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Underrow Ripping of Peanuts in Virginia[1]

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ABSTRACT

The effects of underrow ripping on peanut yields have been studied for several years along with other tillage production practices. In this study, tillage treatments included no ripping and ripping under the plant row in combination with four methods of seedbed preparation. The bed preparations were prepared flat (conventionally), with a rotary tiller and bed shaper, with a disk bedder, and with a rolling cultivator. Test plots were planted at different locations each year to assess different soil conditions. To evaluate these tillage treatments, yield, grade, value, and incidence of pod breakdown were recorded. Results indicated that underrow ripping compared to not ripping directly under the plant row adversely affected crop yield and value in some soil conditions but had no effect in other soil conditions. Peanut roots penetrated the subsoil region even in soil types with an A_2 layer. Under-row ripping appeared to enhance the incidence of pod breakdown, caused by *Pythium myriotylum* and *Rhizoctonia solani.* It does not appear to be an advantageous tillage operation to use in peanut production systems for southeast Virginia based on these responses and the additional energy required to perform the operation.

Key Words: *Arachis hypogaea* L., groundnuts, peanut yield, peanut crop value, tillage practices, pod breakdown, cone index.

As defined by ASAE Engineering Practice (2), chiseling or subsoiling is a tillage operation in which a narrow tool is used to break up hard soil. Chiseling at depths greater than 406 mm (16 in.) is termed subsoiling. The use of this practice, although limited, has shown few advantages for increasing yields (1).

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In more recent years, chiseling directly under the plant row (underrow ripping) has received considerable attention in corn, peanut, and soybean production. In Virginia, yield responses in corn and soybeans (5, 10, 11) were shown to be closely related to soil type and soil conditions. Emporia loamy sand soils showed a favorable yield response with the highest corn yields obtained where moisture stress was not a factor during the critical growing season.

Generally, peanuts (*Arachis hypogaea* L.) are grown in a corn-peanut rotation in Virginia. The soil is moldboard plowed in the spring and disked two to three times to prepare a level seedbed before planting. Pesticides are incorporated during the disking operations or with a rotary tiller in the planting operation. Moldboard plowing in the fall has been shown to give a significant increase in peanut yields over moldboard plowing in the spring (8, 12). Methods of seedbed preparation and cultivation during the growing season showed no significant effect on peanut yields (12).

Pod breakdown, a term used by Garren (7) to describe an in-soil rot of peanuts attached to otherwise healthy plants, is sometimes called pod rot. This disease occurs sporadically and often causes significant economic loss. *Pythium myriotylum* and *Rhizoctonia solani* are the causal agents of pod breakdown in Virginia. Infected pods have degrees of discoloration from superficial russeting to complete rot (9). Crop rotation (6) had no effect on the severity of pod breakdown.

The purpose of this study was to determine the effect of underrow ripping with four methods of seedbed preparation on peanut yield and value, and to evaluate the incidence of pod breakdown under these production practices. These studies include responses to different soil conditions at several locations.

Materials and Methods

Virginia-type peanuts were planted at locations where corn was grown the previous year. Production practices recommended for peanuts in Virginia were followed, except that modified tillage practices were used. All soil types were moderately well drained or well drained with a subsoil of fine sandy loam, loamy fine sand, or sandy clay loam. Field equipment commercially available to growers was used to perform all tillage operations.

Tillage treatments included no ripping vs. underrow ripping, each with four methods of seedbed preparation. Seedbed preparations were made 1) in a conventionally flat manner (flat), 2) with a rotary tiller and 3-inch bed shaper (tiller), 3) with a disk bedder (disk), and with a rolling cultivator (RC).

Tillage operations common to all tests included moldboard plowing in late March or early April. Two diskings were made prior to performing the underrow ripping and bed-forming operations. Preplant herbicides were incorporatd into the flat and tiller plots by use of a rotary tiller and into the disk and rolling cultivator plots by use of a rolling cultivator.

Tillage treatments were arranged in a randomized complete block design with four replications. Plot sizes were 12.2 m or 18.3 m (40 or 60 ft) long by 4 rows wide (row width 0.9 m), depending upon test year. The center two rows were used as the test plot.

Prior to harvest, determinations of pod breakdown caused by *P. myriotylum* and *R. solani* were made. Four plants from each test plot were carefully dug by hand. Pods handpicked from each plant were counted, visually scored as diseased or not diseased, and the percent of pods with pod breakdown was determined. An arcsin square root transformation was used on the pod breakdown data in the statistical analyses. No data were taken at location B in 1979.

Penetrometer measurements, used to characterize the soil resistance to root penetration (4), were made on each of the tillage treatments in 1978. Five random readings were taken in the plant row of each plot and averaged. The cone penetrometer (13) was constructed to meet the ASAE Standard S313.1 (3). The cone index values were calculated from the force and base area of cone (1.3 cm^2). Soil bulk density and soil moisture content determinations were made on each plot where cone index values were determined.

The peanuts were dug with a digger-shaker-inverter and harvested with a commercial combine. The weight and moisture content of peanuts at harvest were determined for each plot. Samples were taken and artificially dried for grade analysis. Yield per acre was computed based on 8% w.b. moisture content and crop value was computed by use of the standard marketing schedule for each year based on sample grade factors. Data were subjected to an analysis of variance, and significant differences were determined by Duncan's multiple range test.

Results and Discussion

Peanut yield comparisons for the ripping tillage treatment were inconsistent throughout the three-year period of this study (Table 1). Yield values for no ripping as compared to ripping ranged from a decrease of 3.5% to an increase of 8.4%. The average yield for the four locations was approximately 2% higher for the no ripping as compared to the ripping treatment. The crop value was affected similarly to the peanut yield for this tillage treatment. Similar trends were observed in another study in southeast Virginia (12).

Table 1. Effect of underrow ripping on peanut yield and crop value, Suffolk, VA.

Year	Yield (kg/ha)		Value ($/ha)	
	Not Ripped	Ripped	Not Ripped	Ripped
1977[1]	2939	2712	1176[b]	1047[a]
1978	3976[a]	4115[b]	1710[a]	1792[b]
1979A	3088	3095	1216	1210
1979B	3107	2958	1350	1271
AV	3277	3220	1358	1330

1 Treatment means within a year followed by unlike letters are significantly different at the 5% level as determined by Duncan's multiple range test.

The method of seedbed preparation before planting significantly affected yield only in 1979 at the A location (Table 2). Although the yield was not significantly different at the other locations, seedbeds prepared with a rolling cultivator had the highest yields except in 1978. Comparing the average yield values, the yield for the flat, tiller, and disk seedbeds were 7.1%, 6.0%, and 2.0% less, respectively, than the yield for the rolling cultivator seedbed. Similarly, the crop value for the flat, tiller, and disk seedbeds ranged from 3.1% to 6.3% less than the crop value for the rolling cultivator seedbed.

The pod breakdown, caused by *P. myriotylum* and *R. solani,* was not appreciably affected by underrow ripping (Table 3). However, the severity of pod breakdown was greater for the underrow ripping treatment than for no ripping two out of three years. Average pod breakdown was two percentage points greater or a 12.5% increase for ripping compared with not ripping.

The method of seedbed preparation did not have a significant effect on the incidence of pod breakdown except in 1978 (Table 4). There was consistently less pod breakdown for the rolling cultivator prepared seedbed than for

Table 2. Effect of seedbed preparation methods on peanut yield, Suffolk, VA.

Year	Yield (kg/ha) Flat	Tiller	Disk	RC
1977	2794[1]	2669	2784	3054
1978	4049	4040	4088	4005
1979A	2830[a]	3082[b]	3194[b]	3257[b]
1979B	2873	2896	3167	3193
AV	3136	3172	3308	3377

1 Treatment means within a year followed by unlike letters are significantly different at the 5% level as determined by Duncan's multiple range test.

Table 3. Effect of underrow ripping on pod breakdown, Suffolk, VA.

Year	Pod Breakdown (%) Not Ripped	Ripped
1977[1]	11.3[a]	17.3[b]
1978	18.2	19.2
1979	18.5	17.4
AV	16.0	18.0

1 Treatment means within a year followed by unlike letters are significantly different at the 5% level as determined by Duncan's multiple range test. No data were taken at location B in 1979.

Table 4. Effect of seedbed preparation methods on pod breakdown, Suffolk, VA.

Year	Pod Breakdown (%) Flat	Tiller	Disk	RC
1977[1]	15.0	17.2	13.2	11.8
1978	16.8[ab]	23.4[b]	21.8[b]	12.8[a]
1979	17.6	17.0	21.5	15.9
AV	16.5	19.2	18.8	13.5

1 Treatment means within a year followed by unlike letters are significantly different at the 5% level as determined by Duncan's multiple range test. No data were taken at location B in 1979.

the other three methods. The pod breakdown for the flat, tiller, and disk bed types increased an average of 35% compared with the rolling cultivator bed type.

Cone index measurements for the underrow ripping treatment (Figure 1) were less than 400 kPa to a soil depth of 30 cm and then increased. The tillage implement was operated at a depth just to penetrate the plow layer (30 cm). Where no ripping was performed, the cone index reached a high of 2050 kPa at the same depth where ripping was performed. In the primary land preparation, the soil was moldboard plowed to a depth of 20-25 cm. The cone index increased gradually up to ca. 800 kPa as shown by the curve for the no ripping treatment.

The cone index values for the different seedbed preparations were significantly affected at the 12 and 18 cm depths (Table 5). The soil prepared with the rolling cultivator was firmer (higher resistance to penetration) than the other three bed types. Up to 6 cm of soil depth (which covers the zone of seed placement), methods of preparing the seedbed did not significantly affect the cone index val-

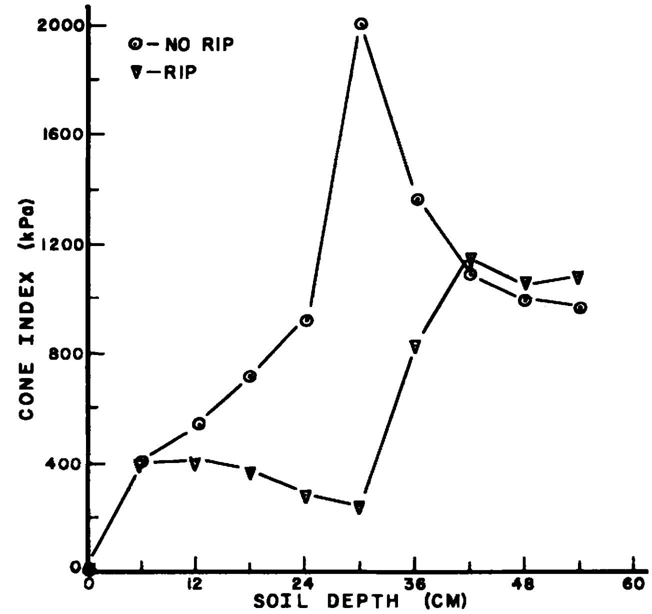

Fig. 1. Average cone index values with soil depth for no ripping and underrow ripping, 1978, (soil moisture content 10-12% d.b.) Suffolk, VA.

Table 5. The cone index values for different soil depths and seedbed preparations, 1978, Suffolk, VA.

Depth (cm)	Cone Index (kPa) Flat	Tiller	Disk	RC
6	372	393	427	407
12	303[a]	434[b]	496[b]	648[c]
18	462[ab]	441[a]	586[bc]	669[c]
24	710	545	558	614
30	1034	1303	1131	1103

Means within a depth followed by unlike letters are significantly different at the 5% level as determined by Duncan's multiple range test.

ues. Soil bulk density measurements (to depth of 12 cm) averaged 1.27 gm/cc and soil moisture content was 10-12% d.b. Observations at other locations have indicated peanut plant roots penetrate "hard" soil layers more readily than do corn plant roots. Additional costs for production equipment to lower soil resistance to root penetration must be assessed for individual farming operations.

Conclusions

Peanut yields and crop values were influenced only slightly by tillage practices included in this study. Although differences in peanut yields were not significantly affected, the general trend showed a slight adverse effect on peanut yields when underrow ripping was used. Preparing the seedbed with a rolling cultivator produced slight yield gains over other seedbed preparation methods tested. In fields with a history of pod breakdown some advantages were indicated for the rolling cultivator seedbed. Additional information is needed to more fully characterize soil parameters along with different tillage practices and yield responses.

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