

Alternate Tillage Practices for Peanut Production in Virginia

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ABSTRACT

This study compared alternate tillage practices for peanut production. The influence of these alternate tillage practices on peanut yield, crop value, and grade factors were evaluated. Alternate tillage practices consisted of a power-driven rotary tiller or rolling cultivators with planters attached. Tillage and planting were performed simultaneously immediately following moldboard plowing. This was compared to the conventional practice of moldboard plowing in late March, and two disking operations prior to planting. Results indicated approximately a 10% increase in peanut yield and crop value for the alternate tillage treatments as compared to the conventional treatment. Although not determined in this study, the alternate tillage practices have the potential to reduce soil compaction, reduce the potential of soil erosion, and reduce land preparation input costs.

Key Words: *Arachis hypogaea* L., groundnuts, peanut yield, peanut crop value, tillage methods.

Peanuts (*Arachis hypogaea* L.) are generally grown in a corn-peanut or corn-corn-peanut rotation. The soil is primary tilled with a moldboard plow to a depth of 25 cm four to twelve weeks before planting. It is then disked two to three times to smooth the soil surface, incorporate pesticides, and prepare a clean flat seedbed for planting. Some growers follow the preceding operations with a power-driven rotary tiller and plant simultaneously. Primary tillage of the soil four to twelve weeks before planting exposes the soil to wind and water erosion. The disking operations performed to incorporate herbicides and prepare a flat seedbed pulverizes the soil surface, compacts the plow layer, and leaves the soil surface more susceptible to wind erosion (1). Also, these two or three disking operations over the field add to the input costs of peanut production.

Another tillage practice used by some producers is ripping and bedding (underrow ripping) after the moldboard plowing and disking operations. Underrow ripping (chiseling to a depth of 35 cm directly under the plant row) has been evaluated for corn and soybean production (2, 6, 10, 11). Yield responses were found to be closely related to soil type and soil condition (6). Underrow ripping in an Emporia loamy sand soil was found to increase corn yields 15% (10), whereas, peanut yield in the same soil type was not influenced (9). In peanut production, the practice of underrow ripping has not been recommended because of the high energy requirement, additional tillage operation, and added input cost without a beneficial yield response.

Previous research (8) on the time of year to perform the primary tillage operation showed peanut yield increased 6.4% when moldboard plowing was done in the fall (Nov. - Dec.) as compared to moldboard plowing in the spring

(March-April). Hallock (3) suggested that performing the primary tillage in the fall reduced the quantities of fresh plant material in the plow layer at planting time. Generally, performing the moldboard plowing in the fall is difficult to accomplish because peanut harvesting is followed by soybean harvesting and wet field conditions often develop before the primary tillage operation can be performed. Also, if the soil is primary tilled in the fall, the corn residue is plowed under or no cover crop can be planted leaving the soil surface unprotected during the winter months and subjecting it to possible erosion. Performing the primary tillage operation of moldboard plowing just prior to planting has the potential to reduce soil erosion and reduce the number of tillage operations or trips across the field.

Since peanuts are produced using "clean crop" tillage practices, alternate approaches are needed to protect the soil from erosion and reduce the number of tillage operations. Each additional tillage operation adds to the input cost of production. The purpose of this study was to evaluate the effects of alternate tillage practices on peanut yield, peanut grade, and crop value.

Materials and Methods

This study was conducted for five years on the Tidewater Research Farm, Suffolk, Virginia. The peanut cultivar, Florigiant, was planted in a 0.91 m row spacing where corn was grown the previous year. Practices recommended for peanut production in Virginia were followed except where the tillage-planting operation was modified for the treatments of this study. Field equipment commercially available to growers was used to perform all tillage operations. The study area was mapped a Kenansville loamy sand, 0 to 4% slopes (loamy, siliceous, thermic Arenic Hapludults) (4).

The three tillage treatments included: 1) conventional tillage followed by planting (C), 2) power driven rotary tiller with planters attached (T/P), and 3) rolling cultivator with planters attached (R/P).

In the C treatment, the soil was moldboard plowed in late March to a depth of 25 cm. Prior to planting in early May, the seedbed was prepared by two diskings. Pre-plant herbicides were incorporated during disking and drag board operations. Peanut seed were planted in a conventionally flat seedbed.

In the T/P treatment, moldboard plowing was completed immediately prior to planting. A power-driven rotary tiller with drag board and planters attached was used to prepare a flat seedbed, pre-plant herbicide incorporation, and seed placement. All operations were performed simultaneously.

In the R/P treatment, moldboard plowing was completed immediately prior to planting. The planters were attached to a KMC adjustable spider gang rolling cultivator with the spiders angled to shape a seedbed approximately 12 cm high. Simultaneously, the seedbed was formed, pre-plant herbicides were incorporated, and peanut seed were planted.

Peanut seed were planted in each treatment the same day. Except for differences between the tillage treatments, production practices for controlling plant diseases, insects, and weeds were applied equally to all plots.

All treatments were arranged in a randomized complete block design with four replications. Plot size was 15.2 m long (50 ft.) by four rows wide. The two center rows of each plot were used to determine peanut yield, peanut grade, and crop value.

The peanut crop was dug with a digger-shaker-inverter (October 5-11) and pods harvested with a commercial combine after four to seven days in the windrow. The weight and moisture content of the peanut pods at harvest were determined for each plot. Samples from each plot were artificially dried for grade analysis. Yield per acre was computed based on 8% w.b. moisture content. Crop value was computed by using the standard

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marketing schedule for each year based on the yield and sample grade factors. Data were analyzed by analyses of variance and significant differences between treatment means were determined by Duncan's multiple range test (7).

Results and Discussion

Rainfall during the growing season (May-Oct.) varied considerably over this study period (Table 1.) In 1981, 1982, and 1983, total rainfall was close to the normal rainfall. In 1980 and 1984, rainfall was 52% and 82% of normal (700 mm), respectively. The monthly distribution of rainfall also varied considerably during the five-year period.

Table 1. Monthly rainfall during the growing season, Suffolk, VA, 1980-1984.

| Months | Normal ^{1/} | RAINFALL (mm) | | | | |
|-----------|----------------------|---------------|------|------|------|------|
| | | 1980 | 1981 | 1982 | 1983 | 1984 |
| May | 97 | 80 | 88 | 161 | 98 | 121 |
| June | 111 | 8 | 98 | 72 | 141 | 35 |
| July | 153 | 70 | 98 | 140 | 53 | 218 |
| August | 149 | 30 | 215 | 190 | 91 | 100 |
| September | 105 | 25 | 84 | 84 | 199 | 78 |
| October | 85 | 149 | 103 | 91 | 103 | 24 |
| Total | 700 | 363 | 685 | 738 | 685 | 575 |

^{1/} Fifty-two year long-term average rainfall for the Tidewater Agricultural Experiment Station, Suffolk, Virginia.

^{2/} Note: Air temperatures in July and August in 1981, 1982, and 1984 were cooler than the air temperature in 1983 in July and August.

The average peanut yields across all tillage treatments were significantly different between years (Table 2). This is typical in field studies even though plot areas were in alternating field positions. The very low rainfall in 1980 contributed to low peanut yields for Virginia as it did for other states.

The average peanut yields between tillage treatments were significantly different within years except 1983 (Table 2). In 1981, 1982, and 1984, the peanut yield for the R/P tillage treatment was significantly higher than the C tillage

Table 2. Average peanut yield (kg/ha) for three tillage treatments, Suffolk, VA, 1980-1984.

| Year | TILLAGE TREATMENTS | | | AV |
|------|--------------------|--------|--------|--------|
| | C | T/P | R/P | |
| 1980 | 1726 a | 1396 b | 1276 b | 1466 e |
| 1981 | 3950 b | 4674 a | 4614 a | 4413 b |
| 1982 | 3737 b | 4054 b | 4586 a | 4126 c |
| 1983 | 4519 a | 5049 a | 4781 a | 4783 a |
| 1984 | 3772 b | 3694 b | 4240 a | 3902 d |
| AV | 3541 b | 3773 a | 3900 a | 3738 |

Tillage treatment means within years followed by unlike letters are significantly different at the 5% level of significance as determined by the Duncan's multiple range test.

Tillage treatment means for averages within years and averages across years followed by unlike letters are significantly different at the 5% level of significance as determined by the Duncan's multiple range test.

treatment. The T/P tillage treatment generally yielded between the C and R/P treatments (Table 2). A reversal in the yield trends occurred in 1980. The reversal could be due to the low rainfall and firmness of the seedbed at planting. Over the five years, the alternate tillage treatments (T/P and R/P) yielded significantly higher by 7 and 10% than the C tillage treatment.

The average values of the grade factors (Table 3) were similar for the three tillage treatments. Only values for the sound mature kernels (SMK) and total kernels (TK) grade factors indicated a significant difference. The SMK and TK values were slightly lower for the R/P tillage treatment as compared to the C and T/P tillage treatments.

Table 3. Five-year average values for peanut grade factors for three tillage treatments, Suffolk, VA, 1980-1984.

| Factors | C | T/P | R/P | AV |
|---------|--------|--------|--------|------|
| ELK (%) | 25.0 | 27.2 | 26.6 | 26.2 |
| SMK (%) | 62.6 b | 64.0 a | 62.2 b | 62.9 |
| SS (%) | 1.5 | 1.6 | 1.8 | 1.6 |
| OK (%) | 3.4 | 3.0 | 3.2 | 3.2 |
| DK (%) | 2.1 | 1.8 | 1.8 | 1.9 |
| TK (%) | 69.6 b | 70.4 a | 69.0 c | 69.6 |
| LSK (%) | 0.8 | 0.7 | 0.7 | 0.7 |
| FM (%) | 1.3 | 1.3 | 1.3 | 1.3 |

Tillage treatment means followed by unlike letters are

significantly different at the 5% level of significance as determined by Duncan's multiple range test.

ELK = extra large kernel; SMK = sound mature kernel; SS = sound split; OK = other kernel; DK = damage kernel; TK = total kernels; LSK = loose shell kernel; FM = foreign material.

The peanut crop value (\$/ha) results (Table 4) over the five years averaged 1910, 2096, and 2140 for the C, T/P, and R/P tillage treatments, respectively. Within years, the crop value trends were similar to the yield trends between the tillage treatments (Table 4). The crop values for the alternate

Table 4. Average crop value (\$/ha) for three tillage treatments, Suffolk, VA, 1980-1984.

| Year | TILLAGE TREATMENTS | | | AV |
|------|--------------------|--------|--------|--------|
| | C | T/P | R/P | |
| 1980 | 719 a | 588 b | 502 b | 603 d |
| 1981 | 1858 b | 2293 a | 2261 a | 2197 c |
| 1982 | 2182 b | 2431 b | 2777 a | 2464 b |
| 1983 | 2503 a | 2869 a | 2535 a | 2637 a |
| 1984 | 2288 b | 2300 b | 2627 a | 2404 b |
| AV | 1910 b | 2096 a | 2140 a | 2061 |

Tillage treatment means within years followed by unlike letters are significantly different at the 5% level of significance as determined by the Duncan's multiple range test.

Tillage treatment means for averages within years and averages across years followed by unlike letters are significantly different at the 5% level of significance as determined by the Duncan's multiple range test.

tillage treatments (T/P and R/P) averaged 10 and 12% higher than the C tillage treatment. Even though the SMK grade value was lowest for the R/P tillage treatment, the peanut yield and crop values were the highest for this treatment.

Several benefits, although not measured in this study, for the alternate tillage treatment (T/P and R/P) as compared to the C tillage treatment are worthy of discussion. Two less diskings or tillage operations are performed in the alternate tillage practices. Economically these two less trips across the field reduce the input cost of production and could provide a typical savings of about \$25/ha. A second important aspect of the alternate tillage practices is that the soil is not tilled in early spring and left barren during the windy months of March and April. Tilling the soil later in the spring immediately prior to planting could significantly reduce soil erosion due to wind and heavy rainfalls. A third aspect is soil compaction. Since the disking operation is one of the greatest compacting tillage operations (1, 5), using these alternate tillage practices in peanut production could greatly reduce the degree of soil compaction during planting.

Conclusions

Peanut yields and crop values were significantly higher (approximately 10%) for the T/P and R/P tillage treatments as compared to the C tillage treatment. In general, the R/P treatment tended to outyield the T/P treatment except in the extremely low rainfall growing season. Grade factors were influenced only slightly between the tillage treatments. The alternate tillage treatments (T/P and R/P) require two or

three less disking operations than the conventional (C) tillage treatment.

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