Supplement to Journal of Nematology 21, No. 4S:720–722. 1989.

Long-term Effect of Crop Rotation on Soybean in a Field Infested with *Meloidogyne arenaria* and *Heterodera glycines*[1]

D. B. WEAVER,[2] R. RODRÍGUEZ-KÁBANA,[3] AND E. L. CARDEN[4]

Abstract: Previous cropping sequence (corn–soybean vs. soybean–soybean) and aldicarb effects on soybean yield and nematode numbers at harvest for soybean cultivars with various combinations of nematode resistance were determined in 1988 in a sandy loam soil infested with *Meloidogyne arenaria* race 2 and *Heterodera glycines* races 3 and 4 at Elberta, Alabama. Yield and nematode numbers differed among cultivars with 'Leflore' having the highest yield. Aldicarb treatment resulted in increased soybean yield but did not affect nematode numbers. Previous cropping sequence did not affect soybean yield or numbers of *H. glycines*, but soybean following corn–soybean had higher numbers of *M. arenaria* than soybean following soybean–soybean. The only significant statistical interaction was aldicarb × cultivar for numbers of *H. glycines*.

Key words: aldicarb, crop rotation, *Glycine max*, *Heterodera glycines*, host-plant resistance, *Meloidogyne arenaria*, root-knot nematode, soybean, soybean cyst nematode.

Mixed populations of *Meloidogyne* spp. and *Heterodera glycines* Inchinohe cause significant yield losses in soybean (*Glycine max* (L.) Merrill) in the southeastern United States (2,7–9). The benefits of crop rotation and resistant soybean cultivars in suppressing yield losses to *Meloidogyne* spp. are documented (1,3,4). Nonhost crops reduce numbers of *H. glycines* (2,6,9), but field studies failed to demonstrate any yield advantage of crop rotation employing nonhost crops over monoculturing resistant soybean cultivars in fields infested with *H. glycines* (5,11). Crop rotation, however, can provide a large yield advantage over monoculturing a susceptible cultivar (6).

Soybean following corn yielded more than soybean following soybean, had fewer numbers of *H. glycines* second-stage juveniles (J2), and the same number of *Meloidogyne arenaria* (Neal) Chitwood J2 (9). Most significant was the large cultivar × previous crop interaction for soybean yield, demonstrating that proper cultivar selection was dependent upon cropping history. Our objective was to determine whether previous crop (corn vs. soybean) had any effect on yield and cultivar performance in the second year of continuous soybean following rotation crops.

The field, soybean cultivars, methods (including the experimental design), and materials for the experiment were described previously (9). The only exception was the substitution of 'Stonewall' soybean for 'Forrest'. Stonewall is resistant to *H. glycines* race 3 and susceptible to race 4 and also to *M. arenaria* (10).

Soybean yields were relatively low in 1988 ($\bar{x}$ = 788 kg/ha) (Table 1) compared with 1987 ($\bar{x}$ = 2,261 kg/ha) (9). Other than lower than average rainfall during the growing season, there was no apparent reason for the low yields. Although the corn–soybean cropping sequence treatment yield exceeded the soybean–soybean cropping sequence (846 kg/ha vs. 730 kg/ha), there were no differences between cropping sequences for yield or for numbers of *H. glycines*. Numbers of *M. arenaria* were higher

Received for publication 2 June 1989.

[1] Journal Series No. 3-892124P of the Alabama Agricultural Experiment Station, Auburn University, AL 36849.

[2] Associate Professor, Department of Agronomy and Soils, Auburn University, Auburn University, AL 36849.

[3] Professor, Department of Plant Pathology, Auburn University, Auburn University, AL 36849.

[4] Superintendent, Gulf Coast Substation, Auburn University, Fairhope, AL 36532.

TABLE 1. Effect of previous cropping sequence, aldicarb,† and soybean cultivar on yield and juvenile numbers of *Meloidogyne arenaria* race 2 and *Heterodera glycines* races 3 and 4.

Previous cropping sequence	Soybean cultivar in 1988	Seed yield (kg/ha)		Second-stage juveniles/100 cm³ soil			
				M. arenaria		*H. glycines*	
		Untreated	Aldicarb	Untreated	Aldicarb	Untreated	Aldicarb
Corn–soybean	Braxton	543	613	35	71	17	8
Soybean–soybean		375	378	45	19	20	29
Corn–soybean	Centennial	946	1,006	39	44	7	9
Soybean–soybean		875	854	34	32	5	13
Corn–soybean	Stonewall	656	564	93	76	15	7
Soybean–soybean		549	555	48	49	19	11
Corn–soybean	Gordon	662	808	40	58	17	17
Soybean–soybean		524	647	24	25	17	12
Corn–soybean	Kirby	1,068	1,159	130	113	15	17
Soybean–soybean		921	915	80	83	7	13
Corn–soybean	Leflore	1,229	1,376	93	128	3	3
Soybean–soybean		1,205	1,403	93	113	6	1
Corn–soybean	Ransom	567	643	64	96	8	23
Soybean–soybean		461	567	57	55	12	29
Corn–soybean	x̄	810	881	71	84	12	12
Soybean–soybean	x̄	701	759	54	54	12	15
LSD ($P = 0.05$)		151		29		12	

Data are means of eight replications.
LSD values are for comparisons among cultivars within previous crop or nematicide treatment.
† Applied at 5.3 g a.i./m row (2.2 kg a.i./ha) in a 25-cm band over the row and incorporated 2–3 cm deep just before planting.

($P = 0.01$) for the corn–soybean sequence than for the soybean–soybean sequence (78 vs. 54 J2/100 cm³ soil). No interactions with cropping sequence were found for any variable (Table 2).

Aldicarb increased ($P = 0.01$) soybean yield relative to the control (820 kg/ha in aldicarb-treated plots vs. 756 kg/ha in untreated plots) but did not affect numbers of nematodes. The nematicide treatment × cultivar interaction was significant ($P = 0.01$) for numbers of *H. glycines*, because 'Ransom' had higher numbers of *H. glycines* in aldicarb-treated plots than in untreated plots. Such differences did not occur on other cultivars.

TABLE 2. Analysis of variance for soybean cultivar yield and juvenile numbers of *Meloidogyne arenaria* race 2 and *Heterodera glycines* races 3 and 4 following corn–soybean or soybean–soybean cropping sequence and with or without aldicarb.

Source	df	Mean squares (×10⁻²)		
		Soybean yield	*M. arenaria*	*H. glycines*
Blocks	1			
Replicates (blocks, previous crop)	28			
Previous crop (P)	1	14,819	591**	4
Error a	1	24,291	0	62
Nematicide (N)	1	4,720**	46	2
P × N	1	48	51	3
Cultivar (C)	6	57,863**	553**	19**
P × C	6	865	24	5
N × C	6	852	25	9**
P × N × C	6	222	33	2
Error b	390	473	18	3

** $P = 0.01$.

Cultivars had the largest effect on all variables (Table 2). Yields ranged from a mean of 1,296 kg/ha for 'Leflore' (higher than any other cultivar) to 560 kg/ha for 'Ransom' averaged across cropping sequences and nematicide treatments. Cultivars fell into three groups based on yield: Leflore, the highest-yielding cultivar, then 'Centennial' and 'Kirby', followed by the remaining cultivars yielding about equally (Table 1). These groupings did not correspond to the resistance category reported for each cultivar (9,10) with the exception of Leflore, which was the highest yielding and the only cultivar resistant to *H. glycines* races 3 and 4. Numbers of *H.*

glycines averaged across cropping sequences and nematicide treatments ranged from a mean of 3 J2/100 cm^3 soil for Leflore (resistant to *H. glycines* races 3 and 4) to 19 J2/100 cm^3 soil for 'Braxton' (susceptible to *H. glycines*) (Table 1). Numbers of *M. arenaria* ranged from 37 J2/100 cm^3 soil for Centennial and 'Gordon' to 107 J2/100 cm^3 for Leflore but showed no relationship to cultivar resistance to *M. arenaria*.

Either the low overall yield level or the large cropping sequence × block interaction mean square may have masked the effect of cropping sequence on yield. Higher yield levels or inclusion of more blocks may give different results. Therefore, while our results on the effect of cropping sequence should be considered inconclusive, there was no evidence that the beneficial effects of corn in the rotation lasted for more than 1 year.

In summary, interactions among previous crop, cultivar, and nematicide treatment were minimal; cultivars had the largest effect, affecting yield as well as nematode numbers. Aldicarb had a small effect on yield but not on nematode numbers.

Literature Cited

1. Crittenden, H. W. 1956. Control of *Meloidogyne incognita acrita* by crop rotations. Plant Disease Reporter 40:977–980.

2. Kinloch, R. A. 1973. Nematode and crop response to short-term rotations of corn and soybean. Soil and Crop Science Society of Florida Proceedings 33:86–87.

3. Kinloch, R. A. 1980. The control of nematodes injurious to soybean. Nematropica 10:141–143.

4. Kinloch, R. A. 1983. Influence of maize rotations on the yield of soybean grown in *Meloidogyne incognita* infested soil. Journal of Nematology 15:398–405.

5. Hartwig, E. E., L. D. Young, and N. Buehring. 1987. Effects of monocropping resistant and susceptible soybean cultivars on cyst nematode infested soil. Crop Science 27:576–579.

6. Ross, J. P. 1962. Crop rotation effects on the soybean cyst nematode population and soybean yields. Phytopathology 52:815–818.

7. Weaver, D. B., R. Rodríguez-Kábana, and E. L. Carden. 1987. Soybean response to ethylene dibromide in a soil infested with *Meloidogyne arenaria* and *Heterodera glycines*. Annals of Applied Nematology (Journal of Nematology 19, Supplement) 1:94–96.

8. Weaver, D. B., R. Rodríguez-Kábana, and E. L. Carden. 1988. Multiple-species nematode resistance in soybean: Effect of genotype and fumigation on yield and nematode numbers. Crop Science 28:293–298.

9. Weaver, D. B., R. Rodríguez-Kábana, D. B. Robertson, R. L. Akridge, and E. L. Carden. 1988. Effect of crop rotation on soybean in a field infested with *Meloidogyne arenaria* and *Heterodera glycines*. Annals of Applied Nematology (Journal of Nematology 20, Supplement) 2:106–109.

10. Weaver, D. B., R. Rodríguez-Kábana, and H. R. Boerma. 1989. Registration of 'Stonewall' soybean. Crop Science 29, in press.

11. Young, L. D., E. E. Hartwig, S. C. Anand, and D. Widick. 1986. Responses of soybeans and soybean cyst nematodes to cropping sequences. Plant Disease 70:787–791.