An analysis of variance test for normality (complete samples). Biometrika 52:591-611.
10. Smittle, D. A., and Johnson, A. W. 1982. Effects of management practices on *Meloidogyne incognita* and snap bean. J. Nematol. 14:63-68.
11. Sumner, D. R., Doupnik, D., Jr., and Boosalis, M. G. 1981. Effects of reduced tillage and multiple cropping on plant diseases. Annu. Rev. Phytopathol. 19:167-187.
12. Thomas, S. H. 1978. Population densities of nematodes under seven tillage regimes. J. Nematol. 10:24-27.