Mechanized Cotton Growing

effects of mechanization on yield and quality studied in tests on planting, thinning, flaming and harvesting

J. R. Tavernetti and H. F. Miller, Jr.

The experiments reported in this article were conducted co-operatively by the University of California Agricultural Experiment Station and the United States Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering.

Cotton plant population—plants per acre—is the determining factor in yield whether obtained by hand thinning, mechanical thinning or planting to a stand—no thinning.

Experiments designed to determine the effect of different plant populations on yield, quality and mechanical picking were conducted at the United States Cotton Field Station at Shafter.

The results of the experiments indicate that hand-labor for thinning or chopping cotton can be eliminated by planting to a stand or by using mechanical choppers. Hand-labor for weed control can be reduced greatly and in some cases eliminated by good cultural practices supplemented with flame and late cultivation.

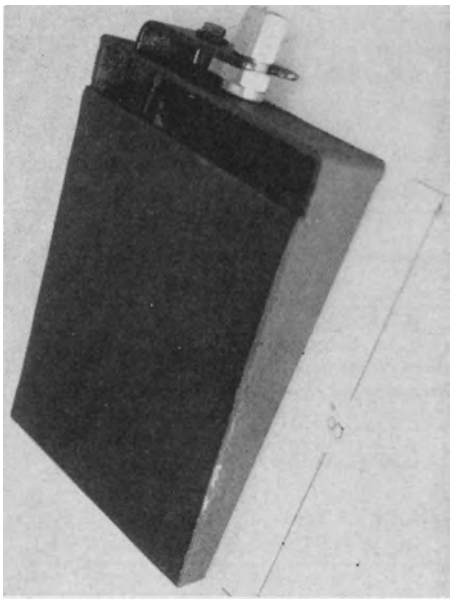
The cotton for the experimental tests was grown on beds in sandy loam soil with rows spaced 40" apart. Planting was done the first part of April with acid delinted seed which averaged approximately 4,000 seeds to the pound. Fertilization consisted of 80 pounds per acre of nitrogen in the form of ammonium sulphate which was drilled into the soil as a side dressing at the time of planting. Irrigation was by the furrow method with one preplanting irrigation and 12 to 14 postplanting irrigations beginning about June 1 and ending about September 1. Harvesting was done with a single row barbed spindle type picker with the first picking in early October and the second picking in November.

With hand thinning, a population of about 20,000 per acre or a spacing of 8" seemed to be the minimum for maximum yield but with mechanical thinning, and planting to a stand, this minimum was closer to 30,000 per acre. The reason for this increase was that hand-thinned single plants were uniformly spaced but with the other methods there was more tendency for two or more plants to be together and also more chance for large skips. Above a population of about 60,000 plants per acre the yield tended to decrease.

The height of the first fruiting node became greater as the plant population was increased. This was consistent in all tests. The height was measured from the ground surface at the base of the plant up the main stalk to the first branch having a boll. This height is important in mechanical harvesting because the greater it is the easier the bottom bolls can be picked.

Picking efficiency—determined by dividing the cotton harvested by the total yield—also increased with the plant population. This was due to the increased height of the bottom bolls and to the difference in the growth of the plants. The greater the population the more tendency the plants had to grow spindly and have fewer and smaller lateral branches which is an advantage for mechanical picking.

The tests indicated that cotton can be planted to a stand or mechanically thinned without detrimental effect if the plant distribution is reasonably uniform and the plant population is between approximately 30,000 and 60,000 per acre.



Type of burner used for flame weed control in cotton.

Liquid petroleum gas flame was tested to determine its value as a means of controlling weeds in the drill row. The flame was produced by burning butane and propane in a burner specially constructed to give a definite flame pattern. The burners were mounted one on each side of the plant row so the flame struck the ground at a 45° angle about 1" to 2" from the plants. The theory in using the flame is not to burn the weeds but to apply only enough heat to cause the liquid in the cells to expand and rupture the cell walls.

Flaming was a definite help in controlling weeds and grasses particularly if applied when they were young and tender. Older weeds were more difficult to kill and required higher intensity heat or repeated applications.

The effect of the flame on the cotton plants was studied in a series of tests. In one series—conducted for three years—all flaming was done at a constant speed of three miles per hour and a con-

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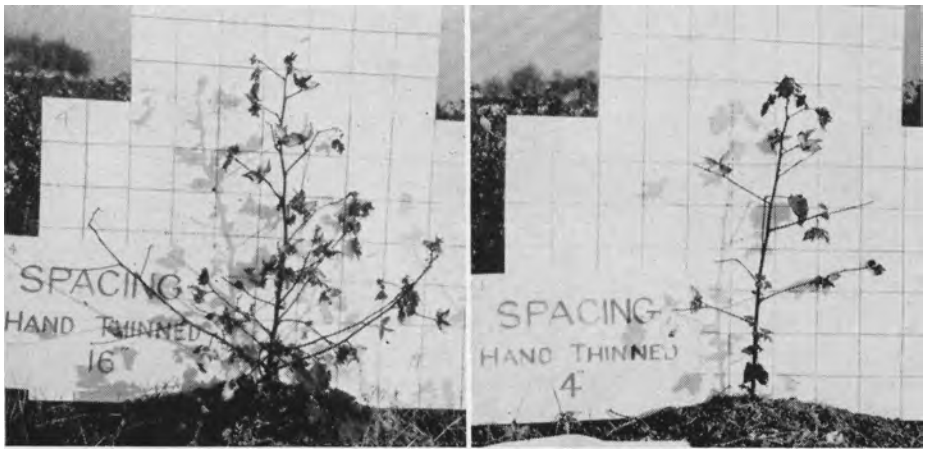
Effect of spacing on plant characteristics with 16" spacing on left and 4" on right.



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stant fuel pressure at the burner of 30 pounds per square inch. The time of the first flaming and the number of flamings were varied, with the earliest flamings applied when the cotton was about 8″ to 10″ high and about 3/16″ in diameter. These tests showed no reduction in yield of the flamed cotton compared to unflamed cotton.

In other tests—conducted for only one year, 1952—the object was to determine the effect on the cotton of different flame intensities. In these tests the speed was constant—3.1 miles per hour—but the fuel pressure was varied from 20 to 50 pounds per square inch. In one of the tests only one flaming was applied when the cotton was 6″ to 11″ in height—June 13—while in the other test there were six flamings—June 13 to August 7. The results showed no significant reduction in yield in the flamed cotton. There was, however, some visible damage to the plants with the 40- and 50-pound pressures at the time of the initial flaming but this did not seem to have any lasting effect.

These tests indicated that flaming can be used to help control weeds in cotton without reducing the yield. It is necessary, however, to have the equipment properly adjusted and to apply the flame before the weeds become too large. Its use at present is limited to the time when the plants are about 8″ high until the first bolls open.

Normal lay-by time—the time when cultivation of cotton is discontinued—is usually the latter part of July because by then the plants are so large they are damaged by the regular cultivating equipment. Irrigation however, continues until the first part of September and many times late weeds become a serious problem.

Tests using specially designed equipment have been conducted for several years to determine if cultivation after the normal lay-by time was possible without damage to the cotton. The equipment consisted of a high clearance tractor—34″ to 36″ under the axle—and cultivator with shields on both the tractor wheels and the cultivator. The test conducted in 1952 used the regular standard tractor and cultivator until July 31 in all plots. All cultivations after that date were with the shielded high clearance equipment.

These tests indicated that with proper equipment cultivation is possible after the normal lay-by time without reducing yield.

J. R. Tavernetti is Agricultural Engineer, University of California, Davis.

H. F. Miller, Jr., is Agricultural Engineer, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture Cotton Field Station, Shafter, California.

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Effect of Intensity of Flame for Weed Control on Cotton Yield—1952*

Treatment	Yield, bales per acre	
	1 flaming	6 flamings
Check—no flaming	2.49	2.13
Flamed—fuel pressure 20 p.s.i	2.37	2.21
Flamed—fuel pressure 30 p.s.i.	2.44	2.19
Flamed—fuel pressure 40 p.s.i.	2.34	2.03
Flamed—fuel pressure 50 p.s.i.	2.54	2.11

* All flamings done at 3.1 m.p.h. First flaming, when plants were 8 to 11 inches high.

Results of Tests on the Effect of Flame for Weed Control on Cotton Yield*

Year	Date of First Flaming	Number of Flamings	Yield, bales, per acre
1949	June 7	9	2.21
	June 24	8	2.22
	July 1	7	2.00
	check	0	2.11
1950	July 8	3	2.56
	July 24	3	2.57
	check	0	2.63
1951	June 5	5	2.85
	June 18	4	2.74
	check	0	2.70

* All flaming in these tests were done with 30 p.s.i. fuel pressure and a speed of 3 m.p.h.

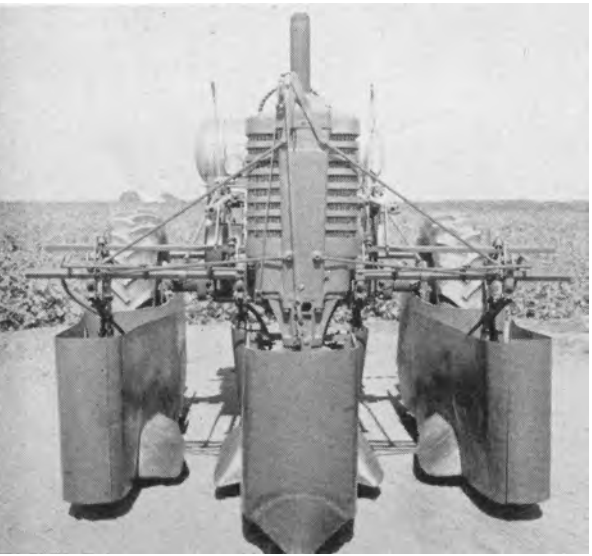
Results of Three Years Tests on the Effect of Plant Population in Cotton

Plants per acre, thousands	Av. plant spacing, inches	Yield, bales per acre			Height of first fruiting node, inches			Efficiency of picker, per cent		
		1949	1950	1951	1949	1950	1951	1949	1950	1951
Hand Thinned										
59–78	2.6–2	...	2.86	2.66	..	10.1	8.0	...	97.1	94.5
39.2	4	2.76	2.64	2.77	6.8	8.5	8.8	97.4	95.8	94.9
19.6	8	2.85	2.73	2.63	3.6	6.6	6.3	97.4	95.6	94.0
13.1	12	2.52	2.52	2.68	2.7	5.9	5.6	97.1	94.4	93.8
9.8	16	2.25	...	...	2.0	..	..	95.1	...	...
Planted to Stand—No Thinning										
59–78	2.6–2	...	2.64	2.55	..	7.3	10.1	...	94.5	96.3
35–50	4.5–3.1	2.75	2.74	2.66	6.3	6.4	7.7	96.2	92.2	95.9
21–23	7.5–6.8	2.60	2.44	2.63	3.9	5.2	6.4	95.3	93.1	94.4
13–14	12.0–11.2	2.53	2.34	2.40	3.6	3.8	4.5	95.6	92.0	94.7
8	19.6	...	...	2.18	..	..	2.7	...	...	92.6
Mechanically Thinned										
70	2.2	...	...	2.60	..			...	...	94.4
46–54	3.4–2.9	...	2.92	2.62	..			...	96.5	94.5
37–45	4.2–3.5	...	2.88	2.63	..			...	96.1	94.6
29–31	5.4–5.1	...	2.75	2.74	..			...	95.8	94.0
19–25	8.3–6.3	...	2.63	2.76	..			...	95.0	93.8

Effect of Late Cultivation on Yield of Cotton—1952

Plants per acre	Date of last cultivation	Yield, bales per acre
57,000	July 31	2.62
57,000	Aug. 7	2.57
57,000	Aug. 15	2.67
57,000	Sept. 2	2.65
17,600	July 31	2.54
17,600	Aug. 7	2.60
17,600	Aug. 15	2.58
17,600	Sept. 2	2.49

High clearance shielded equipment used for both late cultivation and flaming. The flame burners are mounted under the small shields extending out from the bottom of the large shields. Shielding for flaming or cultivation is not necessary until after normal lay-by time.



Rear view of high clearance cultivator with 24-inch sweeps.