BULLETIN 344 APRIL 1963

Effects of DEEP TURNING AND NON-DIRTING CULTIVATION ON BUNCH AND RUNNER PEANUTS

deep covering of organic matter and non-dirting weed control methods evaluated for effects on peanut production in southern Alabama

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RESULTS READY for the FARM

Reported in this publication are results of research that can be put to immediate use on peanut farms. Described are production practices that reduce losses from the damaging stem and peg rot and increase peanut yields in severe disease years.

Those two practices proved valuable in the studies with both bunch and runner peanuts:

(1) Deep covering of organic matter in land preparation. Soil was turned to a depth of about 9 inches.

(2) Controlling weeds without throwing dirt around the plants. This was done by planting level or on slightly raised beds and applying DNBP as a pre-emergence herbicide treatment.

These practices were superior when compared with (1) land preparation by loosening top 9 inches of soil with a spring tooth harrow, thereby leaving organic debris on or near the surface; and (2) planting in a furrow 3 to 4 inches deep and throwing soil around base of plants when cultivating.

Deep turning and non-dirting weed control were most valuable in seasons when stem and peg rot was highly prevalent. However, there were no disadvantages during other years.

Deep turning also aided in controlling weeds. Weed populations were sharply reduced when crop debris was turned deep.

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First Printing 3½M, April 1963

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STEM AND PEG ROT caused by *Sclerotium rolfsii* Sacc. is considered one of the major limiting factors in peanut production wherever peanuts are grown. It is a destructive, erratic, highly unpredictable disease for which no effective practical control was known until recent years.

Crop rotation and deep covering of crop residue have long been suggested for reducing the incidence and severity of disease resulting from inoculum carried over to succeeding crops by crop refuse. In 1919 Taubenhaus *(11)* discussed the role of sclerotia of *S. rolfsii* in infection and suggested deep plowing as a control measure. In 1921 Tisdale *(12)* recommended early plowing of rice fields infested with *S. rolfsii* to induce decay of organic matter and germination and exhaustion of sclerotia. Ciccarone and Platone *(6)* observed in Venezuela in 1949 that piling soil in the peanut row by cultivation was dangerous since it allowed the stem rot fungus to come in contact with stems and made favorable conditions for it.

Boyle *(3)* found that the addition of soybean, cotton, or corn debris to soil naturally infested with *Rhizoctonia* spp. and inoculated with *S. rolfsii* reduced seedling emergence and increased

[1] The author acknowledges the assistance of C. A. Brogden, superintendent, and other personnel of the Wiregrass Substation. Also, valuable suggestions in setting up the study were made by Wallace K. Bailey, Head, Peanut Investigation, USDA-ARS Crops Research Division, Beltsville, Maryland.

incidence and severity of root necrosis of young peanut plants grown in the greenhouse. Boyle *(2)* reported in 1952 that peanut stem rot could be controlled by (a) plowing to provide deep burial of organic litter, (b) control of weeds without throwing soil around the base of the plants, and (c) effective control of leafspot. In 1956 Boyle and Hammons *(4)* published data from a field test with Spanish peanuts in Georgia, which supported Boyle's concepts.

Garren and Duke *(8)* and Garren *(7)*, working with Virginia Bunch 46-2 and Virginia 56-R (runner) peanuts in Virginia, reported effects of deep covering of surface trash during land preparation and cultivation that prevented soil from being placed around the base of plants. These practices resulted in effective control of stem rot and striking yield increases of pods of moderately higher market quality.

Studies were conducted at the Wiregrass Substation of Auburn University Agricultural Experiment Station, Headland, Alabama, on a Norfolk sandy loam for 4 years beginning in 1957. These experiments were designed to determine the effect of selected land preparation and cultivation procedures on the incidence and severity of stem rot and on yields and market qualities of pods of runner and bunch-type peanuts.

EXPERIMENTAL PROCEDURE

In this experiment a split-split plot design was used. A bunch variety and a runner peanut variety were grown under two methods of cultivation, which in turn were superimposed on each of two methods of initial land preparation. Land preparation treatments were: (a) turning the soil to a depth of about 9 inches with a moldboard plow equipped with a coulter and special jointer adjusted to cover all surface litter to a depth of 5 to 9 inches; and (b) thoroughly loosening the soil to a depth of about 9 inches with a spring-tooth harrow, thereby leaving most organic debris on or near the soil surface.

Contrasting cultivation procedures were: (a) planting the peanuts in a furrow 3 to 4 inches deep, and throwing soil about the base of the plants to control weeds; and (b) planting on a level to slightly raised bed and applying DNBP (4, 6 dinitro-o-secondary butylphenol) as a pre-emergence weed control measure. The herbicide spray was applied at the rate of 3 pounds per acre on a 12-inch band centered over the row; no soil was thrown around base of the plants during cultivation. To further aid in controlling weeds in 1958 and 1959, a post-emergence application of sesone (sodium 2, 4-dichlorophenoxyethyl sulfate) was made 10 days after emergence.

Lime was applied on the basis of soil analyses. In 1957 and 1958, 1,800 and 2,000 pounds per acre of high-calcium lime were applied, respectively. Basic slag was used in 1959 at the rate of 1,200 pounds per acre. The liming materials were broadcast prior to initial land preparation in 1957, but immediately afterwards in 1958 and 1959. In 1960, 2,000 pounds per acre of high-calcium lime was broadcast before and 1,000 pounds after land preparation.

An 0-10-20 fertilizer was broadcast after initial land preparation at the rate of 500 pounds per acre in 1957 and 1958. In 1959 the rate was reduced to 400 pounds. The following year, 600 pounds per acre of 0-10-20 fertilizer was broadcast after land preparation on the surface-mulched plots and on half of the deeply turned plots. On the other half of the deeply turned plots, the fertilizer was applied in the plow sole. All broadcast fertilizer was lightly harrowed into the soil.

Gypsum was applied broadcast in 1958, 1959, and 1960 at the rate of 500 pounds per acre to the potential pegging zone of the peanut row at early bloom stage. In 1957 basic slag was used.

Organic residues on test plots were: 1957, peanut debris from the previous season plus early spring weeds; 1958, peanut debris from previous season plus good growth of hairy vetch; 1959, corn litter and good growth of hairy vetch; and 1960, corn litter from previous season. Use of a rotary mower preceding land preparation chopped the organic debris. The 1958 and 1960 experiments were on the same field area; different areas were used in 1957 and 1959.

Varieties of peanuts planted were Dixie Runner and Georgia 119-20 (bunch) in 1957, 1958, and 1959 and Early Runner and Virginia Bunch 67 in 1960. Planting dates were April 17, 24, 15, and 13, respectively, for the 4 years.

Plots of 8 rows spaced 36 inches apart were used. Row lengths were 50 feet in 1957 and 60 feet in other years. Each treatment was replicated 8 times in 1957 and 6 times in 1958, 1959, and 1960. Data from the four center rows of each plot were used in this report.

Each variety was dug and stacked at optimum maturity. Diseased and dying plants were recorded at digging. Pod yields and market-grade data were recorded after curing and picking. Data were evaluated by the analysis of variance procedure.

RESULTS and DISCUSSION

Results are presented graphically in Figures 1-4. Visual effects of treatments in 1960 are shown in Figure 5.

Dead and dying plants of Dixie Runner caused by stem rot organisms were negligible from 1957 through 1959. Stem rot of Georgia 119-20 was negligible in 1957 and 1958. Although incidence of disease was low in 1959, differences between dirting (2.0 per cent) and non-dirting (5.7 per cent) cultivation, and between surface mulching (3.1 per cent) and deep turning (4.6 per cent) were significant. Prolonged drought might have been the primary cause of death of many plants in the non-dirting cul-

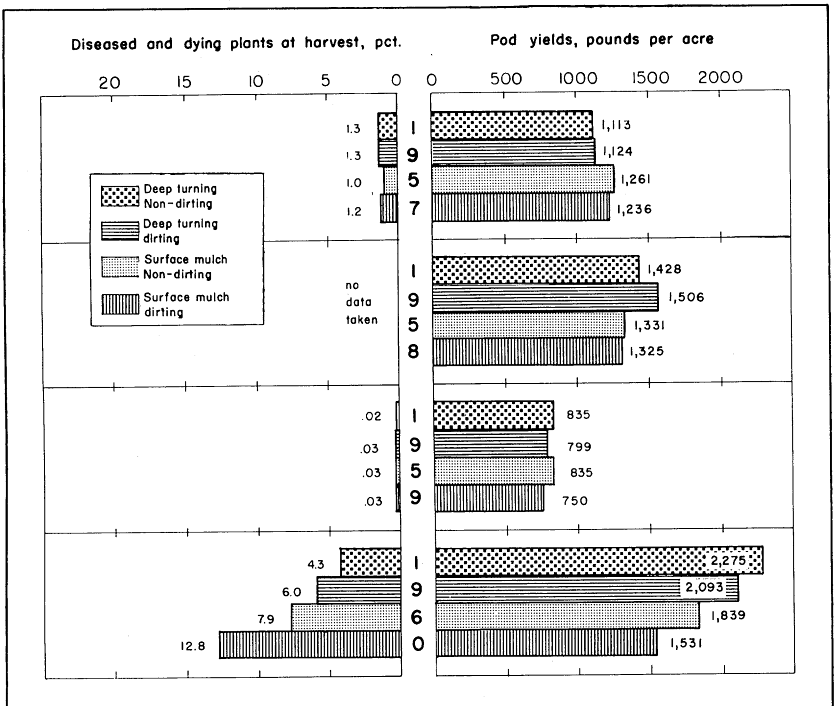

FIG. 1. Relationship between proportion of diseased and dying runner peanut plants and yields of pods per acre is illustrated by the graph. Significant differences (.01 level) were noted as follows: Diseased and dying plants—1960, deep turning vs. surface mulching and dirting vs. non-dirting; pod yields per acre—1957, 1958, and 1960, deep turning vs. surface mulching.

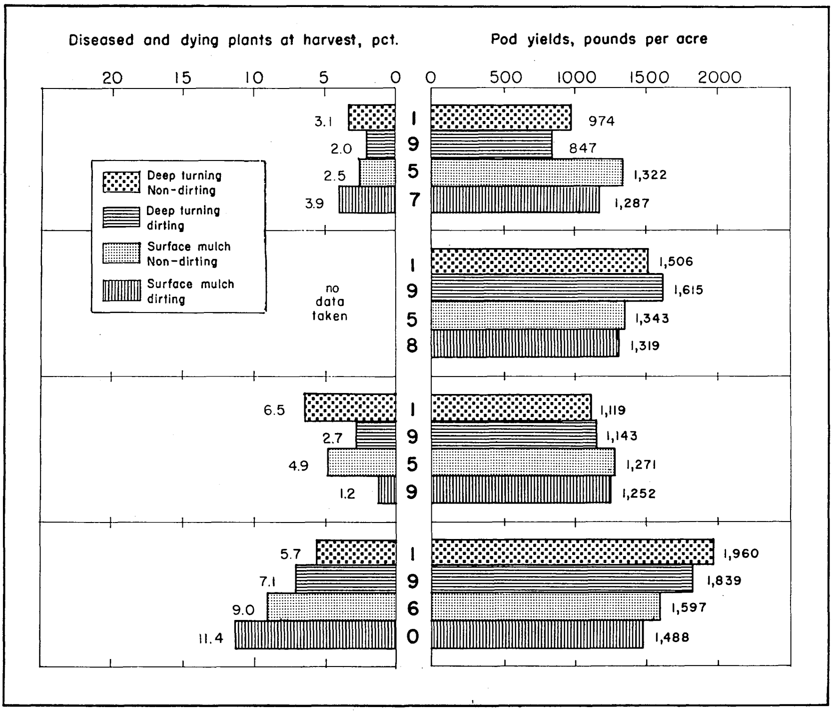

FIG. 2. This graph illustrates, for bunch peanuts, relationship between proportion of diseased and dying plants and yields of pods. Significant differences for diseased and dying plants were noted as follows: 1957, land preparation × cultivation interaction; 1959, deep turning vs. surface mulching; 1959, dirting vs. non-dirting; and 1960, deep turning vs. surface mulching (first two were significant at .05 level, last two at .01 level). For pod yield per acre, there were significant differences at the .05 level for deep turning vs. surface mulching during 1957, 1958, 1959, and 1960.

tivation treatment, especially on the deeply turned plots. Observations indicated that the non-dirting cultivation treatment contributed to drought susceptibility.

With a high level of disease in 1960, a negative correlation was found between incidence of disease and pod yield among the treatments for both Virginia Bunch 67 and Early Runner. With Early Runner the proportion of dead and dying plants ranged from 4.3 per cent for the deep turning, non-dirting treatment to 12.8 per cent for the surface mulching, dirting treatment, Figure 1. Corresponding pod yields were 2,275 and 1,531 pounds per acre, a 744-pound per acre increase from the deep turning, non-dirting treatment. For the same treatments with Virginia Bunch

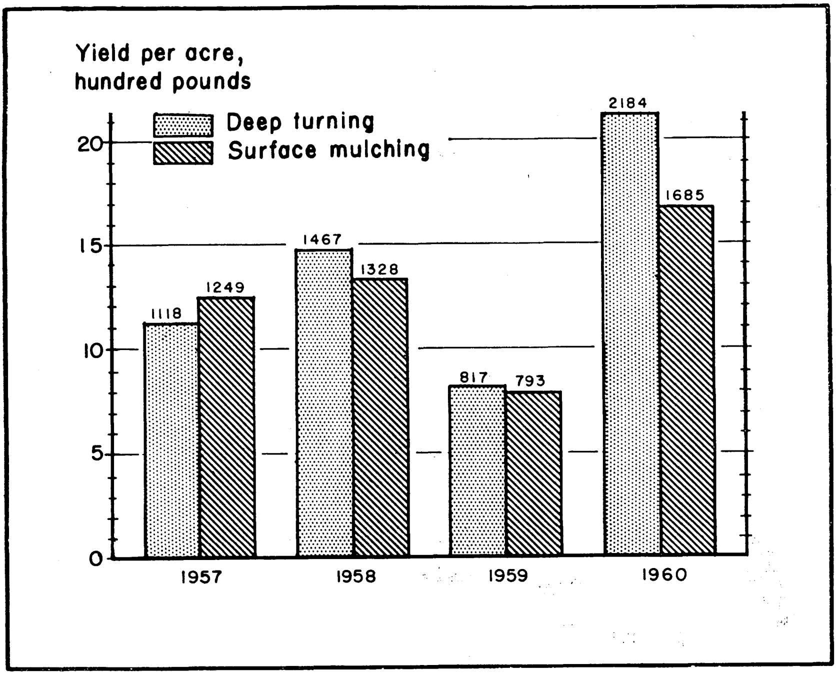

FIG. 3. Effect of land preparation methods on yields of runner peanuts is illustrated by this graph. Differences were highly significant between deep-turned and surface-mulched treatments in 1957, 1958, and 1960 experiments.

67, dead and dying plants ranged from 5.7 per cent to 11.4 per cent with corresponding yields of 1,960 and 1,488 pounds of pods per acre, a 472-pound increase. In the test the major contribution to disease reduction and yield increase was deep coverage of organic debris in initial land preparation. However, non-dirting cultivation also contributed to disease reduction and yield increase of both the runner and bunch peanut varieties.

In 1957, the striking yield reduction of Georgia 119-20 associated with deep coverage of organic trash can be attributed largely to the shortage of readily available calcium in the soil where the pods developed. Although 1,800 pounds per acre of high-calcium lime was applied prior to land preparation and 500 pounds per acre of basic slag was applied directly on the plants at early bloom, there was a calcium deficiency. Analysis of soil samples taken after harvest from the upper 6 inches of the deeply turned plots indicated only 256 pounds per acre of calcium and a pH of

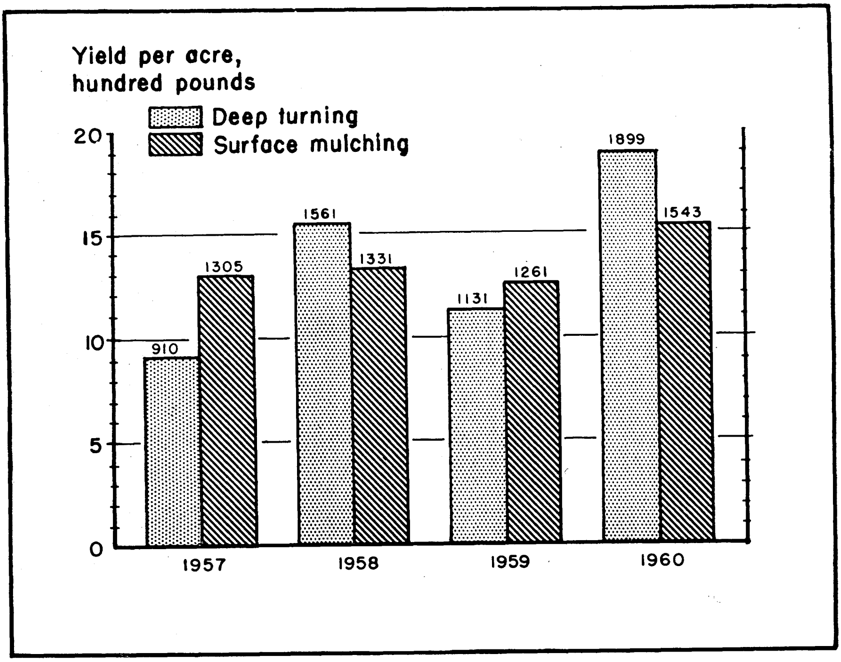

FIG. 4. Land preparation affected pod yields of bunch peanuts as illustrated in the graph. Yield differences were significant between deep-turned and surface-mulched plots in 1958 and 1960 and highly significant in 1957 and 1959.

5.1. The surface-mulched plots with comparable lime treatment showed 720 pounds of calcium and a pH of 6.1.

Results of soil analyses, together with the presence of many unfilled pods, indicate that calcium in the fruiting zone of the deeply turned soil was inadequate to ensure adequate pod filling of the large-seeded peanuts. Other workers *(1,5,10)* have presented evidence that large-seeded peanut varieties require a high-calcium level in the fruiting zone for proper pod development. Although Dixie Runner, with much smaller seed, showed little evidence of insufficient calcium for adequate pod filling, the yield from the surface-mulched plots was significantly higher than that from deeply turned ones.

In absence of appreciable disease in 1958, deep coverage of organic trash in initial land preparation as compared with surface mulching resulted in a significant increase in yield of 17.3 per cent for Georgia 119-20 and 10.5 per cent for Dixie Runner. In 1959

FIG. 5. These early runner peanuts show comparisons among different land preparation and cultivation combinations used in 1960. Combinations were: Upper left, deep turning—non-dirting; upper right, deep turning—dirting; lower left, surface mulching—non-dirting; and lower right, surface mulching—dirting.

differences in pod yields of Dixie Runner between deep turning and surface mulching treatments were negligible. With Georgia 119-20, however, surface mulching resulted in a significant pod yield increase of 11.5 per cent over the 1959 yield from deep coverage of organic trash.

With 1957 yields omitted (because of low pH and obvious calcium deficiency in the fruiting zone in deeply turned plots), the average increase in pod yield from deep coverage of organic trash as compared with surface mulching averaged 11.0 per cent for bunch peanuts and 17.4 per cent for runner varieties. Essentially no average yield advantage was obtained for bunch or runner peanuts from use of non-dirting cultivation.

The shelling percentage of Georgia 119-20 was significantly lower on the deeply turned plots in 1957, 62.2 per cent as compared with 67.5 per cent for the surface-mulched plots. As previously mentioned, this reflects a lack of calcium in the fruiting zone, which is necessary for proper development of pods of the Georgia 119-20 variety. In 1958 through 1960, deep coverage of organic debris resulted in shelling percentages equal to or slightly higher than those of the surface-mulched plots for both bunch and runner varieties. Non-dirting cultivation gave significantly higher shelling percentages of both varieties in 1958 and 1959, but there were no differences between dirting and non-dirting treatments in 1957 and 1960.

No weed population data were taken, but a striking reduction in weed numbers was noted on the deeply turned plots each year.

Results reported in this study show that the major benefit is from deep coverage of organic trash. This is in agreement with results of similar studies in Georgia *(4)*. In Virginia *(7)*, the major benefit of similar treatments was from non-dirting cultivation rather than deep turning of organic debris. The overall average increase in yield of pods, the tendency toward slightly higher shelling percentage, and the observed reduction in weed populations associated with deep coverage of organic trash in land preparation suggest that this practice could be of advantage to Alabama peanut growers.

SUMMARY

Four-year results (1957-1960) of contrasting land preparation (deep turning vs. surface mulching of organic debris) and cultivation treatments (non-dirting vs. dirting weed control) are reported for a bunch and a runner variety.

With low incidence of stem and peg rot during the first 3 years, no major benefits except effective weed control were evident for deep coverage of organic matter and non-dirting weed control procedures. However, under a high level of incidence of stem and peg rot in 1960, deep turning together with non-dirting cultivation significantly decreased the numbers of dead and dying plants at harvest and increased the yield of pods of Early Runner and Virginia Bunch 67 by 48 per cent and 31 per cent, respectively, over the surface mulching – dirting treatments. The major benefit in disease reduction and yield increase was from deep coverage of organic debris, but non-dirting cultivation made some contribution.

The deep coverage of organic debris and non-dirting cultivation procedures suggested require little additional expense, as compared with conventional methods together with currently

recommended chemical weed control practices. Thus, deep coverage of organic trash and non-dirting cultivation could be used advantageously by Alabama growers.

Each year striking reductions in weed numbers were noted on the deeply turned plots.

LITERATURE CITED

(1) BAILEY, WALLACE K. Virginia Type Peanuts in Georgia. Georgia Agr. Expt. Sta. Bul. 267. 1951.

(2) BOYLE, L. W. Factors to be Intergrated in Control of Southern Blight of Peanuts. (Abs.) Phytopath. 42:282. 1952.

(3) ——————. Fundamental Concepts in the Development of Control Measures for Southern Blight and Root Rot of Peanuts. Plant Disease Reptr. 40:661-665. 1956.

(4) ——————, AND HAMMONS, R. O. Cultural Practices with Respect to Peanut Yields and Control of Southern Blight and Root Rot. Georgia Agr. Expt. Sta. Mimeo. Series N. S. 31. 1956.

(5) BURKHART, L., AND COLLINS, E. R. Mineral Nutrients in Peanut Plant Growth. Proc. Soil Sci. Soc. Amer. 1942.

(6) CICCARONE, A., AND PLATONE, E. (Translated Title) Report on *Sclerotium rolfsii* in Venezuela. Riv. Agr. Subtrop. 43:71-80. 1949.

(7) GARREN, K. H. Comparative Development of Stem Rot in a Virginia Bunch and Virginia Runner Variety of Peanuts. Phytopath. 50:575. 1960.

(8) ——————, AND DUKE, G. B. The Peanut Stem Rot Problem and a Preliminary Report on Interrelations of "Non-Dirting" Weed Control and Other Practices to Stem Rot and Yield of Peanuts. Plant Disease Reptr. 41:424-431. 1957.

(9) LOCHHEAD, A. G. Pathology Problems and Progress, 1908-1958, XXX Rhizosphere Microorganisms in Relation to Root-Disease Fungi. The University of Wisconsin Press, pp 327-338. 1958.

(10) MIDDLETON, G. K., COLWELL, W. E., BRADY, N. C., AND SCHULTZ, E. F., JR. The Behavior of Four Varieties of Peanuts as Affected by Calcium and Potash Variables. Jour. Amer. Soc. Agron. 37:443-457. 1945.

(11) TAUBENHAUS, J. J. Recent Studies on *Sclerotium rolfsii*. Jour. Agr. Res. 18:127-139. 1919.

(12) TISDALE, W. B. The Sclerotial Diseases of Rice. Jour. Agr. Res. 21:649-658. 1921.