PRECISION TILLAGE

for cotton production

Drill row preparation for cotton by deep tillage, with either vertical mulching or subsoiling, allowed better root development, accelerated plant growth and significantly increased yields in experiments at the U. S. Cotton Field Station, Shafter.

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Experiments at Shafter, indicating the benefits of deep tillage directly under the drill row for cotton, have led to a new term, "precision tillage." Such operations are designed to prepare the soil for better root development. This new approach contrasts with the normal "broadcast" method of tillage in which the specific area of taproot development is not considered.

Soil compaction

Precision tillage experiments with cotton appear to offer one means of overcoming the continuing deterioration of soil structure that has resulted from increased mechanization of cotton and other row crops. Soil compaction often is the cause of poor penetration of irrigation water and can be compensated for by longer irrigation sets, irrigating more frequently, improving water quality and releveling land. Poor root development, however, will not be improved by these approaches to the problem of soil compaction. The physical limitations of root development, complicated by related nutritional and aeration problems, may be partially overcome by restricting tillage to the area not used to support tractor wheels. Possibilities for reducing the number of tillage operations and for accumulative improvements of the soil may result from this concept of precision tillage—leading not only to improvements in soil management but to a reduction in tillage costs as well.

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Experimental plots to consider the effects of deep tillage under the drill row in cotton included:

1. Check—Normal soil preparation for cotton following cotton was used. The previous year's stalks were cut and shredded. The soil was disked twice, plowed 10 inches deep, disked again and the beds listed for pre-irrigation in early March.

2. Vertical Mulching—Land preparation was similar to the check plot, except that prior to the pre-irrigation a modified two-foot subsoil shank was pulled down the center of each bed to a depth of 21 inches. Two vertical, triangular-shaped plates were attached to the trailing edge of the shank to hold the subsoil slot open for a short distance behind the shank. Gin trash (crop refuse separated from cotton during ginning) was blown into this opening behind the shank at the rate of 13 tons per acre.

3. Subsoiling—This treatment was the same as treatment 2, except that no gin trash was placed in the subsoil slot.

4. Broadcast—Land preparation was the same as for the check plot but, in addition, 13 tons of gin trash was broadcast and disked into the soil prior to listing the beds for pre-irrigation.

Cultural practices

All plots were treated alike after the pre-irrigation. The soil was fumigated for nematode control, planted with Acala 4-42 cotton seed at the rate of 15 pounds per acre and side-dressed at planting with 500 pounds of 16-10-0 fertilizer. The planting date was April 10. Seedling diseases resulted in stand damage in treatment 4 where gin trash was broadcast on the soil. This required spot planting in mid-May. Stand counts at the end of the season showed an average plant population of 50,000 plants per acre and little difference among the four treatments. Summer irrigations were applied about every ten days starting in early June and ending September 1.

Soil type

The test was located on Hesperia loamy sand, a coarse textured alluvial soil that in this area is stratified with sand and clay layers. The bulk density for this soil is 105 pounds per cubic foot and requires little compaction to obtain this density. Water infiltration rates are high (averaging one inch per hour) but root development is limited to a shallow depth, probably due to soil density and stratification. The influence of these four treatments on vegetative growth and cotton yields is shown in the table.

Responses in vegetative growth and yield were obtained by subsoiling in the

Increased plant growth and yield of cotton from plants on the right were the results of precision tillage experiments carried on at the U. S. Cotton Field Station at Shafter. Trials were made in a field where growth had previously been very poor. Subsoiling was done directly down the drill row prior to the pre-irrigation. This approach to deep tillage prevents field traffic from destroying the benefits of subsoiling.

INFLUENCE OF DEEP TILLAGE AND GIN TRASH ON PLANT HEIGHT AND YIELD OF COTTON

TREATMENT	PLANT HEIGHT ON VARIOUS DATES			LINT YIELD
	JUNE 21	JULY 20	AUGUST 23	
	INCHES	INCHES	INCHES	BALES/ACRE
1. Check	11	20	28	1.67
2. Vertical mulch	13	28	40	2.30
3. Subsoil	13	29	36	2.25
4. Broadcast	12	21	32	1.65
LSD, 5%	1	3	2	0.07

drill row with or without the addition of gin trash. Visible response in plant growth was observed in mid-June indicating a rapid early tap root development in the subsoiled treatments. Excavations of cotton tap roots at other locations (under favorable plant growth conditions) generally showed an extension to a depth of 2.5 feet by mid-June and to a depth of 5 to 6 feet by the end of the season. Root development observations in this test were made at harvest by digging trenches across rows in both normal tillage and subsoiled plots. These observations showed extension of large roots to the bottoms of the subsoiled slots and many small roots. On the normal tillage plots there were no large roots below 18 inches.

To evaluate possible nutritional contributions of the gin trash, petiole nitrate and phosphate levels were determined at regular intervals. Although the gin trash increased the content of these nutrients in the plant, particularly nitrates, the levels in the check treatment would not be expected to limit yield according to past experiments at this location. The effect of the treatments at a critical date is shown below:

INFLUENCE OF DEEP TILLAGE AND GIN TRASH ON NITRATE AND PHOSPHATE CONTENT OF COTTON PETIOLES ON JULY 31, 1961

TREATMENT	NO_3-N	PO_4-P
	PPM	PPM
1. Check	2200	1610
2. Vertical mulch	4300	2000
3. Subsoil	1800	1750
4. Broadcast	5600	1710
LSD, 5%	1400	N. S.

POTATO RESPONSE TO PHOSPHORUS

in organic soils at Tulelake

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Soil reaction and weather conditions can influence responses to phosphorus fertilization, according to field trials with potatoes in the Tulelake area of northern California. Further research is needed to clarify the phosphorus availability of soils and potato plant utilization. Studies are also in progress toward obtaining a better understanding of the use of soil analysis to predict phosphorus requirements of these organic soils.

Growers in the Tulelake Basin are using several commercial fertilizer formulations for the production of a potato crop. The reasons for selection of any one formulation are not clear. Data from previous field trials indicate that maintaining high potato yields with uncertain weather and growing conditions involves a relationship between phosphorus present in a formulation and plant uptake.

The organic soils of this region are a mixture of decomposed tule reed, volcanic ash and pumice, and lacustrian deposits. The soil content of potassium, calcium, and magnesium is high. From past field fertilizer trials, rates as low as 60 pounds of P_2O_5 per acre have usually produced potato yields comparable to higher rates of phosphorus. However, growers are apparently realizing increased potato yields in certain years by changing their fertilizer formulations or rates of application. Studies were initiated to re-examine the phosphate availability of soils in the Tulelake area. Results of only two of several field trials are discussed here.

Russet Burbank seed potatoes (cut) were planted and banded with fertilizer through use of a potato planter. The fertilizer formulations were added so that a relatively constant level of nitrogen was applied with varying levels of phosphorus for the Buckingham ranch trial in 1958. At the Dean ranch trial in 1959, the nitrogen and phosphorus levels were varied (see table). Plantings were made in late May and the crop was harvested in early October. Soil samples were taken prior to planting and plant petiole tissue was sampled during the growing season for chemical analysis. At harvest, yield and grade distribution data were recorded and the specific gravity of U. S. No. 1 potatoes was determined by use of a potato hydrometer.

No response, 1958

Data obtained from the 1958 trial indicated that no marked differences in yield or specific gravity of potatoes were found as a result of additions of phosphorus. Nor were there yield differences attributable to either commercial or experimental fertilizer mixtures.

The available water-soluble phosphate in this organic soil, prior to planting, was 1.12 ppm with a soil-solution conductivity of 0.82 mmhos/cm. Plant tissue analysis showed that the total phosphorus concentration in the petioles was high. By including phosphorus in the fertilizer, the concentration of phosphorus in the plant tissue was not materially increased. Therefore, as a result of the relatively high residual available soil phosphates and neutral reaction of the soil (pH 7.0) additions of phosphorus would not be expected to bring about higher tuber yields.

In the Copic Bay area of Tulelake the soil reaction tends to be more alkaline (above pH 7.5). Some beneficial responses to phosphorus applications to the