# Conservational Tillage and Cultivar Influence on Peanut Production[1]

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**ABSTRACT**

The influence of conservational tillage and cultivar on pod yield, crop value, and market grade factors was evaluated as a means to increase the production efficiency of peanut (*Arachis hypogaea* L.). Two conservational tillage systems, in-row and band tillage, and one conventional tillage system were compared over a 4-yr period using the cultivars Florigiant, NC 6, and VA 81B. For all three cultivars, pod yields averaged 15% less and crop values averaged 21% less under the conservational tillage systems as compared to the conventional tillage system. The cultivar NC 6 performed slightly better than Florigiant and VA 81B. The percentage of extra large kernels for NC 6 was significantly higher than for the other two cultivars. There were no significant differences in the percentage of sound mature kernels and total meat content between the three cultivars. Tillage systems did not have a consistent effect on grade factors over the 4-yr period.

Key Words: Market grade, groundnut, *Arachis hypogaea* L., yield, conventional tillage.

Conventional production systems for peanut (*Arachis hypogaea* L.) include primary and secondary tillage operations that prepare a flat or slightly raised seedbed with no plant residue on the surface. These operations require considerable fuel, labor, and time. Producers are becoming increasingly interested in using conservational tillage methods to improve peanut production efficiency.

Conservational tillage systems may include no tillage, minimum tillage, mulch tillage, or strip tillage. These systems consist of planting in essentially an unprepared seedbed, or a seedbed with undisturbed crop residue left on the soil surface, or planting in a narrow strip or band which disturbs less than 30% of the soil surface and crop residue (1).

Conservational tillage for corn (*Zea maize* L.) and soybean (*Glycine max* L.) was proposed as an alternative to conventional methods in the 1950's (15). Soil erosion was greatly reduced, but such tillage resulted in some yield reduction. The relationship between soil temperature, soil moisture, plant nutrients, and crop rotations has been investigated (12, 13, 16, 20). The progress and development of growing corn and soybean using no-tillage practices in Virginia for 20 yr were reported by Grisso and Shanholtz (10).

There are numerous reports concerning conservational tillage and related savings in fuel, labor, and soil erosion (8, 14, 18). However, additional information is needed to better understand the soil-plant-residue environment. Such information will also help to improve pest management strategies, residue management practices, and define the impact on water quality and crop yields.

Although conservational tillage has been used in corn and soybean for over 30 yr, only during the past 10 yr has

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interest developed for use of conservational tillage in peanut production (22). This was brought about by the need to improve peanut production by reducing the input costs for energy, machinery, and labor. Production strategies for conservation tillage of peanut have been slow to develop because of concerns about increases in diseases and insects from crop residue, weed control before over-the-top chemicals were available, potential problems in digging and combining, and crop residue effects on crop yield and market grade.

Cheshire *et al.* (4) compared conventional and no-tillage production practices for peanut in Georgia. Yields and seed quality were reported to be significantly higher for no-tilled peanut than in the conventional-tilled mono-cropped peanut where soil moisture was adequate. Comparison of soil insects and incidence of *Sclerotium rolfsii* indicated current management needs for these pests were similar for the two tillage methods. Grichar and Boswell (9) reported difficulty in controlling broadleaf weeds and grasses which caused some problems in digging the no-tilled peanut as compared to the conventional-tilled peanut. In these tillage studies (9), pod yields and crop values were significantly less for the no-tilled compared to the conventional-tilled peanut; whereas the percentage of sound mature kernels (SMK) was about the same for the different tillage systems 2 out of 4 yr.

Colvin *et al.* (7) observed that pod yields in Florida were similar for minimum or conventional tillage systems in 1983 and higher for minimum than conventional in 1984. Grade factors were not different for the conventional and minimum tillage systems. Hartzog and Adams (11) conducted 17 on-farm reduced tillage experiments in Alabama between 1982 and 1986. Pod yields for the reduced tillage systems increased at three sites, decreased at five sites, and were not different at nine sites when compared to conventional tillage systems. Grade factors, weed control, and disease severity were not influenced by reduced tillage.

The influence of digging date and conservational tillage was investigated by Wright and Porter (24). Florigiant yielded 19% less and had a crop value of 25% less for the conservational tillage as compared to conventional tillage for all digging dates. Digging the peanut approximately 10 d before and after the normal date of 141 d after planting (DAP) reduced yields 15 and 6%, respectively, in the conservational tillage system. Grade factors were significantly reduced by digging early.

Soil type, plant diseases, and environmental conditions in the Virginia-Carolina peanut area differ significantly from the southeast and southwest production areas. This study was initiated to determine the influence on pod yield, crop value, and grade factors of three cultivars in Virginia when peanuts were produced using conventional and conservational tillage systems.

## Materials and Methods

Three virginia-type peanut cultivars were planted for 4 yr (1984-87) on the Tidewater Research Farm, Suffolk, VA, where corn had been grown the previous year. These cultivars, Florigiant, NC 6, and VA 81B (2,3,6), have a prostrate plant growth habit, semi-erect growth habit, and erect growth habit, respectively. The soil type was a Kenansville loamy sand (loamy, siliceous, thermic Arenic Hapludults) with 0 to 4% slope (17). The soil contained less than 0.5% organic matter. Basic practices recommended for peanut production in Virginia were followed except where the tillage-planting operations were modified for the tillage treatments. Plots included four rows 15.2 m long spaced 0.91 m apart. The two center rows of each four-row plot were harvested.

Tillage treatments were the main plot in a split-plot arrangement of a randomized complete block design with four replications. Subplots were cultivars. Climatological data were obtained from the National Weather Service Observation Station at the Tidewater Agricultural Research and Extension Center, located about 1.5 km from the field location. Treatments in the two production systems included a conventional tillage (CT) treatment and two conservational tillage treatments, in-row tillage (NT), and band tillage (BT). Under all tillage treatments, peanuts were planted the second week in May and dug 141 DAP.

In the CT system, the soil with a wheat (*Triticum aestivum* L.) cover crop was tilled to a depth of 25 cm with a moldboard plow in late March or early April and disked twice prior to planting. Peanuts were planted on a conventional, flat seedbed characterized as residue free. In the NT and BT systems, immature winter wheat cover was killed with glyphosate [*N*-(phosphonomethyl) gylcine] approximately 2 wk prior to planting. The NT system consisted of a conservation tillage implement (Kelly Manufacturing Company, Tifton, GA) with planters attached. The implement was equipped with a fluted press-type coulter mounted behind a clay-type ripper shank which had been shortened by 15 cm. A 51-cm ripple coulter was mounted in front of the shortened ripper shank, which ran at a depth of 15 cm. The concept was to provide some in-row tillage or strip tillage without underrow ripping because the practice of underrow ripping is not recommended for peanut production in Virginia (21). The BT system was established with a power-driven rotary tiller (Ferguson Manufacturing Company, Suffolk, VA) with planters attached. All rotors were removed on the tiller except the two centered on the plant row. The tiller was operated at a depth of 6 to 8 cm. In the NT and BT treatments, the soil tilling and planting were performed in a combined operation disturbing less than 30% (25 cm width) of the surface wheat residue.

Immediately following planting, an over-the-top herbicide, metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methlethyl) acetamide] was applied at a rate of 1.63 kg ai/ha to all treatments. A second herbicide application of 1.63 kg ai/ha of metolachlor, plus napthalam [2-((1-naphthalenylamino)carbonyl) benzoic acid] at 3.26 kg ai/ha and dinoseb [2-(1-methylpropl)-4,6-dinitrophenol] at 1.63 kg ai/ha was applied at peanut emergence.

Peanuts were dug with a digger-shaker-inverter and harvested with a commercial combine 4 to 7 d after digging. Weight and moisture contents of pods were determined for each plot. Samples for grading were collected and artificially dried. Pod yields were computed based on 7.5% wet basis moisture content, and crop values were computed by use of the standard marketing schedule for each year based on grade factors. Data were subjected to an analysis of variance, and significant differences were determined by Duncan's multiple range test (19).

## Results and Discussion

Peanut pod yields for the CT system were significantly higher than for the NT and BT systems 3 out of 4 yr (Fig. 1A). The trend was similar for yield in 1986, although the means were not significantly different. The yields between the NT and BT systems were not significantly different for any of the 4 yr.

In both the NT and BT systems, a narrow seedbed about 25 cm wide was prepared which provided good soil-seed contact. The NT method prepared a smooth place for the planter opener to follow, whereas the BT system loosened the whole root system of the wheat plant. The seedbed prepared by the NT method was more uniform than the one prepared by the BT system.

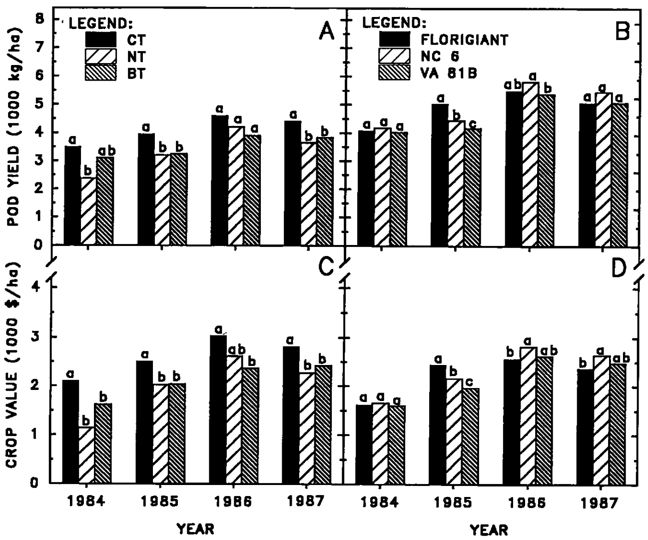


**Fig. 1. Peanut pod yield (A) and crop value (C) response to conventional (CT) and two conservational (NT and BT) tillage systems and pod yield (B) and crop value (D) of Florigiant, NC 6, and VA 81B cultivars for 1984, 1985, 1986, and 1987. (The same letter at the top of vertical bars within a year indicates values were not significantly different at the 0.05 level of significance.)**

Pod yields for the three cultivars were significantly different 2 out of 4 yr (Fig. 1B). In general, NC 6 produced slightly higher yields than Florigiant or VA 81B, except in 1985. VA 81B, which has a bunch growth habit, did not out perform the other two cultivars which have a semi-bunch and prostrate growth habit.

Pod yields averaged across all treatments were 3115 kg/ha in 1984, 3466 kg/ha in 1985, 4236 kg/ha in 1986, and 3963 kg/ha in 1987. Since the lowest rainfall occurred in 1986 and 1987 (Table 1), the distribution of water and the frequency of rainfall occurrences during late July to early September may have contributed to the higher yields. Yields in 1986 and 1987 averaged 25% higher than yields in 1984 and 1985. Plant emergence, plant growth, and pod development can be significantly influenced by rainfall distribution.

**Table 1. Total monthly rainfall during the growing season (May-Sept.), Suffolk, VA (1984-1987) compared to normal (50-yr mean).[a]**

| Month | Rainfall 1984 | 1985 | 1986 | 1987 | Normal |
|---|---|---|---|---|---|
| | mm | | | | |
| May | 121 (12) | 55 (10) | 24 (5) | 48 (6) | 96 |
| June | 35 (5) | 156 (7) | 109 (7) | 67 (8) | 112 |
| July | 218 (14) | 103 (11) | 169 (15) | 58 (8) | 150 |
| Aug. | 100 (9) | 98 (7) | 213 (15) | 141 (8) | 150 |
| Sept. | 78 (8) | 251 (3) | 13 (5) | 154 (13) | 107 |
| Total | 552 | 663 | 528 | 468 | 615 |

[a]Rainfall data reported by the National Weather Service Observation Station, Tidewater Agric. Res. and Ext. Center, Suffolk, VA. Number of days rainfall occurred is given in parentheses.

Comparisons and trends among the mean crop values for the CT, NT, and BT systems and three cultivars were very similar to the responses for pod yields (Fig. 1C,D). The CT system had a significantly higher crop value than the NT and BT systems. NC 6 out-performed Florigiant in 1986 and 1987, while in 1985 Florigiant out-performed NC 6. No differences between cultivars were noted in 1984. The average crop values were 1620 $/ha in 1984, 2186 $/ha in 1985, 2667 $/ha in 1986, and 2499 $/ha in 1987.

Since the pod yields and crop values responded similarly each year for the NT and BT systems, the results were combined in Fig. 2. The ratio of NT-BT to CT for pod yield was 0.89 for Florigiant and 0.82 for NC 6 and VA 81B, or an average of 0.85. This indicates that the tillage treatment had slightly less influence on Florigiant than NC 6 and VA 81B. For crop value, the ratio NT-BT and CT was 0.84 for Florigiant, 0.77 for NC 6 and 0.75 for VA 81B, or an average of 0.79. Stated in another way, peanut produced under the NT-BT system yielded 15% less and had a crop value of 21% less than peanut produced under the CT system across all cultivars.

All grade factors were analyzed, but only the percentage of ELK, SMK, and TM are presented (Fig. 3). The percentage of ELK for the CT system was significantly less 3 out of 4 yr (Fig. 3A) than for the NT and BT systems. Rainfall distribution during the growing season and amount may have influenced the ELK response in 1986.

The percentages of SMK (Fig. 3B) and TM (Fig. 3C) among CT, NT, and BT were significantly different in 1984 and 1986. The SMK for the CT system averaged 6.2% higher than the NT and BT systems, whereas, the percentages of TM for the CT system averaged 3.0% higher compared to the NT and BT systems.

The percentage of ELK was significantly higher for NC 6 (Fig. 3D) compared to Florigiant and VA 81B for all years except 1986. As indicated earlier, NC 6 per-

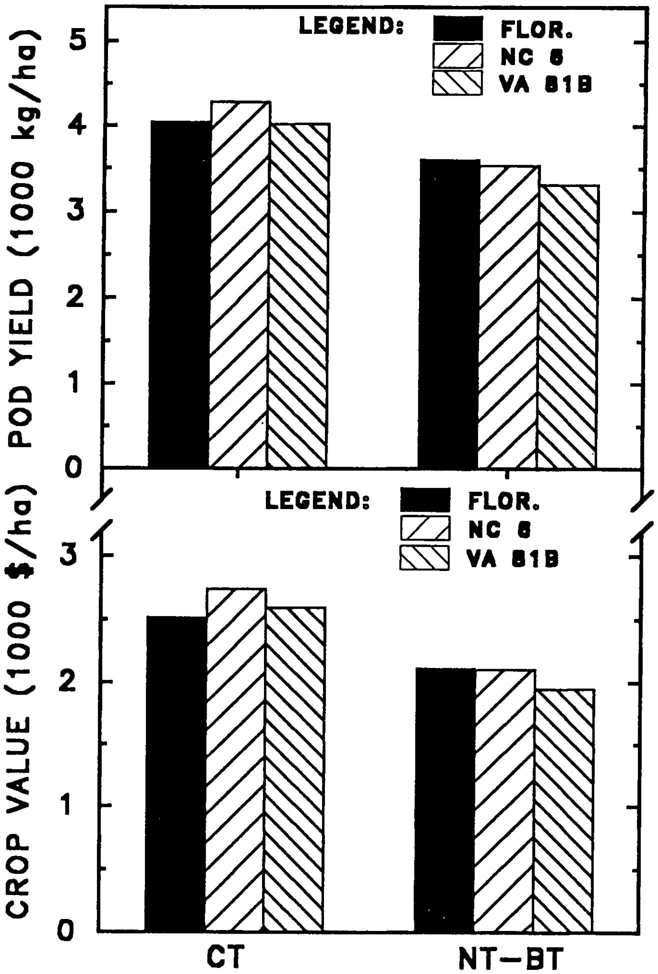


Fig. 2. **Mean peanut pod yield and crop value response (1984-1987) to conventional (CT) and conservational (NT and BT pooled) tillage systems for Florigiant, NC 6, and VA 81B cultivars.**

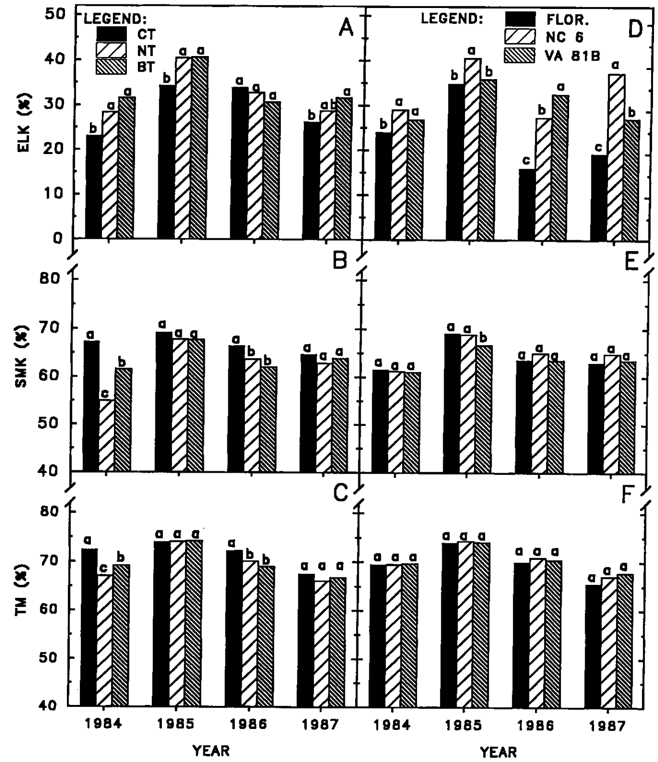


Fig. 3. **Peanut grade factors, extra-large kernels (ELK), sound mature kernels (SMK), and total meat content (TM), for the Florigiant, NC 6, and VA 81B cultivars (D, E, F) produced under conventional (CT) and conservational (NT and BT) tillage systems (A, B, C) during 1984, 1985, 1986, and 1987. (The same letter at the top of vertical bars within a year indicates values were not significantly different at the 0.05 level of significance.)**

formed slightly better across all tillage treatments. The percentages of SMK (Fig. 3E) and TM (Fig. 3F) were not significantly different between the three cultivars within years when the three tillage systems were combined.

By visual observation, plant growth in the NT-BT systems was not affected by the presence of wheat residues. Plant size and growth appeared similar in the CT, NT, and BT treatments. Total number of pods per plant were 10% less for the NT-BT systems as compared to the CT system (23). Slight delay in flowering and reduced flower production were observed for peanut plants produced under the NT-BT systems as compared to the CT system (5). Resistance of the peg to enter the soil surface did not appear to be related to soil compaction since the soil type was a loamy sand and no hard crusting was evident. Fewer total pods per plant may attribute to the lower yields in the NT-BT systems. The indeterminate characteristics of the peanut plant and perhaps a delay in flowering could influence the pod yield and grade factors with digging date to a greater extent in the NT-BT than CT system.

The results in this study were different from the Florida and Alabama studies (7, 11). Even though soil type and environmental conditions were different, the tillage implement used in Florida and Alabama disturbed most of the soil surface compared to 30% or less in Virginia.

## Conclusions

Peanut pod yields and crop values were significantly influenced by tillage systems. Cultivars indicated a similar response for pod yields and crop values. The average yield for the NT-BT systems was 15% less than that of the CT system, and crop value was 21% less. The two systems, NT and BT, performed about equally in pod yield and crop value. However, the NT method appeared to result in a more preferable seedbed than the BT method. In general, the NC 6 cultivar performed slightly better than the Florigiant and VA 81B cultivars. The percentage of ELK for NC 6 cultivar was significantly higher as compared to the other cultivars. The percentage of SMK and TM responded similarly for all cultivars. Additional research will be needed to increase yields using the conservational systems before this production method will be widely accepted by peanut growers.

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