Peanut Cultivar Response to Tillage Systems[1]

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ABSTRACT

Field experiments were conducted during 1984 and 1985 at Williston, Florida on a Zuber loamy sand (fine, mixed hyperthermic Ultic Hapludalfs) and at Jay, Florida in 1985 on a Red Bay sandy loam (fine-loamy, siliceous, thermic Rhodic Paleudults) to investigate the effects of conventional and minimum tillage on the grade and yield of eight peanut (*Arachis hypogaea* L.) cultivars. Cultivars studied included: 1) three runner-type peanuts - Florunner, Sunrunner, and GK-7, 2) four virginia-type peanuts - Early Bunch, Florigiant, GK-3, and NC-7, and 3) one spanish-type peanut - Valencia C. Conventional plots were established using a moldboard plow with repeated diskings to provide a smooth even seedbed. Minimum-tillage plots were established using a modified Brown-Harden Ro-Till®. Tillage did not affect peanut yield, and cultivars generally did not differ in response to tillage systems. There appears to be no immediate need for peanut cultivar performance testing in different tillage systems. However, in 1984 at Williston Florunner and Sunrunner yielded 20% and 12% better, respectively, in conventional tillage conditions than in minimum-tillage, whereas in 1985 Early Bunch yielded 17% less in tilled systems compared to minimum-tillage systems. This response may be related to slight plant density differences, harvestability problems or genotypic differences. Results indicate that yield and quality of peanuts, based on the data collected from the cultivars utilized in this study would be equal under conventional or minimum-tillage production.

Key Words: *Arachis hypogaea* L., minimum tillage, strip tillage, no-tillage, conventional tillage, cultivars, variety, tillage comparisons.

Several tillage steps including moldboard plowing followed by several diskings have traditionally been performed to prepare a seedbed, incorporate fertilizer and chemicals, and to mechanically control weeds. With the introduction of modern conservation tillage equipment, adequate seed-soil contact can be achieved without conventional tillage methods. Acceptance of conservation tillage in most areas of the United States, however, has been greatly hampered by less than adequate weed control (11, 14, 24, 25, 28). The introduction of new pre- and postemergence herbicides is beginning to lessen weed control problems (7). Interest in conservation til-

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lage is increasing in the southern United States due to a concern for soil erosion and water conservation, and as a means for reducing production costs and increasing yields and net returns (2, 23).

Soybean [*Glycine max* (L. Merr.)] yields are often not affected by tillage systems ranging from complete residue incorporation to no-tillage (3, 8, 24). However, soybean yields in some studies have been lower (24) and in some cases higher (26) than comparative conventional systems. Corn (*Zea mays* L.) studies have shown similar contradictory results (9, 12, 13, 18, 19, 22, 26). Several authors (7, 15, 21) have proposed that certain cultivars may be better suited for a particular tillage system but previous investigations into cultivar performance differences as influenced by tillage have been inconclusive or have found that no cultivar by tillage interactions exist (10, 20, 21). Ciha (1) working with spring barley (*Hordeum vulgare* L.) cultivars found that those selected under conventional tillage practices performed equally well under no-tillage systems. Likewise, Hallauer and Colvin (10) working with corn found no significant hybrid by tillage interactions and suggested that it was not necessary to test hybrids under different tillage regimes. In addition, Elmore (7) reported that tillage did not affect yield and cultivars of soybeans tested responded similarly to tillage systems. Conversely, Desborough (6) found that tillage affected cultivars differently when several soybean cultivars were planted in both conventional and no-tillage situations in Australia. In a year with no drought stress, cultivars responded similarly to both tillage systems, while in two dry years late maturing cultivars yielded better in no-tillage than in the conventional-tillage system.

Most cultivar-tillage research has been performed with crops that produce their fruit and thus the yield above ground. This research appears to indicate that cultivars of these crops selected for conventional tillage can perform equally well when grown with conservation tillage methods. Peanuts (*Arachis hypogaea* L.) produce their fruit and yield below ground, and the interaction between tillage and peanut cultivars has not been fully investigated. As a result, there may be significant yield and quality differences with different tillage regimes. In addition, peanuts are a crop with a broad base of morphologically different cultivars that exhibit a variety of underground fruiting habits. Cultivars of peanuts that exhibit the runner growth habit rely heavily on the maturation of a nut crop on the outer limb portion of the canopy while cultivars of the virginia market type produce most of their fruit near the central axis of the plant in the region of the tap root. Spanish type peanuts blend both fruiting habits about equally. Little (2, 4, 5) is known about the potential for various peanut types to be produced through conservation tillage and if the quality and yield will equal that of conventionally produced peanuts.

Peanut cultivars presently available were developed in cleanly tilled environments. However, with increased interest in reduced tillage, we must determine if tillage affects peanut cultivars differently. If so, cultivar performance tests might need to be conducted in different tillage systems. Furthermore, if certain cultivars respond better in a particular tillage system, this genetic variability might be used in breeding programs to select new tillage-specific cultivars.

The objective of this research was to compare the response of eight peanut cultivars to different tillage systems in Florida.

Materials and Methods

Field experiments were conducted during 1984 in Williston, Florida and in 1985 in Williston and Jay, Florida. The soil type in Williston was a Zuber loamy sand (fine, mixed hyperthermic Ultic Hapludalfs) and in Jay was a Red Bay sandy loam (fine-loamy, siliceous, thermic Rhodic Paleudults). The experimental design was a split-plot with four replications. Whole plots were conventional tillage or minimum-tillage. Split plots consisted of eight peanut cultivars. Three cultivars of the runner market-type - Florunner, Sunrunner, and GK-7, four virginia-market-type cultivars - Early Bunch, Florigiant, GK-3, and NC-7, and one spanish market-type Valencia C were used. All plots were seeded with approximately 140 kg/ha of the assigned cultivars. The row spacing used was a twin 0.23 m row pattern set on 0.76 m row centers with 0.53 m wheel middles between sets of rows. While this row spacing was not the normal 0.91 m row pattern used in conventional peanut culture, it was somewhat standard for corn and soybean no-till production within the southeastern United States. The experimental area at both locations was seeded with wheat (*Triticum aestivum* L.) in the fall prior to the initiation of the experiments. Minimum-tillage plots were sprayed with 1.12 kg ai/ha of glyphosate (N-(phosphonomethyl) glycine) two weeks prior to peanut planting to kill the wheat cover and existing weeds.

Herbicides used in all tillage systems included pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine) applied preemergence at 1.12 kg ai/ha, alachlor (2-chloro-N-(2,6- diethylphenyl)-N-(methoxymethyl)acetamide) and dinoseb (2-(1-methylpropyl)-4,6-dinitrophenol) plus naptalam (2-[(1-naphthal enylamino) carbonyl] benzoic acid) applied at ground-cracking at 3.36 + 1.12 + 2.24 kg ai/ha respectively, and 2,4-DB (4-(2,4 dichlorophenoxy) butyric acid) applied both early and late postemergence at 0.28 kg ai/ha. Escaped weeds were removed biweekly by hand to prevent weed competition from confounding yield data. Soil fertilization and liming practices were in accordance with soil test recommendations by the University of Florida Soil Testing Laboratory.

In order to simulate a wheat harvest and reduce stubble height, the test area was mowed before planting allowing the straw to scatter randomly over the plots. Minimum-tillage treatments were prepared using a modified Brown-Harden Ro-Till® planter with the actual planter units removed. The modified Ro-Till® consists of a short subsoiler shank with an attachable slitter bar that penetrates the soil to a depth of approximately 0.40 m. Fluted coulters were mounted on either side of the shank. The short subsoiler shank and slitter blade combination opens the soil and destroys plow pans beneath the row while fluted coulters smooth the ripped soil and dissipate large clods. 'Rolling crumblers' (barrel-shaped devices that resemble stalk cutters) were mounted immediately behind the fluted coulters and served to further smooth and shape the seedbed. Conventional tillage plots were moldboard plowed followed by three diskings to further smooth the seedbed.

Planting was done in a separate operation due to equipment limitations. The twin-row pattern was achieved by using a tool-bar-mounted twin-row planter with the individual planter units situated .76 m apart center-to-center on the tool bar. Fungicides were applied on a 14 day schedule and insecticide applications were made on an as needed basis throughout the season in accordance with accepted recommendations. Pesticides were applied with a tractor-mounted, compressed air sprayer set to deliver 187 L/ha.

Peanuts were planted in early May at both locations. The Valencia C cultivar was dug approximately 120 days after planting (DAP), Early Bunch at 126 DAP, and NC-7 at 130 DAP. All other cultivars were dug 135 days after planting. A conventional digger-shaker-inverter was used to remove peanuts from the soil. Plots were harvested with conventional equipment after three days of field drying.

Data collected included final peanut yields (adjusted to 7% moisture) and at Williston, peanut grade data was obtained. Peanut yields and grades were subjected to analysis of variance and treatment means were tested for differences using the Least Significant Difference Test (P = 0.05) and Duncans New Multiple Range Test, respectively.

Results and Discussion

General Cultivar Observations

Cultivar emergence did not differ between conventional and minimum-tillage (MT) treatments (data not shown). Runner cultivars produced a more spreading foliage earlier in the season and were able to shade out row middles sooner than virginia-type cultivars, while the valencia cultivar produced an erect foliage in which row middle areas were not completely shaded even at the time of digging. Some visual damage was manifest in certain cultivars due to herbicide application. Early Bunch and Valencia C showed considerably more foliar damage from ground cracking and early postemergence herbicide application. Although visual damage was no longer present by mid-season, some yield suppression may have occurred due to herbicide injury. Soilborne diseases were not a problem at any of the locations and leafspot diseases were controlled with repeated fungicide applications. Near the end of the season (five days before harvest) in 1984 there was a severe outbreak of rust. The virginia-type cultivars appeared to be more susceptible. However, peanut yields were not affected so late in the growing season. No visual differences in foliar or soilborne disease incidence could be detected between any cultivar grown with minimum or conventional-tillage.

Effects of Tillage by Cultivar

Cultivar yields differed very little with respect to tillage system (Table 1). Six of the eight cultivars had similar yields in 1984 at Williston while both Florunner and Sunrunner had better yields when produced conventionally. Yield differences with these two cultivars did not occur at other locations. Early Bunch produced higher yields under minimum-tillage compared to conventional tillage at Williston in 1985. Results from Jay show that tillage did not affect cultivar yield and no differences were noted (Table 1).

Table 1. Effects of tillage on peanut cultivar yield at Williston and Jay, FL.

	Peanut yield[a]						
Cultivar	Williston 1984		Williston 1985		Jay 1985		
	Conv.	MT	Conv.	MT	Conv.	MT	Mean
	kg/ha						
Florunner	4880	3880	4010	3650	5180	4730	4390
GK-7	4010	4300	4270	3850	5600	5230	4540
Sunrunner	5080	4460	3860	3410	5260	5000	4510
Early Bunch	4700	4700	3310	4000	4290	3950	4160
Florigiant	3260	2860	2990	2910	4840	4690	3590
GK-3	3260	2750	3280	3170	5100	5160	3790
NC-7	3380	3600	3240	2940	4930	4540	3770
Valencia C	2720	2900	2680	2810	2350	2390	2640
Mean	3910	3680	3460	3340	4690	4460	
LSD=0.05	573		553		621		

[a] LSD statistic calculated for each experimental location.

Cultivar yield data shows that runner-type peanut yields (4480 kg/ha averaged across cultivars, Florunner, GK-7, and Sunrunner) were higher than cultivars not as well suited for Southeastern production. Although large seeded virginia-type peanuts can be grown in Florida, yields (3380 kg/ha averaged across Early Bunch, Florigiant, GK-3 and NC-7) may not be as consistently high as in the Virginia-Carolina region. The spanish-type cultivar Valencia C can be grown in the Southeast as well but yields (2640 kg/ha) are usually lower than better adapted runner cultivars. The results from this study indicate that with few exceptions, all cultivars in this study can be produced equally well regardless of the tillage system chosen.

Effects of Tillage on Peanut Grade

Peanuts from the Williston location were graded in both years of this study. Peanut grades combined over all cultivars with respect to tillage type showed no significant differences (Table 2). Sound mature kernel (SMK) percentages showed a trend to be slightly higher under conventional tillage while sound splits (SS) were slightly higher for minimum tillage treatments. Although individual cultivar grades varied numerically from year to year (Table 3), no differences in quality as measured by peanut grade could be detected due to tillage type. In general, the runner-type cultivars evaluated in these studies graded better than other cultivars (Table 3). Upon examination of individual cultivar grades, the virginia-type peanuts appear to have had a disproportionate amount of SS whether produced conventionally or with minimum-tillage. This may be due to lack of expertise on the part of the grader in grading these particular peanut types or to the lengthy period of time which elapsed from the completion of harvest to the time they were graded.

Table 2. Effects of tillage on overall peanut grade characteristics (averaged across all cultivars).

	Peanut grades[1]					
Tillage TRT	Williston 1984			Williston 1985		
	SMK[2]	SS[3]	TOTAL[4]	SMK	SS	TOTAL
	%					
Conventional	62.4a	10.7a	73.1a	60.5a	13.8a	74.3a
Minimum-tillage	61.6a	11.4a	73.0a	59.9a	14.2a	74.1a

[1]Means followed by different letter within a column are significantly different according to Duncan's New Multiple Range Test (P=0.05).

[2]SMK -- % sound mature kernels.

[3]SS -- % sound split kernels.

[4]TOTAL — % SMK plus % SS.

Overall Conclusions

Data from these three studies indicate that tillage type has little effect on peanut yield or quality regardless of the cultivar chosen. The original hypothesis was that runner cultivars, which have a more spreading growth and reproductive pattern, might have decreased

Table 3. Peanut grades by cultivar (averaged over tillages).

Peanut Cultivar	1984 Williston			1985 Williston		
	SMK[2]	SS[3]	TOTAL[4]	SMK	SS	TOTAL
	Peanut grades[1] (%)					
Florunner	72.9a	7.2c	80.1a	67.1a	10.3de	77.4a
GK-7	66.7b	5.9cd	72.6c	69.0a	9.3de	78.3a
Sunrunner	76.9a	6.3cd	80.2a	70.0a	8.6e	78.6a
Early Bunch	48.1e	23.8a	71.9c	53.8d	18.3b	72.1b
Florigiant	57.6c	17.1b	74.7b	57.6c	16.9bc	74.5b
GK-3	67.5b	4.1d	71.6c	52.0d	16.0c	68.0c
NC-7	51.7d	23.9a	75.6b	50.5d	21.6a	72.1b
Valencia C	57.5c	0.1e	57.6d	61.7b	11.0d	72.7b

[1]Means followed by different letters within a column are significantly different according to Duncan's New Multiple Range Test (P=0.05).

[2]SMK -- % sound mature kernels.

[3]SS -- % sound split kernels.

[4]TOTAL -- % SMK plus SS.

yields due to the lack of tilled soil in minimum-tillage treatments. This hypothesis was disproved since the runner cultivars produced well under either tillage system. Furthermore, it was hypothesized that the virginia botanical-type peanuts might provide higher yield compared to other cultivars under minimum-tillage due to their bunch type fruiting pattern which would be located primarily in the tilled planting strips. Final data, however, indicates that this is not true since the virginia cultivars yielded near equally regardless of tillage regime. In addition, this work indicates that there is little need for breeding or performance testing of peanut cultivars for varying tillage systems. As a result, growers on marginal soils high in erodability may consider minimum-tillage production without concern to yield performance of the cultivars studied. In addition, previous research has shown that weed control and net returns from minimum tillage can equal and sometimes exceed that from conventional-tillage production (4, 16, 17, 27, 29).

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