Effects of Tillage, Row Width, and Cultivar on Foliar Diseases of Double-Crop Soybean

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ABSTRACT

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Experiments were conducted over two years, 1985 and 1986, to determine the effect of tillage systems, row widths, and soybean cultivars on foliar diseases in double-crop soybean. The soybean cultivars Pershing, susceptible to bacterial blight, and Avery, resistant to bacterial blight, were each planted in 38-cm and 75-cm row widths in soil under conventional tillage or no-tillage following winter wheat. There was a significant interaction ($P = 0.0001$) between tillage and cultivar for the severity of bacterial blight and a significant interaction ($P = 0.001$) for tillage, cultivar, and year for the severity of brown spot. Tillage did not influence bacterial blight severity on Avery; however, disease severity was higher on Pershing soybean in tilled plots. Generally, brown spot severity was higher in 1986 than in 1985, lower on Avery than Pershing in both years, and higher in tilled than no-tilled conditions. Row width did not affect the severity of these diseases.

Planting soybean, *Glycine max* (L.) Merr., in fields soon after the winter wheat crop is harvested is a common practice and is referred to as double-crop. In southern Missouri, about 50% of the soybean acreage is planted this way. Most of these fields are tilled before planting soybean. About 50% of the fields are planted to wide rows, 75 cm or more, and the others are planted to narrow rows, 38 cm or less.

Tillage before planting full-season soybean can affect the severity of diseases such as brown spot (12), purple seed stain (11), and stem canker (8,12). However, the effect of tillage on diseases in double-crop soybean has not been described. The effect of row width on diseases of double-crop soybean also is unknown.

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Our objectives were to determine the effect of tillage, row width, and cultivar on foliar diseases in double-crop soybean, and to determine if disease severity varied by cultivar.

MATERIALS AND METHODS

Double-crop soybean plots were established at Portageville, Missouri, on a Tiptonville sandy loam soil (Typic Argiudolls) consisting of 70% sand, 25% silt, and 5% clay. The soil, pH 6.0, contained a tillage pan 7.5-cm thick and 15-cm below the surface of the soil. The field was planted to cotton, *Gossypium hirsutum* L., the previous year. Wheat, *Triticum aestivum* L. 'Caldwell', was planted no-till in the fall after the cotton was harvested and each subsequent year after the soybean plots were harvested. Each year after wheat harvest in early June, the soil was tilled by subsoiling to a depth of 45 cm with parabolic shanks spaced 50-cm apart and followed with a light disking, or it was left undisturbed. Soybean was then planted between 10 and 20 June each year. Each soybean plot (3.1-m wide and 9.1-m long) was treated with a preemergence application of alachlor at 0.4 kg a.i./ha plus imazaquin at 0.14 kg a.i./ha. All plots were irrigated by overhead sprinkler after planting (equivalent to 2.5 cm) to activate herbicides and enhance soybean germination. Plots were weeded by hand if necessary but not cultivated.

The experiment was a split-plot design with whole-plot treatments arranged in a randomized complete block design with four replications. Whole plots were two tillage treatments, till and no-till. Subplots were Pershing and Avery soybean, each planted in row widths of 37.5 and 75 cm.

The severity of brown spot, caused by *Septoria glycines* (4), and bacterial blight, caused by *Pseudomonas syringae* pv. *glycinea* (3), was estimated on trifoliate leaves within the center 2.4 × 9.1 m area of each plot using a modified 0–5 rating scale (1) at the R1 stage of soybean growth (2): 0 = no symptoms, 1 = 1–20% leaf area with symptoms, 2 = 21–40%, 3 = 41–60%, 4 = 61–80%, and 5 = 81–100%.

Foliar disease severity ratings were subjected to an appropriate analysis of variance (9). Fisher's least significant difference test was used for mean comparison ($P < 0.05$) (5).

RESULTS

Analysis of variance (ANOVA) indicated a significant tillage-by-cultivar interaction for severity of bacterial blight with no differences observed between years and row widths (Table 1). Bacterial blight severity was considerably less on Avery than on Pershing. Tillage did not influence bacterial blight severity on Avery, whereas disease severity was higher on tilled than on no-tilled Pershing soybean (Table 2).

ANOVA indicated a significant year-by-tillage-by-cultivar interaction for se-

Table 1. Analysis of variance for effect of tillage, soybean cultivar, and row width on brown spot and bacterial blight severity[a]

Source of variation	df	Mean square[b] Bacterial blight	Brown spot
Year (Y)	1	0.141	17.015**
Error A	6	0.245	0.536
Till (T)	1	5.641**	17.016****
Y × T	1	0.016	2.641**
Error B	6	0.203	0.203
Width (W)	1	0.142	0.391
Y × W	1	0.016	0.391
T × W	1	0.016	0.766
Y × T × W	1	0.391	0.016
Cultivar (C)	1	70.141****	31.640****
Y × C	1	0.016	0.016
T × C	1	5.641****	0.391
W × C	1	0.766	0.016
Y × T × C	1	0.156	3.516***
Y × W × C	1	0.141	0.016
T × W × C	1	0.016	0.766
Y × T × W × C	1	0.391	0.016
Error C	36	0.224	0.203

[a] Disease severity was evaluated at the R1 stage of cvs. Avery and Pershing soybean growth in till and no-till plots.
[b] Significance levels: ** $P = 0.01$; *** $P = 0.001$; **** $P = 0.0001$.

Table 2. Effect of tillage and soybean cultivar on bacterial blight severity

Tillage	Disease severity[a,b] cv. Avery	cv. Pershing
No-till	0.063	1.56
Till	0.063	2.75

[a] Disease severity was evaluated at the R1 stage of soybean growth on a scale of 0–5, for which 0 = no symptoms and 5 = 81–100% leaf area with symptoms.
[b] Fisher's least significant difference ($P < 0.05$) for comparison of cultivar within a tillage was 0.3397 and for comparison of tillage, same or different cultivar, was 0.3517.

Table 3. Effect of tillage, soybean cultivar, and year on brown spot severity

Year Tillage	Disease severity[a,b] cv. Avery	cv. Pershing
1985		
No-till	0	0.75
Till	0	2.00
1986		
No-till	0.13	1.88
Till	1.88	3.00

[a] Disease severity was evaluated at the R1 stage of soybean growth on a scale of 0–5, for which 0 = no symptoms and 5 = 81–100% leaf area with symptoms.
[b] Fisher's least significant difference ($P < 0.05$) for comparison of cultivar, same year and tillage, was 0.4575; for comparison of cultivar, same year, and same or different tillage, was 0.4809; and for comparison of cultivar, different year, and same or different tillage, was 0.5412.

verity of brown spot (Table 1). Row width did not influence brown spot. Generally, brown spot severity was higher in 1986 than in 1985 (Table 3) and was lower on Avery than on Pershing in both years. Brown spot severity was higher in tilled than in no-tilled conditions.

DISCUSSION

Brown spot and bacterial blight were the only foliar diseases observed in our test. Both were less severe in no-till than in tilled double-crop soybean plantings. This is the first time this has been reported. We do not know why the severity of these two diseases was less in no-till than in conventional till. The wheat mulch in the no-till plots may reduce splash transmission of inoculum from residue to seedlings as hypothesized by Sumner et al (10).

Brown spot was less severe on full-season soybean under no-till than under tilled conditions in Tennessee (12). It appears that brown spot is less severe in no-till than conventional-till plantings of both full-season and double-crop soybean. Unfortunately, this is not the case with all foliar diseases. Stem canker was more severe in no-till than in tilled full-season soybean in Tennessee (12) and North Carolina (8).

There is a trend to more conservation-till and no-till culture of soybean (6). Planting resistant cultivars may alleviate some disease problems accentuated by no-till culture. During this study the resistant cultivar, Avery, had significantly less foliar disease than cv. Pershing.

In our test, row width did not affect the severity of bacterial blight or brown spot. This finding differs from that of Mmbaga et al (7) in which the brown spot disease index was higher in narrow-row (18 cm) than wide-row (76 cm) full-season soybean. Double-cropping soybean may account for these differences.

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LITERATURE CITED

1. Backman, P. A., Rodriguez-Kabana, R., Hammond, J. M., and Thurlow, D. L. 1979. Cultivar, environment, and fungicide effects on foliar disease losses in soybeans. Phytopathology 69:562-564.
2. Fehr, W. R., Caviness, C. E., Burmoood, D. T., and Pennington, J. S. 1971. Stage of development descriptions for soybeans, *Glycine max* (L.) Merr. Crop Sci. 11:929-931.
3. Kennedy, B. W., and Sinclair, J. B. 1989. Bacterial blight. Pages 5-6 in: Compendium of Soybean Diseases. 3rd ed. J. B. Sinclair and P. A. Backman, eds. American Phytopathological Society, St. Paul, MN.
4. Lim, S. M. 1989. Brown spot. Pages 15-16 in: Compendium of Soybean Diseases. 3rd ed. J. B. Sinclair and P. A. Backman, eds. American Phytopathological Society, St. Paul, MN.
5. Little, T. M., and Hills, F. J. 1978. Agriculture Experimentation. John Wiley & Sons, New York.
6. Mangold, G. 1992. CRM acres climb. Soybean Dig. 3:40-41.
7. Mmbaga, M. T., Grau, C. R., and Arny, D. C. 1979. Septoria brown spot of soybeans: Effect of row width and tillage practices on disease development. (Abstr.) Phytopathology 69:541.
8. Rothrock, C. S., Phillips, D. V., and Hobbs, T. W. 1988. Effects of cultivar, tillage, and cropping system on infection of soybean by *Diaporthe phaseolorum* var. *caulivora* and southern stem canker symptom development. Phytopathology 78:266-270.
9. SAS Institute. 1988. SAS/STAT User's Guide. Release 6.03. SAS Institute, Cary, NC.
10. Sumner, D. R., Doupnik, B., and Boosalis, M. G. 1981. Effects of reduced tillage and multiple cropping on plant diseases. Annu. Rev. Phytopathol. 19:167-187.
11. Tyler, D. D., and Overton, J. R. 1982. No-tillage advantages for soybean seed quality during drought stress. Agron. J. 74:344-347.
12. Tyler, D. D., Overton, J. R., and Chambers, A. Y. 1983. Tillage effects on soil properties, diseases, cyst nematodes, and soybean yields. J. Soil Water Conserv. 38:374-376.