

straight-line relationship was obtained, with yields inversely proportional to penetrability, as shown in the graph. This correlation indicates the possibilities of using a penetrometer as a diagnostic tool.

Other locations

The response to precision tillage at other locations in the San Joaquin Valley was variable. Yield increases of 15% to 21% were obtained on coarse-textured soils in Kern and Madera counties. On fine-textured soils in Tulare County, essentially no response was obtained. Although a decrease of 5.9% was observed at one location, the data were not statistically significant. All of these soils were at field-capacity moisture content at the time of the precision tillage application, due to above-normal rainfall in February.

RESPONSE OF PRECISION TILLAGE ON VARIOUS SOILS

Soil type	Percent soil moisture	Increase in yield with precision tillage
Chino clay loam	22	+ 2.6 NS
Traver loam	27	- 5.9 NS
Chino silty clay loam	20	- 5.1 NS
Ripparidan fine sandy loam	7	+14.9 * *
Atwater loamy sand	11	+17.7 *
Fresno fine sandy loam	12	+11.2 *
Hesperia fine sandy loam	9	+21.2 * *

* Significant at the 1% level
** Significant at the 5% level

The effectiveness of a standard nematocide application (9 gallons of DD, 10 to 12 inches deep) was increased when precision tillage was applied. A further increase in nematode control was obtained when the nematocide was injected at the bottom of the subsoil slot. The yields from these plots reflected both the effects of increased nematode control and precision tillage, as shown in the table:

INTERACTION OF PRECISION TILLAGE AND NEMATOCIDE APPLICATIONS

Treatment	Yield lbs/acre	Nematode index*
A Check	1910	98
B Normal fumigation	2530	51
C Precision tillage	2240	94
D Treat. B + Treat. C	2790	36
E Treat. B + deep fumigation	3010	18
	LSD 5%	330 18

* Arbitrary scale 0 = perfect control, 100 = no control (based on extent of root galling by root knot nematode, *Meloidogyne incognita*).

In two field trials, where potash deficiency symptoms were noted in previous years, the addition of potassium fertilizer was effective only when precision tillage was used. This response is of a different nature than the response with nematocide since the potassium deficiency appears not to be a limiting factor in plant growth until precision tillage increased root ex-

tension and plant growth, as shown in the table.

INTERACTION OF PRECISION TILLAGE AND POTASSIUM FERTILIZER ON MADERA COUNTY SOILS.

Treatment	Seed Cotton Yield lbs/acre	
	Test 1	Test 2
A Check	2210	1750
B Precision tillage	2540	2060
C B + deep K	2860	2400
D B + sidedress K	2980	2260
E Sidedress K	2190	1730
	LSD 5%	160 410

Mechanical impedance to root development is a factor in nearly all agricultural soils. Studies of soil physical properties in other states have shown that coarse textured soils with their greater pore space rigidity more effectively resist root penetration. Limited root development in coarse-textured soils as compared to fine-

textured soils can be more harmful to growth and production due to the lower water-holding capacity and nutrient availability of these soils.

Field studies in 1963 have confirmed the greater benefits to be derived from precision tillage for cotton on coarse textured soils in the San Joaquin Valley.

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MINIMUM TILLAGE FOR COTTON

THE CONCEPT OF PLACING permanent tracks in the field to support traction equipment and machinery has often been discussed as a possible method of reducing soil compaction, decreasing the number of field operations, and allowing tillage to be applied only to the specific zones requiring soil modification. Based on the precision tillage concept, and a modification of the permanent track principle, a minimized tillage or permanent bed system for cotton following cotton was developed. A long-term replicated test was initiated in January 1961 to compare this minimized tillage system with normal tillage practices.

The minimized tillage system included stalk disposal with a special root and stalk shredder, precision tillage, nematocide application and planting for a total of four tractor operations. Further refinements included using wide front axle tractors to restrict traffic to alternate furrows, leaving untraveled furrows for irrigation. The beds in these plots are to remain in the same location for at least three years.

The normal tillage system consisted of stalk disposal using the same special machine, double-disk harrowing, plowing at right angles to the beds, disk harrowing, listing for irrigation, nematocide application and planting. The total traffic for the normal system was eight trips. Using 80% of the rated horsepower of each tractor as an approximate guide, 130 horsepower-hours per acre were used on the normal tillage and 52 hp-hrs/acre on

the minimized tillage system. This represents a decrease of 60% in the total energy requirements.

Control of trash was found to be the greatest operational problem in the permanent bed plots. This problem was minimized by adjusting the listers on the precision tillage equipment for maximum-height beds and adjusting the planter so the planter wings removed about one-third of the bed, thus planting below the trash. No experience was obtained on early post-emergence weed control since the field, fortunately, was relatively weed free. Prior to the first irrigation a dirting-cultivation was applied with no serious trash interference problems. Trash caused no problems after the first irrigation.

The cotton stands obtained were the same for both treatments. All measurements of soil moisture, bulk density, plant height, and yield were almost identical for the two treatments.

The permanent bed test will be continued for at least two additional years to allow observation of long-term effects. The permanent bed treatment will be considered a success and a possibility for a minimum tillage practice for cotton if the yields continue to be equal or greater than normal tillage. During this period, precision tillage plots will be applied on as many soil types and moisture conditions as possible to complete the overall evaluation of this minimized tillage system for cotton, incorporating the precision tillage concept.