

Evaluation of Nematicides and Resistant Cultivar for Control of Soybean Cyst Nematode Race 4

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ABSTRACT

Epps, J. M., Young, L. D., and Hartwig, E. E. 1981. Evaluation of nematicides and resistant cultivar for control of soybean cyst nematode race 4. *Plant Disease* 65:665-666.

Studies in two fields infested with soybean cyst nematode race 4 compared yields and nematode population levels of a resistant cultivar and susceptible cultivars with and without nematicide treatments. The 3-yr mean yield of the resistant cultivar Bedford was 32% greater than the yields of susceptible cultivars Forrest, Centennial, and Tracy without nematicide treatment and 22% greater than their yields with nematicide treatment. The 3-yr mean yield of Bedford was also 44% greater than that of Forrest without nematicide treatment and 33% greater than the mean yield of Forrest with five nematicide treatments.

The soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe, was first reported in the United States in 1955 (8);

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Accepted for publication 8 December 1980.

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by 1970, four races were identified (1). Cultivars resistant to races 1 and 3 have been available since 1967, and cultivar Bedford, which is resistant to race 4, was available to soybean growers in 1979. Estimated losses to SCN in the southern United States were 18,685,000 and 31,922,000 bushels in 1976 and 1977, respectively (6,7). Most of these losses were probably due to race 4 because high-yielding cultivars resistant to race 3 were planted.

When soybean fields are infested with SCN race 4, growers can plant a resistant cultivar or use a nematicide. This study compared the effectiveness of these two practices.

MATERIALS AND METHODS

Two fields were used for these studies. Field 1, located in Obion County, northwest Tennessee, was identified as a problem field in 1975 when the cultivar Forrest, which is resistant to SCN races 1 and 3 (3), was being grown. Plants were stunted and leaves chlorotic, two symptoms of SCN damage but also of potash deficiency. The soil, a Morganfield silt loam, was heavily infested with SCN and was low in potash. Seed yield was estimated at 300 kg/ha.

Field 2, located near Jackson, TN and also planted with Forrest, was identified as a problem field in 1977. Growth characteristics were similar to those in field 1. The soil, a Falaya silt loam, had a heavy infestation of SCN and was low in potash. Seed yield was estimated at 400 kg/ha.

Trifluralin (0.84 kg a.i./ha) was applied before planting for weed control. Herbicides were applied postemergence as needed. Each field received 100-200 kg/ha of K₂O before planting. All plantings were made between 10 May and 20 May each year in rows 1 m apart with approximately 35 seeds per meter. We collected soil samples for SCN assay

Table 1. Yields of four soybean cultivars grown with and without nematicides in soil infested with soybean cyst nematode race 4

Treatment	Yield of cultivar ^{1,2} (kg/ha)			
	Bedford	Forrest	Centennial	Tracy
None	2,960	2,280	2,220	2,226
DBCP	3,190	2,685	2,410	2,580
Phenamiphos	3,125	2,482	2,270	2,180
Ethoprop	3,091	2,670	2,225	2,400

¹Yields given as 3-yr means.

²Analysis of variance showed that yield of Bedford untreated (2,960 kg/ha) was not significantly different ($P = 0.05$) from that of Bedford treated (3,135 kg/ha). Yield of Bedford untreated was significantly different ($P = 0.01$) from mean yield of Forrest, Centennial, and Tracy untreated (2,242) and treated (2,435 kg/ha). The last two yields were also significantly different ($P = 0.05$) from each other. (C.V. = 9%.)

Table 2. Number of cysts of soybean cyst nematode race 4 in soil of four soybean cultivars grown with and without nematicides

Treatment	Cysts in soil of cultivar ² (no./250 cm ³)			
	Bedford	Forrest	Centennial	Tracy
None	90	202	262	367
DBCP	83	193	192	195
Phenamiphos	75	213	228	412
Ethoprop	70	180	193	310

²Analysis of variance showed that number of cysts in soil of Bedford untreated (90) was not significantly different ($P = 0.05$) from number in soil of Bedford treated (76). Number in soil of Bedford untreated was significantly different ($P = 0.01$) from mean number in soil of Forrest, Centennial, and Tracy untreated (277) and treated (235). The last two numbers were also significantly different ($P = 0.05$) from each other.

Table 3. Yield and number of cysts associated with soybean cultivars Bedford and Forrest grown with and without nematicides in soil infested with soybean cyst nematode race 4

Cultivar	Treatment	Seed yield ^y (kg/ha)	Cysts in soil (no./250 cm ³)
Bedford	None	2,984 a ^z	36 c ^z
Forrest	Phenamiphos	2,431 b	159 b
	Aldicarb	2,312 bc	133 b
	DBCP	2,227 cd	138 b
	Carbofuran	2,183 cde	131 b
	Ethoprop	2,031 e	184 b
	None	2,072 de	287 a

^yC.V. = 9%.

^zMeans in same column followed by same letter are not significantly different (Duncan's multiple range test, $P = 0.05$).

60–120 days after planting. Ten soil cores (2.5 cm diam × 30 cm deep) were taken from the center rows of each plot and mixed together, and a 250-cm³ subsample was washed through a 60-mesh sieve to extract cysts.

We performed analyses of variance for data from individual experiments and combined the analyses for experiments conducted over a 3-yr period. A *t*-test was used to compare mean yields of resistant with those of susceptible cultivars, and a logarithmic transformation was applied to numbers of cysts before analyses of variance were made.

Experiment 1. Soybean (*Glycine max* (L.) Merr.) was planted in a split plot design, with four nematicide treatments as the main plots and cultivars as subplots. Nematicide treatments included DBCP (1,2-dibromo-3-chloropropane at 13.5 kg a.i./ha, injected 20 cm deep; ethoprop at 3.4 kg a.i./ha, in a 30-cm band

incorporated 2–7 cm deep with a rotary cultivator; phenamiphos at 1.9 kg a.i./ha, in a 15- to 30-cm band incorporated 2–7 cm deep; and an untreated check. Each treatment was replicated four times.

The cultivars grown were Bedford (5), resistant to races 1, 3, and 4; Forrest (3), resistant to races 1 and 3; Centennial (4), resistant to races 1 and 3; and Tracy (2), susceptible to all races. Forrest and Bedford mature at the same time, while Tracy and Centennial mature about 14 days later. All cultivars were planted in four-row plots that were 6 m long. Seeds from plants in the two center rows were harvested with a stationary plot thresher.

Experiments were conducted in field 1 in 1976 and 1977 and in field 2 in 1978. Tests were conducted in an area of the field where a cultivar susceptible to race 4 had been grown the previous year.

Experiment 2. Plantings included Forrest with five nematicide treatments,

Forrest without treatment, and Bedford without treatment. The same fields and conditions were used as in experiment 1, except that in 1976 and 1977 the plants were grown in two-row plots and both rows were harvested.

Nematicide treatments were aldicarb at 1.7 kg a.i./ha, in a 10- to 20-cm band incorporated 2–7 cm deep; carbofuran at 2.2 kg a.i./ha, in a 25- to 40-cm band incorporated 2–7 cm deep; DBCP at 13.5 kg a.i./ha, injected 20 cm deep; ethoprop at 2.2 kg a.i./ha, in a 30-cm band incorporated 2–7 cm deep; and phenamiphos at 1.8 kg a.i./ha in a 10- to 15-cm band incorporated 2–7 cm deep.

RESULTS AND DISCUSSION

In experiment 1, Bedford did not respond to nematicides, but untreated Bedford yielded 32% more than the mean of three untreated susceptible cultivars (Table 1). Yield of untreated Bedford was 22% greater than the mean yield of the three susceptible cultivars with treatments. The nematicide treatments increased yields of the susceptible cultivars 8.6%. There were significantly fewer cysts in treated plots of the susceptible cultivars (Table 2).

In experiment 2, untreated Bedford yielded 44% more than untreated Forrest and 23% more than Forrest with the best nematicide treatment (phenamiphos) (Table 3). Nematicides reduced the number of cysts on Forrest. Phenamiphos and aldicarb significantly increased yield.

The results show a distinct advantage in using resistant cultivars rather than presently available nematicides where SCN race 4 is a problem. Nematicides did not significantly increase yields of Bedford, the resistant cultivar.

Untreated Forrest (experiment 1 in fields 1 and 2) yielded a mean of 2,280 kg/ha and showed no leaf chlorosis. Yields in those fields the year before the experiments were 300–400 kg/ha, and plants were chlorotic. The data suggest that previous yields were limited by SCN and low levels of potassium in the soil.

ACKNOWLEDGMENT

We thank M. A. Brown, Stoneville, MS, for helping in the analysis and interpretation of the data.

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