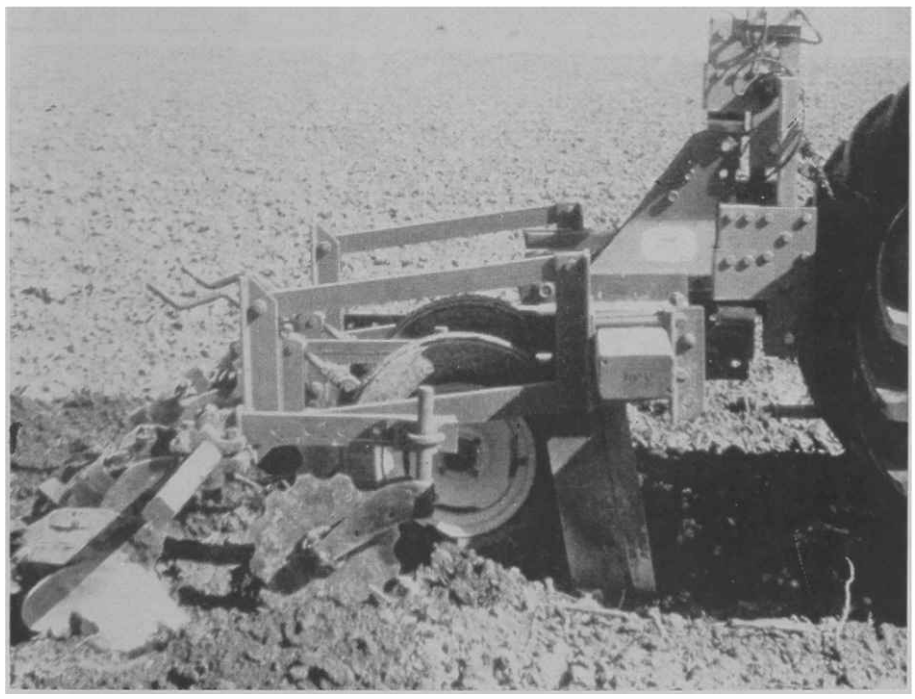
The tractor was equipped with three chisels and four listers splitting old beds and building new beds on the old furrows.



Chisel bed equipment as installed on the tractor is shown above. The arch at hitch point was used to make the draft measurements.

The Evaluation of Pre-plant Tillage Systems in Cotton Production

*by H. N. Stapleton and M. M. Machado**

Cost reduction in a production system contributes to optimization of net return. In Arizona, more than 50 percent of the production costs for cotton can be attributed to machine operations and labor. The costs of land, water and production supplies are essentially rigid. The selection, management, and operation of machines offer the cotton grower the most feasible approach to cost reduction.

Pre-plant tillage operations in the cotton production system are a major source of machinery and labor costs. The pre-plant tillage operation usually pre-sets the power, the size, and the number of units, and may prescribe the basic design of the equipment tool bars or "carriages" in the machinery system.

The "conventional" pre-plant tillage system (chop stalks-disk-plow-disk-float-bed) has dictated large prime movers due to the heavy tillage operation (plowing), and the development of higher field capacities. A considerable array of equipment is also required, together with multiple passes and a large expenditure of energy. Alternatives in pre-plant systems had been suggested, but the comparative yield response to these systems was not known.

In 1965, experiments were initiated at the Cotton Research Center, and at the Marana, and Safford Experiment Farms to: (1) Evaluate and compare the cotton yield response to certain pre-plant tillage systems and, (2) Provide numerical data for comparing the energy input and capacitive performance of the machines used in these pre-plant tillage systems.

The pre-plant tillage systems used in the experiment were as follows:

Marana & Safford	CRC	Treatment
1	A	Conventional: Chop stalks, disc, plow, disc to reduce clods, float or drag and bed.
2		List Only: Chop stalks, bed.
3		Chisel-List (shallow): Chop stalks, chisel-list with chisels set at 10-14 inches below the surface of the old furrow.
4	B	Chisel-List (medium): Chop stalks, chisel-list with chisels set at 15-18 inches below the surface of the old furrow.
5	C	Chisel-List (deep): Chop stalks, chisel-list with chisels set at 18-22 inches below the surface of the old furrow.

Three years of data were collected at the three Experiment Farms in the crop years from 1965 through 1967. Four replications of each treatment were used at each plot location. The yield data for the three years of experiments were consolidated and the data analyzed. Gross field yield in pounds of seed cotton per acre was used as the basis of comparison.

The results of the 3 years data from each location are presented graphically in Figure 1. This bar-chart shows that there was a trend of increased yield for one or more of the minimum-pass chisel-list treatments.

Statistical analysis of the data showed significant differences in yields at Marana and CRC in 1966, and at Marana and Safford in 1967. However, when the data for the three years of tests were combined, no statistically significant differences could be shown.

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Tillage Systems . . .

(*from page 3*)

Time and energy inputs were measured for each of the five tillage systems. (See Table 1) List-only, shallow chisel-list, and medium chisel-list treatments required ¼ to ⅓ the energy input of the "conventional" system. The energy inputs reflect the amount of soil movement and the number of passes. The time inputs reflect the number of separate operations within the pre-plant system.

From a cost-return standpoint all the chisel list treatments show less cost and a greater net return than the "conventional" system.

An estimate of the difference in costs of these systems can be based on their energy requirements. The cost of "conventional" pre-plant land preparation for Arizona in 1967 was estimated at $17.00 per acre. ("Arizona Agriculture, 1968") Tests showed that the "conventional" system required 44.5 HP-HRS/AC. (One HP-HR is the quantity of work performed when one horsepower is used for one hour) From:

$$\frac{\$17/\text{Ac}}{44.5\ \text{HP-HRS/Ac}} = \$0.382/\text{HP-HRS},$$

each HP-HR of energy costs 38.2¢ for land preparation operations. Based on energy requirements, shallow and medium chisel-list costs project as:

Shallow chisel-list: 11.5 HP-HRS/AC x 38.2¢/HP-PR = $4.39/AC.

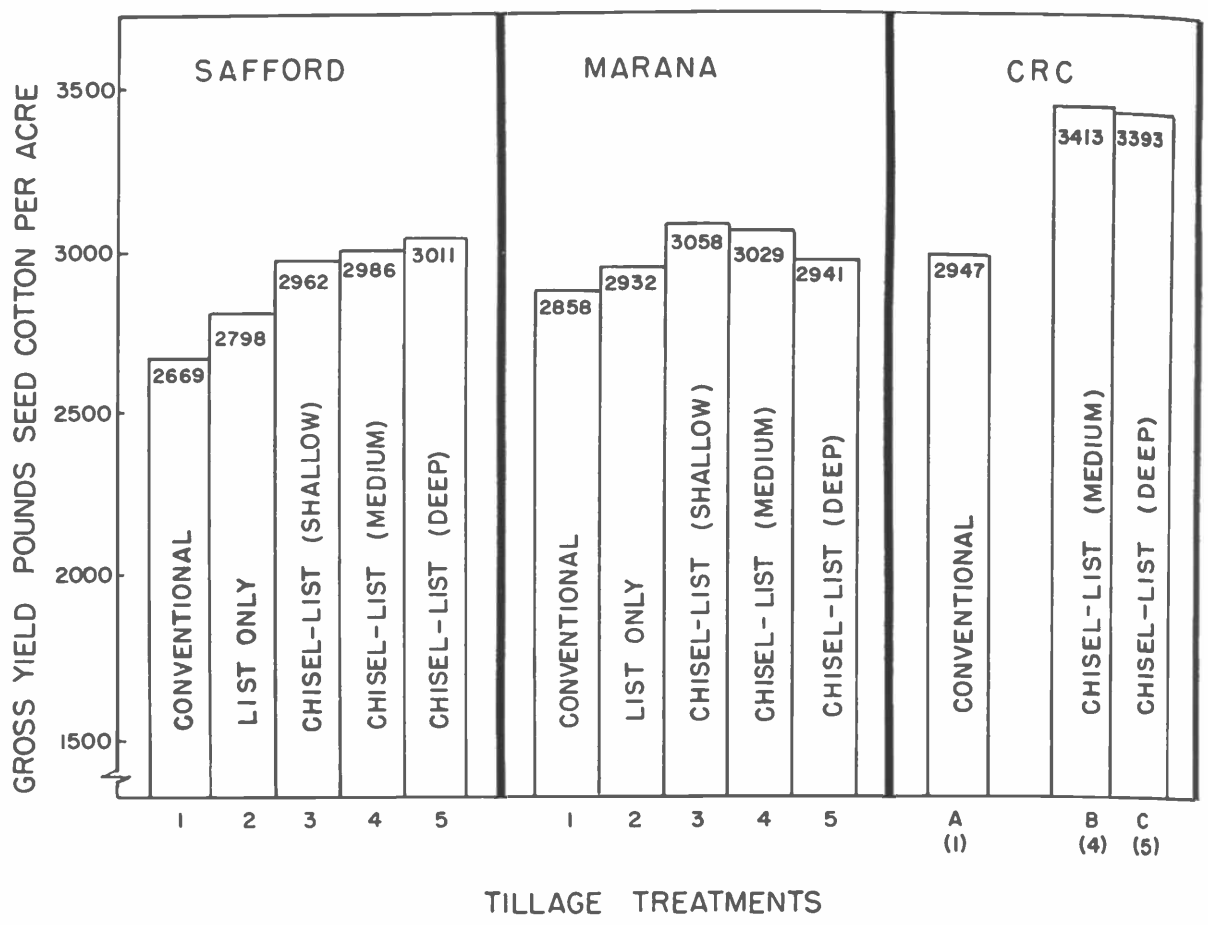

Figure 1. The bar chart shows the average yield over a three year period for each treatment at the three experimental farms. See text for description of treatments.

Medium chisel-list: 13.3 HP-HRS/AC x 38.2¢/HP-HR = $5.08/AC.

Using one of the chisel-list systems shows potential savings of nearly $12.00 per acre, or about $3,000 on a 250-acre cotton allotment.

This estimate of possible savings with one of the chisel-list systems assumes that the cost of energy is related to fuel use, and that the total cost includes labor and the annual use of the tractor and the tillage machinery. The reduced investment in machinery provides an offset for the higher unit-cost related to reduced annual hours of tractor use in producing an overall operating cost for this cost projection.

Actual costs and savings would depend upon the size of the farm, annual use of equipment, and other factors, as in any machine selection problem.

Summary. The chisel-list systems are not approved for use with cotton after cotton in the current Pink Bollworm control program. They may be used in any other cropping program. Yield data and cost projections indicate that these alternatives in preplant tillage systems could provide a means for cost reduction without a sacrifice in yield.

Table 1**

Treatment	*Operation*	*HP-HR per Acre*	*Percent of Conventional*	*Projected Cost Dollars per Acre*	*Time Input Minutes per Acre*	*Theoretical Capacity AC/HR*
1	**Conventional**	**44.5**	**100.0**	**$17.00**	**84**	**.7**
2	**List Only**	**11.2**	**25.2**	**4.28**	**18**	**3.3**
3	**Chisel-List**	**11.5**	**25.8**	**4.39**	**18**	**3.3**
4	**Chisel-List**	**13.3**	**29.9**	**5.08**	**22**	**2.7**
5	**Chisel & Chisel-List**	**32.1**	**72.1**	**12.26**	**51**	**1.2**

** **The tractor used (92 PTO-HP, Nebraska Tractor Test) was ballasted to a gross weight of approximately 11,000 lbs. The drawbar pull on firm ground was near 7,000 lbs. and on loose ground was approximately 4,000 lbs. due to slippage. The equipment used consisted of a 2-row rotary stalk cutter; a 3-bottom, 16-inch, 2-way plow; a 15 ft. tandem disc; a 12 ft. float; and 4-row chisel-list equipment.**