Digging Date and Conservational Tillage Influence on Peanut Production[1]

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ABSTRACT

The influence of conservational tillage and date of digging on pod yield, crop value, and grade factors were evaluated as a means to increase the production efficiency of peanuts. Two conservational tillage systems, in-row and band tillage, and one conventional tillage system were compared over 3 yr. The Florigiant cultivar was planted in immature wheat killed with glyphosate (Roundup) or clean tilled soil. Peanuts were dug 8 to 11 d before and after the medium (normal) digging date of 141 DAP. Pod yields averaged 19% less and crop values averaged 25% less for the conservational tillage systems as compared to the conventional tillage system. Digging 8 to 11 d early reduced yield 15% and value 21%; whereas, digging 8 to 9 d late reduced yield 6% and value 5% as compared to the medium digging date. The early digging date significantly decreased the grade factors of extra-large kernels (ELK), sound mature kernels (SMK), and total meat content (TM). Tillage systems did not have a consistent effect on grade factors over the 3-yr period. Results from this study indicate that yield and value for the Florigiant cultivar were significantly less under conservational tillage as compared to conventional tillage.

Key Words: Conservational tillage, digging date, peanut, yield, conventional tillage, tillage, market grade.

Conventional production systems for peanuts (*Arachis hypogaea* L.) include primary and secondary tillage operations that prepare a nonresidue flat or slightly raised seedbed. These operations require considerable fuel, and labor, and time. To increase production efficiency, producer interest in using conservational tillage methods for peanut production is increasing.

Conservational tillage systems may include no tillage, minimum tillage, mulch tillage, and 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 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 (12). 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 (9, 10, 13, 17). The progress and development on no-tillage practices in Virginia for 20 yr were reported by Grisso and Shanholtz (7).

There are numerous reports concerning conservational tillage and related savings in fuel, labor, and soil erosion (5, 11, 15). 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 interest developed for use of conservational tillage in peanut production (19). This was brought about by the need to improve peanut production efficiency or by reducing the input costs for energy, machinery, and labor. Production strategies for peanuts have been slow to develop because of concerns about increases in diseases and insects from crop residue, control of weeds 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.* (2) compared conventional and no-tillage production practices for peanuts in Georgia. Yields and seed quality were reported to be significantly higher for the no-tilled peanut than in the conventional-tilled mono-cropped peanut where soil moisture was adequate. Comparison of soil insects and incidence of *S. rolfsii* indicated current management needs for these pests were similar for the two tillage methods. Grichar and Boswell (6) reported difficulty in controlling weeds and grasses which caused some problems in digging the no-tilled peanut as compared to the conventional-tilled peanut. In these tillage studies (6), pod yields and crop values were significantly less for the no-tilled compared to the conventional-tilled peanut; whereas, percent sound mature kernels were about the same for the different tillage systems 2 out of 4 yr.

Colvin *et al.* (4) 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 (8) conducted 17 reduced tillage experiments on-farm 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 above studies were not conducted in Virginia and a different tillage implement, which disturbed most of the soil surface, also was used. Soil type was different and environmental conditions between the southeast and Virgina-Carolina area were different. Likewise the study reported herein was conducted for the same general time period as the Florida and Alabama studies (4, 8).

The purpose of this study was to determine the influence on pod yield, crop value, and grade factors when peanuts were produced using conventional and conservational tillage systems and dug at three digging dates. If these tillage systems respond similarly, more cost efficient peanut production systems could be developed.

Materials and Methods

The virginia-type Florigiant peanut cultivar was planted on the Tidewater Research Farm, Suffolk, Virginia, where corn had been grown the previous year. The soil type was a Kenansville loamy sand (loamy, siliceous, thermic Arenic Hapludults) with 0 to 4% slope (14). Basic practices recommended

[1]Mention of firm names or trade products in this paper does not constitute a recommendation by the USDA nor does it imply registration under FIFRA.

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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 as the test rows.

This paper reports a 3-yr study (1984 to 1986) where the Florigiant cultivar was grown using conventional and conservational tillage production systems. Treatments in the two production systems included a conventional tillage (CT) treatment and two conservational tillage treatments (MT), in-row tillage (NT) and band tillage (BT). Under all tillage treatments, peanuts were dug at three different times; 1) early, 8 to 11 d before normal digging, 2) medium (normal), 141 d after planting (DAP), and 3) late, 8 to 10 d after normal digging. Planting and digging dates are presented in Table 1.

Table 1. Planting and digging dates for the Florigiant cultivar in 1984, 1985, and 1986.

Year	Planting Date	Digging Date 1/	DAP 2/ to Digging Early	Medium	Late
1984	May 15	Oct. 2	130	141	150
1985	May 15	Oct. 2	133	141	149
1986	May 16	Oct. 3	132	141	149

1/ Date of medium (normal) digging.

2/ DAP is d after planting.

In the CT system, the soil with wheat (*T. aestivum* L.) cover crop was primary tilled to a depth of 25 cm with a moldboard plow in late March or early April. The seedbed was prepared by two secondary diskings 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 (Roundup) about two weeks prior to planting. The NT system consisted of a KMC (Kelly Manufacturing Company, Tifton, Georgia) conservation-tillage implement 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. Underrow ripping is not a recommended tillage practice for peanut production (20). The 25-cm BT system was established with a Ferguson power-driven rotary tiller (Ferguson Manufacturing Company, Suffolk, Virginia) 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 MT treatments, the soil tilling and planting were performed in a combined operation disturbing less than 30% of the wheat residue.

Immediately following planting, an over-the-top herbicide, metolachlor (Dual), was applied at a rate of 1.7 Lha^{-1} to all treatments. A second herbicide application of 1.7 Lha^{-1} of metolachlor, plus 14.0 Lha^{-1} of dinoseb (Dynap) was applied at emergence.

Tillage treatments were the main plot in a split-plot arrangement of a randomized complete block design with four replications. Sub-plots were digging date. Climatological data were obtained from the National Weather Service Observation Station at the Tidewater Agricultural Experiment Station, located about 1.5 km from the field study.

At the designated digging date, peanuts were dug with a digger-shaker-inverter and harvested with a commercial combine 4 to7 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 (16).

Results and Discussion

Peanut pod yields for the CT system were significantly higher than for the NT and BT systems for 1984 and 1985 (Fig. 1A). The trend was similar for the yield in 1986, but apparent differences in the tillage yield means were not significantly different. The yields between the NT and BT systems were not significantly different for any year.

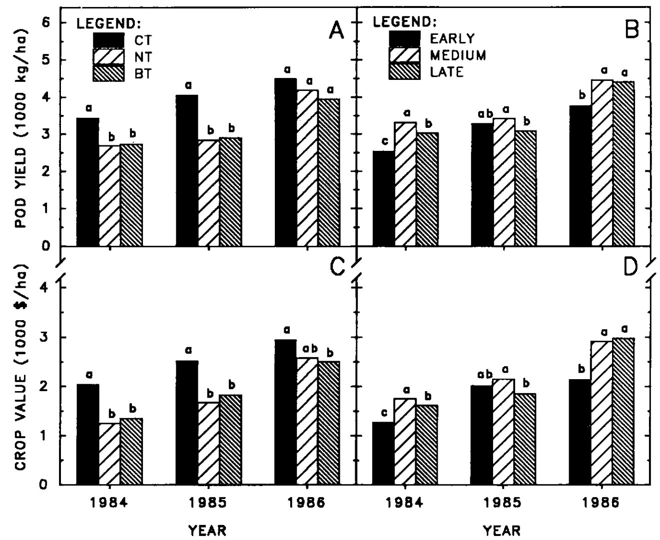

Fig. 1. Peanut pod yield (A) and crop value (C) response to conventional (CT) and two conservational (NT and BT) tillage systems and the influence on pod yield (B) and crop value (D) of digging early, medium (normal), and late for 1984, 1985, and 1986. (The same letter at the top of vertical bars within a year indicates values were not significantly different at the 0.05 level of significance.)

In both the NT and BT systems, about 25 cm width of soil was disturbed. A more uniform seedbed was prepared with the NT method than with the BT method. The BT method loosened the whole root system of the wheat plant; whereas, the NT method prepared a smooth place for the planter opener to follow. Both methods prepared a narrow seedbed that provided good soil-seed contact.

Pod yields for the early digging date were significantly less than the medium and late digging dates 2 out of 3 yr (Fig 1B). In 1985, yield differences between the digging dates were not as great. In 1986, yields for the medium and late digging dates were not significantly different.

Pod yields averaged across all treatments were 2960 kg/ha in 1984, 3263 kg/ha in 1985, and 4213 kg/ha in 1986. Since the lowest rainfall occurred in 1986 (Table 2), the distribution of water and the frequency of rainfall occurrences during July and August may have played an important role in the higher yields. In 1985, the total rainfall was 8% higher than normal; and in 1986, total rainfall was 15% less than normal. The distribution or timing of rainfall apparently can significantly influence plant emergence, plant growth, and pod development between CT and MT systems (Fig. 1A).

Comparisons among the mean crop values for the CT, NT, and BT systems and digging dates were very similar to those for pod yields. In general, the CT system had the higher crop value (Fig. 1C) and the early digging date (Fig. 1D) had the lower crop value as compared to other tillage systems and digging dates. The average crop values across all treatments were 1548 $/ha in 1984, 2008 $/ha in 1985, and 2678 $/ha in 1986.

Since pod yields and crop values were not significantly

Table 2. Total rainfall for each month during the growing season (May-Sept.), Suffolk, Virginia.

MONTH	1984	1985	1986	NORMAL[1/]
		Rainfall (mm) [2/]		
May	121 (12) [3/]	55 (10)	24 (5)	96
June	35 (5)	156 (7)	109 (7)	112
July	218 (14)	103 (11)	169 (15)	150
Aug.	100 (9)	98 (7)	213 (15)	150
Sept.	78 (8)	251 (3)	13 (5)	107
Total	552	663	528	615

1/ Normal is the monthly average rainfall since 1933.

2/ Rainfall data reported by the National Weather Service Observation Station. Tidewater Agricultural Experiment Station, Suffolk, Virginia.

3/ Number of d rainfall occurred is given in parentheses.

different each year for the NT and BT systems, the two systems were pooled and referred to as the MT system. Pod yields and crop values for the MT and the CT systems were plotted for the three digging dates (Fig. 2). The ratio of MT/CT for pod yield was 0.83 for the early, 0.80 for the medium, and 0.78 for the late digging date, or an average of 0.81. This computation indicated only a small difference between the ratio values for the early, medium, and late digging dates. For crop value, the ratio was 0.77 for the early, 0.74 for the medium, and 0.72 for the late digging dates, or an average of 0.75. Stated in another way the MT (conservational tillage) system yielded 19% less than the CT (conventional tillage) system when averaged over the 3 yr and three digging dates. Likewise, the crop value for the MT system was 25% lower than the crop value for the CT system.

All grade factors were analyzed, but only the percentage of extra-large kernels (ELK), sound mature kernels (SMK), and total meat content (TM) are presented in Figure 3. The percent of ELK for the CT, NT, and BT systems was inconsistent for the 3 yr (Fig. 3A). Two of the 3 yr, percent ELK for the CT system was less than the percent ELK for the NT and BT systems.

The percent of SMK (Fig 3B) and TM (Fig. 3C) among CT, NT, and BT were not consistently different during 1984, 1985, and 1986. Although not significantly higher in all 3 yr, percent of SMK for the CT system averaged 6.6% higher than the NT and BT systems; whereas, the percent of TM averaged 4.2% higher for the CT as compared to the NT and BT systems.

The percent of ELK was significantly different among the early, medium, and late digging dates (Fig. 3D). Percent of ELK increased with delay in digging date.

The percent of SMK (Fig. 3E) and TM (Fig. 3F) for the early digging date was significantly lower than the percent of SMK and TM for the medium and late digging date in 2 of 3 yr. On the average, the percent of SMK and TM were 6.7% and 5.2% less, respectively, for the early as compared to the medium and late digging date.

By visual observation, plant growth in the MT 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 found to be 10% less for the MT systems as compared to the CT system (18). A slight delay in flowering and a reduced flower production were observed for peanut plants produced under the MT systems as compared to the CT system (3). 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 MT 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 MT than CT system.

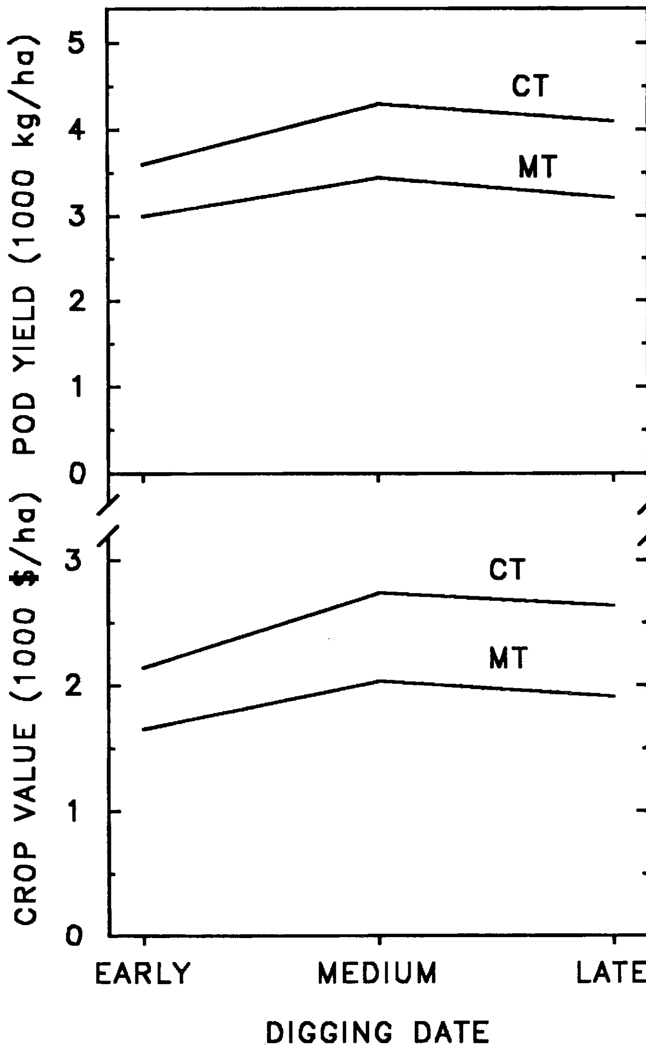

Fig. 2. Peanut pod yield and crop value response to conventional (CT) and conservational (MT - NT and BT pooled) tillage systems for early, medium, and late diggings averaged over 1984, 1985, and 1986.

Conclusions

Peanut pod yields and crop values were significantly influenced by tillage systems and digging dates. The average yield for MT systems was 19% less than that of the CT system, and crop value was 25% less. The two MT systems, NT and BT, performed about equally in pod yield and crop

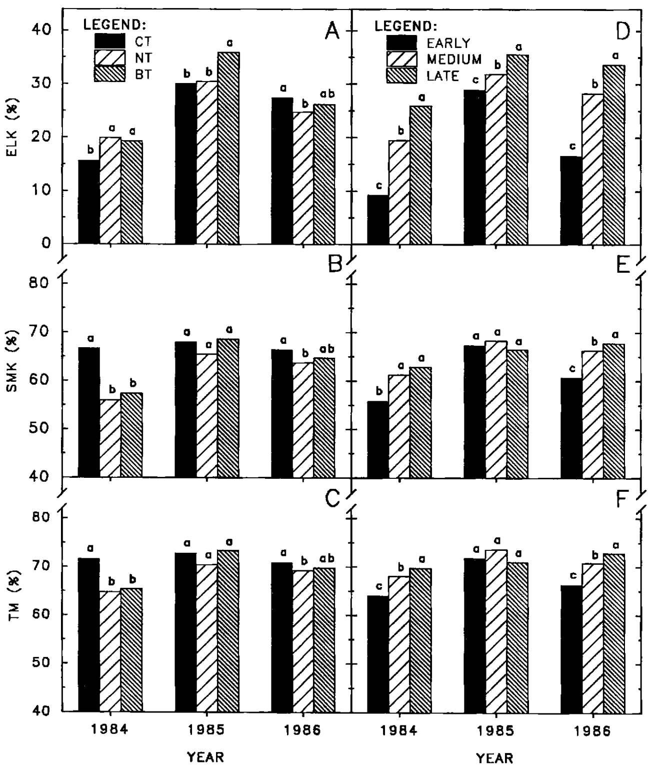

Fig. 3. Grade factors, extra-large kernels (ELK), sound mature kernels (SMK), and total meat content (TM), for the Florigiant cultivar for conventional (CT) and conservational (NT and BT) tillage systems (A, B, C) and early, medium (normal), and late digging dates (D, E, F) during 1984, 1985, and 1986. (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.)

value. However, the NT method appeared to result in a more preferable seedbed than the BT method. Digging 8 to 11 d early reduced yield 15% and crop value 21%; whereas, digging 8 to 9 d late reduced yield 6% and crop value 5% as compared to the medium digging date. The early digging date produced a significantly lower percent of ELK, SMK, and TM as compared to the medium and late digging date. Percent of ELK, SMK, and TM did not show a consistent trend to the tillage systems. More research is needed to increase yields using the MT systems before this production method will be widely accepted by peanut growers.

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Accepted April 8, 1991