Yields of Soybean Cultivars with High Cyst Nematode Levels as Affected by Tillage, Crop Rotation, and Cultivar

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Abstract

Strip-tillage (in-row chiseling), no-tillage, and conventional tillage (turnplow) systems have been evaluated for 7 years in Alabama with cropping sequences of continuous corn *(Zea mays* L.), continuous soybeans *(Glycine max* [L.] Merr.), and corn-wheat *(Triricum aestivum* sp.)-soybeans. Soybean yields for 1981 to 1984 were highly correlated with soybean cyst nematode *(Heterodera glycine* Ichinohe) (SCN) population; they were 39 percent higher with strip and no-tillage than with conventional tillage, and were 28 percent higher when rotated with corn. In 1985, strip-tillage treatments were split to include a SCN-resistant soybean cultivar, and in 1987 all tillage treatments were split to include the SCN-resistant cultivar. Soybeans yields in all tillage treatments were increased by use of a SCN-resistant cultivar, however, when crop rotation was considered, soybean yields were increased by 30 to 46 percent when compared to Essex soybean yields.

Introduction

In the first 4 years of a conservation tillage study conducted on a Hartsells fine sandy loam (tine-loamy, siliceous, thermic, Typic Hapludults) soil, conservation tillage resulted in 16 to 39 percent higher soybean yields than conventional tillage in 3 of 4 years. By the fourth year of the experiment (1983), soybean yields with conventional tillage were reduced to 690 kg ha^{-1} compared to 1,660 and 1,930 kg ha^{-1} with strip and no tillage.

A significant tillage x rotation interaction occurred in 1981, 1982, and 1983, and was probably caused by a buildup of soybean cyst nematode population. These SCN populations increased faster with conventional than with strip or no-tillage treatments. The SCN populations in 1984 were highest in all tillage systems with continuous soybeans and were lowest with no tillage when soybeans were rotated with corn. In 1985 and 1986, all strip-tillage soybeans were split so that Forrest, a SCN race three-resistant cultivar, could be compared with Essex, a non-resistant race three SCN cultivar. All tillage treatments were split to compare soybean yields in 1985 and 1986 with respect to corn-soybean rotation. The objective of this study was to follow the soybean cyst nematode population as influenced by crop rotation, conservation tillage, and soybean cultivars.

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Materials and Methods

Strip-tillage treatments consisted of planting soybeans over 20- to 22-cm-deep chisel slots. No-tillage treatments were planted with a double-disk opener planter directly into the untilled soil surface. Conventional tillage consisted of turning the wheat cover in spring, disking in herbicides, and planting. Cropping sequences were continuous soybeans; continuous corn; corn-soybeans; and corn-wheat-soybeans. Wheat was planted in the fall on all plots as a winter cover, including those plots not used for grain crop. The wheat was killed on the winter cover plots 10 days before planting corn or soybeans. The experiment was located on a Hartsells fine sandy loam soil on the Sand Mountain Substation at Crossville, Alabama in the Appalachian Plateau area of the state. The experimental design was a split plot in a randomized complete block with four replications. The corn treatment was planted in six 90-cm rows 16 m long. Essex soybeans have been used since the experiment was started in 1980. In 1984, the soybean treatments were split to include a soybean cyst nematode resistant cultivar Forrest.

Soil samples were collected in March, July, and August for nematode analysis. These samples were taken 12 to 14 cm deep under the rows of each plot. The July and August samples were taken 58 and 59 days after planting full-season and doublecropped soybeans. The full-season soybeans were planted in late May and doublecropped soybeans were planted in late June after wheat was harvested for grain. All plots were uniformly fertilized according to Auburn University soil test recommendations.

Results and Discussion

Rotating Essex soybeans with corn resulted in higher yields each year (1981-1987) than continuous soybeans (Figure 1). The 7-year average yields were 1,900 and 2,430 kg/ha for

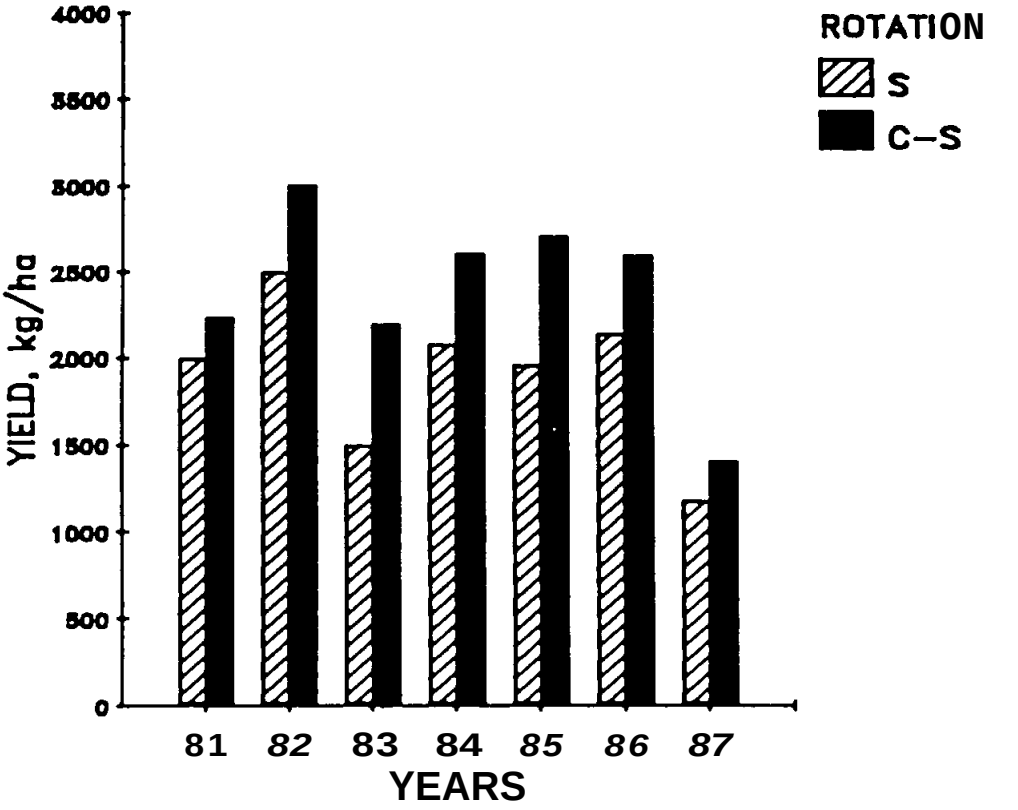

Figure 1. Seven-year average Essex soybean yields for continuous soybean and corn-soybean rotation (S = soybeans; C = corn).

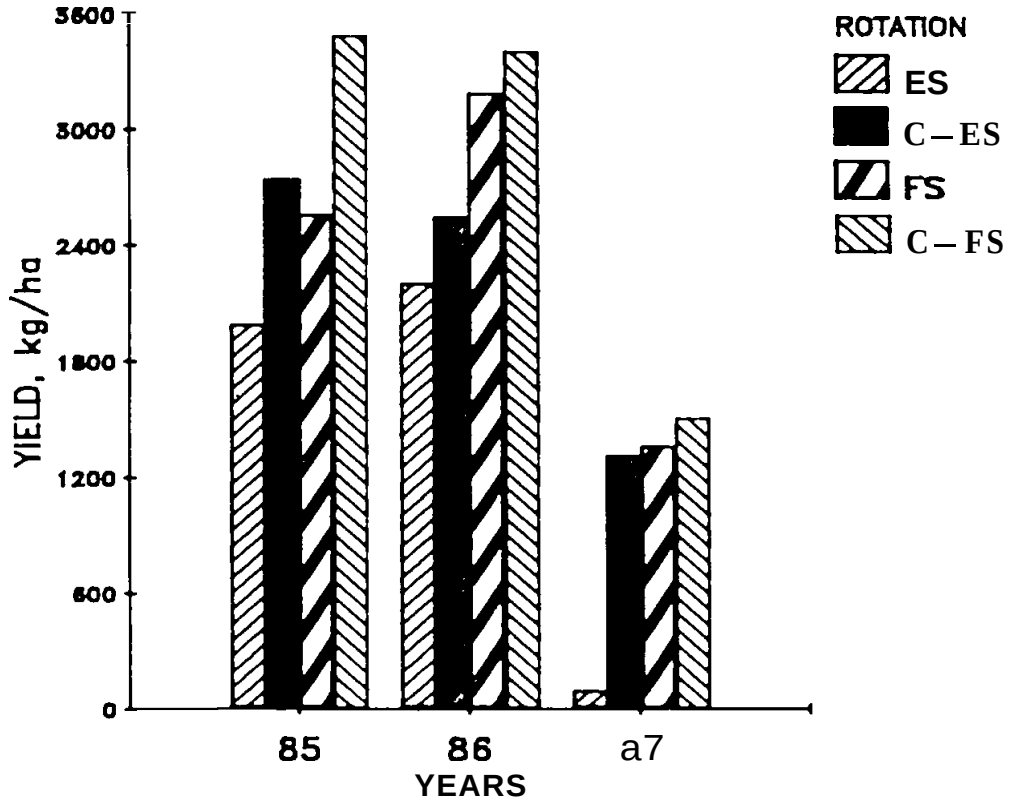

Figure 2. Three-year average Essex and Forrest soybean yields as influenced by continuous soybean and corn-soybean rotation (S = soybean; C = corn; E = Essex; F = Forrest).

continuous soybeans and soybeans grown in rotation with corn, respectively.

Within the strip-tillage system, average yields of Essex soybeans were lower the last 3 years than the first 4 years, but were higher the last 3 years than the first 4 years when SCN-resistant cultivar Forrest was planted (Table 1). The highest yields for the 3 years were obtained when a SCN-resistant soybean cultivar was rotated with corn and full-season soybeans were grown (Figure 2).

The drop in yields of Essex soybean between the first 4 years and last 3 years (Table 2) was influenced by tillage systems. The loss was smaller for no-tillage (8%) than conventional (19%) or strip-tillage (22%). However, the SCN populations were higher with no-tillage than with conventional tillage. This rate of yield loss with time could be due to the SCN populations building up very rapidly in the early stages of the tests under the conventional tillage, with these yields dropping during the second and third years.

The number of SCN counts 60 days after planting with conventional tillage declined with time (Table 3). However, yields of Essex soybeans continue to be lowest with conventional tillage, indicating that other factors may be reducing the SCN populations at a lower levels during the early years of the tests. The Essex yields are continuing to drop with low SCN populations.

Table 1. Influence of crop rotation on average soybean yields for Essex and Forrest with strip tillage.

Crop rotation	Soybean yield under strip tillage		
	Essex 4-yr avg 1981-84	Essex 3-yr avg 1985-87	Forrest 3-yr avg 1985-87
	kg ha^{-1}		
Continuous soybeans	2,034	1,720	2,410
Soybeans-corn	2,625	2,160	2,810
C-W-S*	2,445	1.680	2,450

*Corn-wheat for grain-soybeans.

Table 2. Influence of conservation tillage systems on average sovbean yields for Essex and Forrest.

Crop rotation	Soybean yields as affected by tillage		
	Essex 4-yr avg 1981-84	Essex 3-yr avg 1985-87	Forrest 3-yr avg 1985-87
	kg ha^{-1}		
Conventional	2,090	1,700	
Strip tillage	2,370	1,850	2,550
No tillage	2,400	2,200	

Table 3. Soybean cyst nematode counts found in 1985 through 1987 at Crossville, AL, with different tillage and crop rotation svstems.

Tillage systems	Soybean cyst nematode count/100 cc soil Sampled in July (60 days after planting)						
	1984	1985		1986		1987	
	Essex	Essex	Forrest	Essex	Forrest	Essex	Forrest
Corn-Soybean							
Conventional	712	260		161		134	19
Strip tillage	632	612	36	538	48	362	12
No-tillage	216	149		399		171	13
Continuous Soybeans							
Conventional	586	303		126		91	21
Strip tillage	779	627	133	238	23	510	52
No-tillage	797	426		310		264	128

Related Literature

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