Effects of Tillage Systems on Southern Blight and Pod Yields of Five Runner Peanut Genotypes

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ABSTRACT

Four runner-type peanut (*Arachis hypogaea* L.) cultivars, moderately resistant to *Pythium myriotylum* pod rot and/or southern blight (*Sclerotium rolfsii*), and Florunner were compared under full-tillage, minimum-tillage, and no-tillage cultural systems from 1985 to 1987. Disease, yield, and grade evaluation were made to ascertain if the soilborne disease resistance would be beneficial to peanut production under minimum-tillage systems. Averaged over genotypes, yield was 500 kg/ha more with full-than no-tillage. In one of three years, Florunner yielded less than the highest yielding cultivar. Neither pod rot nor southern blight was a major deterrent to minimum-tillage production. Genotype differences in number of southern blight infection sites, over tillage systems, occurred in two years but the relative disease incidence was inconsistent among cultivars over years. More pod discoloration occurred in Florunner than in all other cultivars in two of three years. Percent sound mature kernels (SMK) + percent sound-split kernels (SS) averaged 3.6% less for the no-tillage than for the full-tillage system, and in all years the grade for Florunner was as good or better than for all other cultivars. A significant genotype x tillage system interaction was apparent for SMK + SS. TX835820 and TX835841 grades were significantly lower with no-tillage systems while other cultivars produced no significant changes in grade.

Key Words: Groundnut, *Sclerotium rolfsii*, southern blight, no-tillage, minimum-tillage.

The use of minimum-tillage and no-tillage production practices has reduced production costs in corn, grain sorghum, soybeans, and other crops (1, 10, 13, 14, 15, 16, 18, 19, 21). However, limited research (2, 3, 4, 5, 6, 7, 8, 9, 11) has been reported with the use of no-tillage cultural practices in peanuts. Minimum-tillage or no-tillage production practices reduce soil erosion and water runoff. Unger and co-workers (19) noted that crop residue on the soil surface nearly eliminated erosion problems. Musick *et al.* (14) reported that a heavy mulch after irrigated wheat increased soil water storage 6 cm in an 11-month fallow. The extra soil water increased subsequent grain sorghum yield by 1120 kg/ha.

Peanut pod yields with minimum-tillage and no-tillage have varied among locations. Wright and Porter (22) stated that no-tillage peanuts matured later than conventionally tilled peanuts and produced lower pod yields and grade than peanuts produced with full-tillage. Colvin and co-workers (4) stated that peanut yields were higher in several minimum-tillage systems with in-row subsoiler than those produced with full-tillage methods. They found that peanut grade was not influenced by a minimum-tillage system, while Hartzog and Adams (12) found that the elimination of deep tillage did not affect either yield or grade.

In early work by Boswell and Grichar (2, 3), Florunner no-tillage plots yielded 1000 to 1200 kg/ha less than full-tillage, while the minimum-tillage plots were intermediate in yield. They also reported southern blight was a major problem in the plots with surface residue. A later study by Grichar and Boswell (11) reported yield reductions of 600 to 2400 kg/ha with no-tillage system, as compared with full-tillage, without an increase in southern blight development.

Varnell *et al.* (20) stated that no-till peanuts had reduced pod yield and quality. In comparison with conventional cultural practices, no-tillage reduced foliage, pod, and kernel yields by 58, 64, and 62 percent, respectively. Rajan *et al.* (17) conducted no-tillage research in India and found that no-tillage did not reduce pod yields. They found that sandy loam soil facilitated easy peg penetration and pod development, and higher soil moisture retention in no-tillage plots accounted for no yield reductions.

Surprisingly, in many cases, southern blight has not become a severe problem in the no-tillage system (6, 11, 12). Grichar and Boswell (11) found southern blight was a disease problem in no-tillage plots in only one of four years. Hartzog and Adams (12) stated that elimination of deep plowing did not affect white mold hits. Colvin *et al.* (6) reported that *Sclerotium rolfsii* occurred more frequently in full-tillage plots than in the strip-tillage or no-tillage treatments in 1984, while in 1985 disease development was less in no-tillage and full-tillage than strip-tillage plots.

Colvin and Brecke (7) found that minimum-tillage did not affect peanut yield, and the cultivars used did not differ in response to tillage system. They concluded that there was no immediate need for peanut cultivar performance testing in different tillage systems.

The objectives of this study were to evaluate plant growth, pod yield, grade and disease response of Florunner and four runner type peanut breeding lines, which have shown moderate soilborne disease resistance, in field screening tests under full-tillage, minimum-tillage, and no-tillage peanut culture.

Materials and Methods

Florunner and four runner type breeding lines with Florunner and PI 365553 parentage were evaluated under three tillage systems. The four runner type breeding lines were selected on the basis of performance in previous field tests with heavy disease pressure.

The systems compared in this study included minimum-, no-, and full-tillage in small plot tests from 1985 to 1987 on Experiment Station land at Yoakum, Texas. Annual ryegrass (*Lolium multiflorum* Lam.) was planted in the fall and grown uniformly during the winter months in the test area. Under full-tillage, the cover crop was shredded; soil was turned with a moldboard plow, disced, bedded, and beds were leveled for planting. Preplant herbicides were applied and incorporated and peanuts were then planted. In minimum-tillage, all steps remained the same as above except for the omission of the moldboard plow. In no-tillage, the cover crop was shredded to a height of 25-30 cm and a herbicide applied to kill all vegetation. Peanuts were then planted into the stubble and preemergence herbicides applied. No in-row subsoiling of minimum- or no-tillage plots was attempted. There was no cultivation in any of the tillage systems, but postemergence herbicides were applied as necessary to control weeds.

Paraquat (1, 1'-dimethyl-4,4'-bipyridinium ion) at 0.84 kg ai/ha or glyphosate [N-(phosphonomethyl)glycine] at 2.4 kg ai/ha in 187 L/ha of water was sprayed broadcast over the no-till areas to kill all existing

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Table 1. Yield of peanuts for five cultivars grown under three tillage systems (1985-1987).

Tillage Systems or Cultivars	Years 1985 (kg/ha)	1986	1987	Avg.
	Tillage System			
Full	2196	3430	2419	2682 a[1/]
Minimum	1354	2685	1856	1965 b
No	1714	2859	1975	2183 b
	Cultivars			
Florunner	1872 a	3357 a	2020 b	2416
TX835820	1563 b	2514 b	1517 b	1865
TX835841	1804 a	3116 a	2303 ab	2408
TX833841	1676 ab	3017 a	2435 a	2376
TX833843	1862 a	2952 ab	2157 ab	2324

[1/]Means for each parameter within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

vegetation prior to planting peanuts. A tank mix of trifluralin [2, 6-dinitro-N, N-dipropyl-4-(trifluoromethyl)benzenamine] at 0.56 kg ai/ha plus metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] at 1.68 kg ai/ha was preplant incorporated 7.6 cm deep with a power tiller in the full-tillage and minimum-tillage plots. In the no-tillage plots, the trifluralin plus metolachlor tank mix was applied preemergence. 2, 4-DB [4-(2, 4-dichlorophenoxy)butanoic acid], bentazon [3-(1-methylethyl)-(1H)-2, 1, 3-benzothiadiazin-4(3H)-one 2,2-dioxide], and sethoxydim [2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] were applied postemergence one to two times during the growing season to control broadleaf weeds, yellow nutsedge (*Cyperus esculentus* L.), and Texas panicum (*Panicum texanum* Buckl.), respectively.

Tillage treatments were arranged in a randomized split-plot complete block design 10 rows wide with four replications. Subplots were two rows wide (row width 0.9 m) by 10.7 m long. The main plot treatments were tillage system, while subplot treatments were peanut genotypes. Soil type was a Tremona loamy fine sand (Clayey, mixed, thermic Aquic Arenic Palenstalfs) with a pH of 7.4 and 1% organic matter. Seed (350 per 2 row plot) were planted for each genotype on July 10, June 26, and June 25 in 1985, 1986, and 1987, respectively. Peanuts were dug on November 22 when 135 days old in 1985, November 11 when 138 days old in 1986, and November 19 when 147 days old in 1987. Plots were irrigated with a sprinkler system throughout the growing season as needed. Leafspot and insect control was consistent with Extension Service recommendations.

After digging, southern blight disease loci (a locus is 31 cm or less of row which has been killed by the southern blight fungus, *Sclerotium rolfsii*) were recorded. *Sclerotium rolfsii* was isolated in the laboratory from randomly selected pods to establish the presence of the pathogen. Diseased tissue from pods was placed on potato dextrose agar (PDA) containing 20 mg streptomycin sulfate. Plates were incubated at 26C for 72 hr. All isolates were subcultured on PDA. Pod samples (approximately 450 grams) for disease evaluation were randomly handpicked after digging and prior to combining. Visual ratings were used to determine the amount of southern blight damage to pods. A rating scale of 0-10 (0=no disease, 10=completely diseased) was used to determine severity of southern blight on pod tissue. After threshing, samples were dried to 12% moisture, foreign material was removed from samples, pod weights recorded, and percent sound mature kernels + percent sound splits (SMK+SS) determined for each plot. The data were subjected to analysis of variance and significant differences were determined by Duncan's multiple range test.

Results and Discussion

Analysis of data pooled over years indicated that the year by cultivar interaction was significant for yield, SMK+SS, infection hits, and pod disease ratings; therefore, each year is analyzed separately. The year by tillage interaction was significant only for the pod disease rating; therefore, only that data is analyzed separately. Because the cultivar by tillage interaction for SMK+SS was significant, these data are presented for each cultivar. No year by cultivar by tillage interaction was observed.

The full-tillage plots produced a significant yield increase over the minimum-and no-tillage plots when averaged over the five cultivars and three years (Table 1). In earlier work with Florunner, Grichar and Boswell (11) reported higher yields in full-tillage compared with no-tillage. Florunner produced significantly more peanuts than TX835820 in 1985 and 1986. In 1987 TX833841 produced more than Florunner.

No attempt was made to schedule digging dates according to pod maturity among the tillage systems; all plots were dug simultaneously. Multiple digging dates for the various tillage systems or digging each treatment at optimum maturity would have provided a better comparison of treatments. This is especially true since the breeding lines tend to mature slower than Florunner, and most of these diggings were scheduled for Florunner.

A significant cultivar by tillage system interaction occurred for percent SMK+SS. TX835820 and TX835841 grades were significantly reduced by the no-tillage system (Table 2). The lower grades could be the result of genotypic differences or a lack of peanut maturity. Similar observations were made by Wright and Porter (22). Colvin and Brecke (7), however, reported no differences in quality, as measured by grade, due to tillage systems. Florunner was the only common cultivar in our experiment and those of Colvin and Brecke. TX833843 was consistent in producing a lower grade over the 3-year period regardless of tillage system, while Florunner and TX833841 were not affected by tillage system.

The mean number of infection sites caused by *Sclerotium rolfsii* across years did not differ significantly among tillage systems (Table 3). In 1985, more than twice the number of infection sites occurred in full-tillage than in no-tillage plots. Several other researchers (6, 11, 12) have also found that minimum-tillage compared to full-tillage did not increase S. rolfsii. Colvin and co-workers (6) postulated that leachates from wheat straw might have a significant negative effect on

Table 2. Percent sound mature kernels plus sound split kernels of cultivars as influenced by tillage system (1985-1987).

Cultivar	TILLAGE SYSTEM Full (SMK + SS)[1/]	Minimum	No	Mean
Florunner	71.8 ab[2/]	69.1 ab	70.0 ab	70.3
TX835820	67.4 ab	67.4 ab	62.9 cd	65.9
TX835841	67.8 ab	66.9 bc	61.9 d	65.5
TX833841	72.6 a	70.9 ab	69.3 ab	70.9
TX833843	61.9 d	60.9 d	59.6 d	60.8
Mean	68.3	67.0	64.7	

[1/]Percent sound mature kernels plus percent sound splits.

[2/]Means within tillage systems followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Table 3. Effect of tillage systems and cultivars on southern blight incidence.

Tillage Systems or Cultivars	1985	1986	1987	Avg.
	(disease loci/plot[1])			
Tillage System				
Full	6.0	11.2	5.5	7.6 a[2]
Minimum	4.1	10.4	4.3	6.3 a
No	2.6	9.3	5.6	5.8 a
Cultivars				
Florunner	4.8 a	8.8 bc	9.3 a	7.6
TX835820	4.2 a	15.7 a	2.8 c	7.3
TX835841	3.1 a	9.2 b	6.9 b	6.4
TX833841	5.8 a	13.0 ab	2.3 c	7.0
TX833843	3.1 a	4.7 c	4.3 c	4.0

[1]A disease locus consists of 31 cm or less of row which has been killed by S. rolfsii. Plots consisted of 21.4 m of linear row.

[2]Means for each parameter within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

the germination of sclerotia, thereby reducing the incidence of *S. rolfsii* in minimum- or no-tillage peanuts.

The number of infection sites in TX833843 in each of the three test years was generally low, but differences were significant in only 1986 and 1987. The number of infection sites for TX835820 and TX833841 was generally high in 1986.

Sclerotium rolfsii was commonly isolated from symptomatic pods. *Rhizoctonia solani* Kuhn also was isolated from some of the pod tissue, but was not considered serious enough to warrant evaluation.

The amount of pod disease caused by S. rolfsii was not significantly different among tillage systems (Table 4). Thus, differences in the organic matter present in the minimum- or no-tillage plots did not result in an increase in pod disease. Florunner had significantly more pod disease than the other entries in two of the three test years. The disease severity for TX835820 was significantly less than Florunner for all years.

Yield of breeding lines were generally lower than that of Florunner even though disease incidences were generally lower in the breeding lines. This maybe due to the delayed maturity of the breeding lines. Also, yields across all cultivars were generally lower in minimum- and no-tillage plots than in full-tillage. Disease did not appear to be a major constraint in these tests. Grichar and Boswell (7) attributed reduced yields for the no-tillage system to poor weed control (especially annual grasses) and problems with digging due to soil compaction. However, with the clearance of sethoxydim and fenoxaprop [(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid] for use on peanuts, control of annual grasses is less of a problem. Factors which have not been addressed must play an important part in reduced performance of the minimum-tillage systems.

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Table 4. Effect of tillage systems and cultivars on peanut pod disease caused by *S. rolfsii.*

Tillage Systems or Cultivars	1985	1986	1987	Avg.
	Disease Rating[1]			
Tillage System				
Full	0.6 a[2]	0.8 a	1.2 b	0.8
Minimum	0.8 a	0.9 a	1.8 a	1.2
No	0.6 a	1.2 a	1.6 ab	1.1
Cultivars				
Florunner	0.9 a	1.7 a	2.0 a	1.5
TX835820	0.4 b	0.7 bc	1.4 b	0.8
TX835841	0.7 ab	0.9 b	1.4 b	1.0
TX833841	0.6 ab	0.6 c	1.3 b	0.8
TX833843	0.7 ab	0.7 bc	1.5 b	1.0

[1]Pod disease index: 0=no disease; 10=completely diseased.

[2]Means for each parameter within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

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