

DISEASE AND NEMATODE PROBLEMS IN NO-TILL SOYBEANS

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INTRODUCTION

One of the unanswered questions related to no-till production of soybeans concerns the probability of increasing disease and nematode problems. Destruction of old plant residue by plowing the soil, especially deep plowing, has long been a fundamental practice for disease control in soybeans and other crops (1, 3). Under no-till production, plant residues remain on the soil surface, and disease severity would be expected to increase if the practice were continued for a number of years,

Much of the soybean acreage in Tennessee is infested with the soybean cyst nematode. Varieties that perform well under no-tillage and comprise a large portion of the acreage are susceptible to either race 4 or to both races 3 and 4. Growing soybeans continuously also would be expected to increase cyst nematode populations.

Research was initiated in 1979 at the University of Tennessee Milan Experiment Station at Milan designed to study the effects of no-tillage on the incidence of foliar diseases of soybeans. Additional studies were begun in 1980 at Milan to compare population dynamics of the soybean cyst nematode, crop injury, and yields of soybeans double-cropped with wheat under no-tillage and conventional-tillage conditions.

MATERIALS AND METHODS

Plots (13 1/3 x 60 ft., 6 reps) for investigating soybean foliar diseases were established in the fall of 1979 by seeding wheat in plots that were to be double-cropped with soybeans. Soil sampling indicated the plot area to be free of cyst nematodes. 'Essex' soybean was planted by both no-tillage and conventional methods after wheat was harvested in the spring of 1980. A conventional single-crop planting of soybeans (without wheat in the previous winter) was also made. Conventional plantings were made in 40-in. rows; no-till plantings were made in 20-in. rows. Observations were made of foliar diseases throughout the season. Disease ratings were made shortly before harvest when yields were recorded. Wheat was seeded in the fall of 1980 by conventional and no-tillage (simulated aerial seeding) methods. Work was continued without change in 1981 and 1982.

An additional experiment was set up in 1980 on a nematode-infested area to study the effects of no-tillage on cyst nematode populations. A nematode-susceptible variety was planted in the plot area during 1980 to increase the

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existing nematode population. Wheat was seeded in the fall in plots (13 1/3 x 60 ft., 6 reps) to be double-cropped. 'Essex' soybean was planted in the spring of 1981 using no-tillage and conventional-tillage methods as above. Wheat was seeded in the fall by both methods. Plots were sampled at planting, midseason, and harvest to determine any changes in nematode populations. Plots were harvested to obtain yields. Work was continued similarly in the same plots in 1982. Foliar disease and stem canker ratings were also made in 1982.

RESULTS AND DISCUSSION

Severity of Septoria brown spot was lower in 1980 in no-tillage soybean plots than in conventional-tillage, single-crop plots (Table 1). Brown spot was even less severe in conventional-tillage, double-crop plots possibly due to later planting and hot, dry weather present in 1980. Anthracnose was less severe on pods in no-tillage plantings while more was observed on stems. Yields were slightly higher in double-crop plots, possibly due to late-season rains that came before the later-planted soybeans had matured.

Brown spot severity was lower in no-tillage plots in 1981 and 1982 (Tables 2 and 3). Anthracnose injury was less on pods in no-till plots in 1982 and greater on stems both years. Yields were not significantly different in any of the plantings in 1981. Yields in no-till plots were generally higher than in conventional-tillage plots in 1982.

Soybean cyst nematode levels (cysts) increased three- to six-fold in plots planted conventionally in 1981 while increases ranged from none to two-fold in no-tillage plantings (Table 4). Yields were also significantly higher in no-tillage plots than in conventional-tillage, double-cropped plantings but not higher than in single-crop soybeans. Some of the yield increases may have been due to narrower rows in no-till plantings.

In 1982, cyst levels increased one and one-half to almost three times during the season in conventional-tillage plots while there was no increase in no-tillage plots (Table 5). Yields were again generally higher in no-tillage plantings. Brown spot incidence was lower in no-tillage plots in the nematode experiment while anthracnose injury was less on pods and greater on stems (Table 6). Stem canker symptoms appeared late in the season, but injury, although only moderate, was significantly greater in no-till plots.

Following no-tillage research at the University of Tennessee West Tennessee Experiment Station at Jackson in 1980, Tyler and Overton (2) reported that seed quality was higher and purple stain incidence was lower in soybeans produced in no-till plots compared to those produced in plots of five different variations of conventional-tillage. Soybeans produced in the no-till plots in the present study at Milan were of higher quality and germinated slightly better than those from conventional-tillage plots, especially in the hot, dry season of 1980.

In later work at the West Tennessee Experiment Station at Jackson, brown spot was found to be greatly reduced in no-till soybean plots compared to conventional-tillage plots (D. D. Tyler, Personal Communication). Cyst nematode counts were from three to six times higher in conventional-tillage plots than in no-till plots at the end of the 1982 season. Stem canker appeared in Jackson plots late in the season in 1982 and did not cause severe injury, but

Table 1. Effects of no-tillage on soybean foliar diseases, Milan Experiment Station, Milan, TN, 1980.

Tillage Treatment	Disease Severity (0-9)			Yield, Bu./A.
	Leaf	Pod	Stem	
Soybeans conventional, no wheat in winter	6.3 a	8.5 a	6.8 c	13.5 c
Soybeans conventional, wheat conventional	4.1 c	7.6 b	7.3 b	18.4 ab
Soybeans conventional, wheat no-till	4.3 c	7.8 b	7.4 b	18.9 ab
Soybeans no-till, wheat conventional	5.3 b	7.0 c	8.2 a	18.0 b
Soybeans no-till, wheat no-till	5.1 b	6.6 d	8.5 a	20.9 a

'Essex' planted 5/20 (single-crop) and 6/27 (double-crop); 'McNair 1003' wheat. Leaf ratings were of brown spot; pod and stem ratings were of anthracnose. Soybeans harvested 10/13 and 21.

Table 2. Effects of no-tillage on soybean foliar diseases, Milan Experiment Station, Milan, TN, 1981.

Tillage Treatment	Disease Severity (0-9)			Yield, Bu./A.
	Leaf	Pod	Stem	
Soybeans conventional, no wheat in winter	8.7 a	8.7 a	8.2 b	47.1 a
Soybeans conventional, wheat conventional	8.4 ab	7.8 b	8.4 b	40.5 a
Soybeans conventional, wheat no-till	8.2 b	7.6 b	8.3 b	41.1 a
Soybeans no-till, wheat conventional	7.3 c	7.8 b	9.0 a	44.8 a
Soybeans no-till, wheat no-till	7.3 c	7.7 b	8.8 a	44.3 a

'Essex' planted 5/21 (single-crop) and 6/18 (double-crop); 'McNair 1003' wheat. Leaf ratings were of brown spot; pod and stem ratings were of anthracnose. Soybeans harvested 10/29.

Table 3. Effects of no-tillage on soybean foliar diseases, Milan Experiment Station, Milan, TN, 1982.

Tillage Treatment	Disease Severity (0-9)			Yield, Bu./A.
	Leaf	Pod	Stem	
Soybeans conventional, no wheat in winter	8.8 a	8.2 a	8.4 a	31.8 c
Soybeans conventional, wheat conventional	8.3 b	6.5 b	6.5 c	34.9 bc
Soybeans conventional, wheat no-till	8.1 b	6.4 b	6.7 c	36.9 b
Soybeans no-till, wheat conventional	7.3 c	4.8 c	7.8 b	35.9 b
Soybeans no-till, wheat no-till	6.9 c	4.7 c	7.9 b	41.9 a

'Essex' planted 5/12 (single-crop) and 6/18 (double-crop); 'Arthur' wheat. Leaf ratings were of brown spot; pod and stem ratings were of anthracnose. Soybeans harvested 10/21.

Table 4. Effects of no-tillage on soybean cyst nematode populations, Milan Experiment Station, Milan, TN, 1981.

Tillage Treatment	Cysts/Pt.		Yield, Bu./A.
	6/24	10/30	
Soybeans conventional, no wheat in winter	75 a	196 ab	44.9 a
Soybeans conventional, wheat conventional	47 a	285 a	35.1 b
Soybeans conventional, wheat no-till	61 a	196 ab	35.7 b
Soybeans no-till, wheat conventional	112 a	117 b	43.2 a
Soybeans no-till, wheat no-till	75 a	159 b	42.7 a

'Essex' planted 5/21 (single-crop) and 6/18 (double-crop); 'McNair 1003' wheat. Soybeans harvested 10/29.

Table 5. Effects of no-tillage on soybean cyst nematode populations, Milan Experiment Station, Milan, TN, 1982.

Tillage Treatment	Cyst/Pt.		Yield, Bu./A.
	5/21	10/26	
Soybeans conventional, no wheat in winter	88 a	138 a	38.4 a
Soybeans conventional, wheat conventional	43 a	115 ab	33.2 b
Soybeans conventional, wheat no-till	63 a	120 ab	38.7 a
Soybeans no-till, wheat conventional	65 a	62 b	42.4 a
Soybeans no-till, wheat no-till	62 a	58 b	41.6 a

'Essex' planted 5/12 (single-crop) and 6/18 (double-crop); 'Arthur' wheat. Soybeans harvested 10/21.

Table 6. Effects of no-tillage on soybean foliar diseases and stem canker, Milan Experiment Station, Milan, TN, 1982.

Tillage Treatment	Disease Severity (0-9)			Stem Canker Rating (0-5)
	Leaf	Pod	Stem	
Soybeans conventional, no wheat in winter	8.8 a	8.6 a	8.8 a	0.3 d
Soybeans conventional, wheat conventional	7.6 b	7.2 b	6.9 c	1.4 cd
Soybeans conventional, wheat no-till	7.1 c	7.1 b	6.7 c	1.4 c
Soybeans no-till, wheat conventional	6.3 d	4.9 c	8.2 b	1.7 b
Soybeans no-till, wheat no-till	5.8 e	4.8 c	8.0 b	2.2 a

'Essex' planted 5/12 (single-crop) and 6/18 (double-crop); 'Arthur' wheat. Leaf ratings were of brown spot; pod and stem ratings were of anthracnose.

incidence was much higher in no-tillage plots than in conventional-tillage plots. Yields were greatly reduced in plots which were prepared using a mold-board plow and in which nematode counts were highest.

SUMMARY AND CONCLUSIONS

Disease ratings of *Septoria* brown spot were lower in no-till plots than in conventional-tillage plots in all three seasons (1980-82). Incidence of anthracnose was lower on pods but was slightly higher on stems.

Build-up of cyst nematodes was much less under no-tillage than under conventional-tillage in 1981 and 1982. Stem canker appeared late in the nematode experiment in 1982 but was more severe in the no-tillage plots.

Results obtained from the above experiments indicate that some build-up of disease and nematode problems may be expected in soybeans grown under no-till conditions but that increases will probably be no more rapid, or possibly less rapid, than in conventional-tillage. In the case of brown spot and anthracnose on pods, disease severity was lower under no-tillage. Cyst nematode populations increased more slowly in no-till soybeans. Stem canker may be more severe in no-tillage, but more work is needed before a definite conclusion can be made. Additional work is also needed on other diseases and nematodes.

REFERENCES

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