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Heterodera glycines Invasion and Reproduction on Soybean Grown in Clay and Silt Loam Soils

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The soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe, is a severe pest of soybean, *Glycine max* (L.) Merr., in the United States. Nematode reproduction and the seed yield losses caused by this nematode are influenced by soil texture (3,5,6). Todd and Pearson (5) recovered higher numbers of SCN females and cysts from a sandy loam soil than from silty loams. Soybean yield also has been negatively correlated with increasing sand content of a fine sandy loam soil (3). Young and Heatherly (6) reported six times more SCN cysts at seed harvest in a silt loam soil than in a clay soil. SCN population increased from planting to harvest in silt loam soil but declined significantly in clay soil (unpubl.). The clay content (58%) of Sharkey clay in this study was much higher than in soils cited in other studies. The study reported here describes tests to determine if the SCN population decline in the clay soil was due to lower juvenile invasion or lower nematode reproduction.

Experiment 1: Dry, uninfested Sharkey clay (8.5% sand, 34.0% silt, 57.5% clay; pH 6.6, 2.9% organic matter) and Dubbs silt loam (23.0% sand, 60.5% silt, 16.5% clay; pH 6.8, 1.3% organic matter) surface soils were passed through 6-mm-d hardware cloth, transferred to 7.5-cm-d pots, and thoroughly wetted for 2 days. Twenty-five hand-picked cysts collected from plants grown in SCN-infested soil for 40 days were added to the soil surface in each pot and covered with approximately 2 cm friable soil of the appropriate soil type. Seedlings of 'Tracy-M' soybean with 2–3-cm-long roots were transplanted, one into the center of each pot, and plants were grown in a greenhouse at 24–30 C. Roots from 10 plants were removed from each soil and washed 10 days after transplanting. The roots were weighed and stained with acid-fuchsin in lactophenol (4). After destaining (1), roots were pressed between glass plates for enumeration of juveniles. Numbers of females and cysts at 30 days after transplanting were determined for an additional 10 plants in each soil with the elutriation technique (2). Twenty-five randomly selected females and cysts from each pot were pooled and crushed in water with a tissue grinder, and the average number of eggs per cyst was determined.

Experiment 2: Soils and plants were prepared as in experiment 1 except that soil was transferred to 10-cm-d pots and the soil was infested with 2,000 eggs in 1 ml water. To obtain eggs, cysts were crushed with a tissue grinder. Five days after transplanting, roots of five plants from each soil were collected, weighed, and stained as in experiment 1, and juveniles in the roots were counted. Five additional plants were harvested from each soil at 30 and 60 days after transplanting; numbers of females and cysts and average number of eggs per cyst were determined.

Data were subjected to standard analysis of variance for treatments in a randomized complete block design with 10 and 5 replications in experiments 1 and 2, respectively.

Weight of soybean roots and number of juveniles per root were not significantly different ($P > 0.05$) between soils when measured at 10 (experiment 1) and 5 (experiment 2) days after transplanting (Table 1). Numbers of juveniles per gram of root were

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TABLE 1. Soybean root and cyst nematode parameter values in clay and silt loam soils.†

	Experiment 1				Experiment 2			
	Clay	Loam	CV	*P* value	Clay	Loam	CV	*P* value
Beginning root wt.‡	0.64	0.07	13	0.17	0.34	0.30	25	0.48
Juveniles per root	512	564	22	0.37	148	166	8	0.08
Cysts/pot at 30 days	360	542	49	0.10	289	326	43	0.68
Cysts/pot at 60 days	—§	—	—	—	443	1,427	53	0.04
Change in cysts/pot	—	—	—	—	154	1,101‖	84	0.05
Eggs/cyst at 30 days	108	169	18	0.01	81	124	16	0.02
Eggs/cyst at 60 days	—	—	—	—	89	171	14	0.01
Change in eggs/cyst	—	—	—	—	8	47	70	0.04

† Clay = Sharkey clay surface soil; loam = Dubbs silt loam surface soil.
‡ Grams per pot at day 10 (experiment 1) and day 5 (experiment 2).
§ Samples were not taken on day 60 in experiment 1.
‖ Increases in number of cysts per pot and eggs per cyst at 60 days versus 30 days were significant ($P = 0.05$) in the silt loam soil but not in the clay.

similar in both soils within each experiment. Number of cysts per pot in the two soils was not significantly different at 30 days, but the number of eggs per cyst was higher in the silt loam soil. The number of eggs produced per pot at 30 days was significantly higher in the silt loam than in the clay in experiment 1 but not in experiment 2 (data not shown). This can be attributed to the smaller difference in number of cysts between soils in experiment 2 than in experiment 1. Evidently, the SCN juveniles penetrated roots in both soils, but the fewer eggs per cyst and the trend toward fewer cysts in the clay soil at 30 days indicated a less favorable environment for SCN females. This may have resulted from slower maturation of cysts in the clay. Although differential detection of cysts between the soils could have occurred, there were no significant differences between the soils in number of cysts recovered from seeded samples. Extraction efficiency was 88% (range 70–120) in the clay and 90% (range 60–120) in the silt loam soil.

At 60 days in experiment 2, both number of cysts per pot and number of eggs per cyst were significantly higher ($P = 0.05$) in the silt loam than in the clay soil. Also, number of cysts per pot, number of eggs per cyst, and total number of eggs per pot increased significantly between 30 and 60 days in the silt loam. Numbers of cysts per pot and eggs per cyst in the clay soil were not significantly different between 30 and 60 days.

This research has demonstrated that the lower rate of reproduction of SCN in clay vs. loam soil is not due to differences in penetration of roots by juveniles. Further research is needed to determine how soil type affects reproduction. Field studies also are needed to determine if plant yield is affected by differences in SCN development in the two soils.

LITERATURE CITED

1. Alves, L. M., and G. B. Bergeson. 1967. A quick destaining procedure for showing contrast between nematodes and root tissues. Plant Disease Reporter 51:511.

2. Barker, K. R., J. F. Townshend, G. W. Bird, I. J. Thomason, and D. W. Dickson. 1986. Determining nematode population responses to control agents. Pp. 283–296 *in* K. D. Hickey, ed. Methods for evaluating pesticides for control of plant pathogens. St. Paul, MN: The American Phytopathological Society Press.

3. Koenning, S. R., S. C. Anand, and J. A. Wrather. 1988. Effect of within-field variation in soil texture on *Heterodera glycines* and soybean yield. Journal of Nematology 20:373–380.

4. McBeth, C. W., A. L. Taylor, and A. L. Smith. 1941. Note on staining nematodes in root tissues. Proceedings of the Helminthological Society of Washington 8:26.

5. Todd, T. C., and C. A. S. Pearson. 1988. Establishment of *Heterodera glycines* in three soil types. Annals of Applied Nematology (Journal of Nematology 20, Supplement) 2:57–60.

6. Young, L. D., and L. G. Heatherly. 1988. Soil texture and water potential effects on soybean and *Heterodera glycines*. Journal of Nematology 20:664–665 (Abstr.).