Mechanical Thinning of Sugar Beets[1]

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The idea that sugar beets might be mechanically thinned first received attention in 1933 when mechanical "blocking" experiments at the Colorado Agricultural Experiment Station showed that a large percentage of the "blocks" consisted of single seedlings. When beets were blocked with 8-inch knives leaving 4-inch blocks, approximately 20 percent of the remaining beets were singles. It was estimated that if the beet blocks were reduced to 1/2 or 1/3 of this size the proportion of singles would be raised to 40 or 60 percent. These exact proportions were not attained in subsequent experiments since there were several contributing factors, such as trash in the soil and ability of the knife to slide through the soil, which tended to diminish the resulting stand of beets.

The objective in mechanical thinning is to leave as small blocks as practical, thus obtaining a large percentage of blocks containing single seedlings and at the same time leaving the remaining plants close enough together so that in spite of the blank spaces resulting from blocking and those left by subsequent removal of bunched plants, enough beet seedlings would remain to give a good yield.

Discussion of Experiments

In the early experiments 2-inch knife blades set on 3-inch centers were used, thus leaving 4 one-inch blocks in each foot of row. If there were beets in each block there would be 400 beet-containing blocks in each 100 feet of row. Figure 1 shows that actually with a 40 percent germination stand the remaining beet-containing blocks numbered about 145, or with a 50 percent germination stand about 185 per 100 feet of row.

Normally, out of 185 beet blocks approximately one-third would be singles. A laborer operating a long-handled hoe could chop out all but the singles and still leave more than 60 beets per 100 feet of row, and by leaving a few doubles get the desired 100 beets.

The results of the first experimental plot in 1933 are given in table 1.

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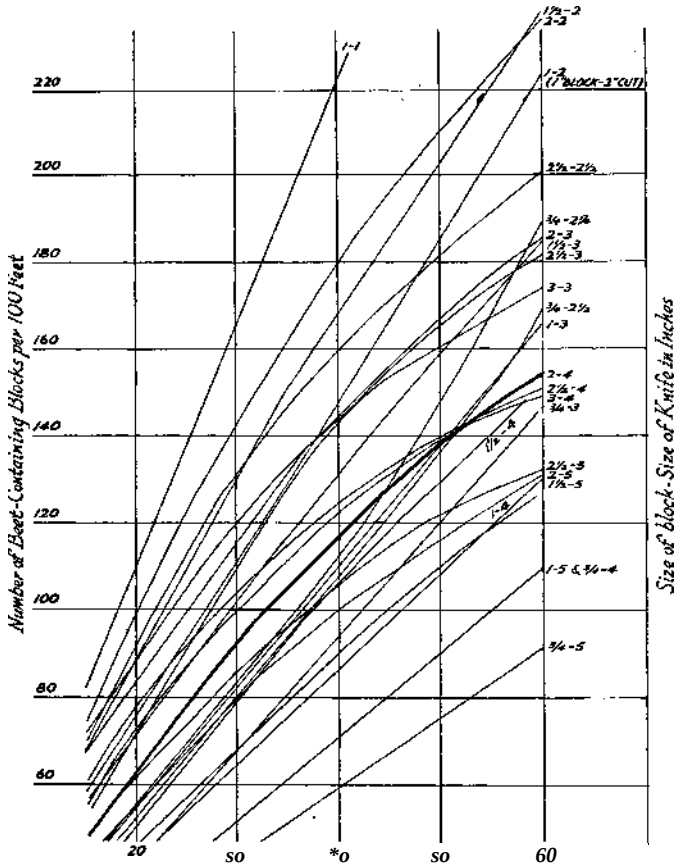

Figure 1.—Resulting beet blocks •when using varying knife sizes on varying beet stands.

Table 1.—Results in 1933.

	Mechanically thinned	Hand-thinned
Average diameter of beets—inches	3.5	4.4
Number of beets in plot	2362	1870
Average weight of beets—pounds	.85	1.14
Marketable beets per 100 feet	136	107
Tons per acre	15.08	16.13

The next step was the mounting of knives on a horse-drawn cultivator and cross-blocking to the small dimensions desirable for mechanical thinning. The results in 1934 showed that with the excellent germination stand of 60.6 percent it was possible to leave 60 singles per 100 feet of row. These results were obtained in a field planted with the standard planter, using the customary 20 pounds of seed per acre.

In 1935 a somewhat larger plot was mechanically thinned. The results are recorded in table 2. The figures given are averages of those obtained in a test where 12 comparisons were made with adjoining hand-thinned plots.

Table 2.—Results in 1935.

	Mechanically thinned	Hand-thinned
Tons per acre	11.84± .35	10.86± .30
Marketable beets per 100 feet	151.4±3.6	118.0 ±3.0
Number of multiple-plant blocks per 100 feet	36.7	8.7
Beet containing blocks after thinning	209.0 ±4.7	....
Number of single plants per 100 feet after thinning	65.2 ±2.3	....

Subsequent tests were conducted to determine a more desirable technique for mechanical thinning. The most important development was the result of our work on planters. It is evident that improved planting, i.e., a better distribution of beet seedballs in the row, would produce more desirable results. Not only did we improve distribution, but by using small-sized seedballs we got a higher percentage of singles.

In 1938 some extensive time studies were made on the amount of labor involved in the different thinning methods. The results are shown in table 3. The figures given are averages of those obtained in 15 tests.

Table 3.—Time in man hours per acre to block and thin mechanically, and by hand. (Machine used: Cotton chopper)

	Man hours per acre	Range
Hand blocking and thinning	22.13±4.18	16.14—31.55
Mechanical blocking followed by hand thinning	18.22±5.2	10.08—25.91
Mechanical blocking followed by thinning with long-handled hoe	9.37±1.7	6.04—13.07
Hoe thinning only	12.14±2.06	10.64—16.50
(Mechanical thinning only—3 tests in 1941)	2.55± .49	2.2 — 3.1)
	Standard deviations.	

Summary

A summary of results of mechanical thinning versus hand thinning is shown in table 4. The following 3 methods of thinning with implements were used. Each was compared with the old method of hand thinning.

1. Mechanically thin-to-medium dimensions with either a row blocker or a cross blocker and then followed by thinning with a long-handled hoe.

2. Mechanically thin-to-smaller dimensions with no subsequent labor, the size of knife chosen depending on the germination stand as indicated in figure 1.

3. No mechanical thinning; laborers used long-handled hoes. (This eliminates the stoop labor and saves nearly half the laborers' time.)

As might be expected, as regards these 3 methods, there is the least loss of tonnage when the thinning is done with the long-handled hoe. However, the loss is not much greater when the machine is used and the work is finished with the long-handled hoe.

All 3 methods are open to improvement. In 1935, the only year in which mechanically thinned beet plots actually outyielded hand-thinned plots, a considerably higher stand of beets was left in the row. Achieving higher stands may be one method of improvement. Probably better results will be obtained when it is possible to plant a higher percentage of single-germ seeds. Only the standard seed used by farmers was planted in the tests described in this paper.

Table 4.—Mechanical thinning versus hand thinning.

	1933	1935	1937	1939	1941	1941	1941	Average
			Yield in tons per acre					
Mechanical blocking followed by thinning with long-handled hoe	15.08	11.86	20.1	9.5	10.1	13.3	19.7	14.23
Hand blocking and thinning	16.13	10.S6	22.9	11.4	11.1	15.9	22.9	15.80
Loss from mechanical thinning vs. hand thinning—percentage	6.5	9.2 (gain)	12.2	10.7	9.0	16.3		

Average loss, 9.4 percent.

Harvest stand from mechanical thinning=93 percent of that from hand thinning.

Mechanical blocking only	14.73	15.66	13.1		14.28
Hand blocking and thinning	15.70	20.32	14.55		16.47
Loss from mechanical blocking vs. hand thinning—percentage	6.2	22.9	10.0		

Average loss, 13.0 percent.

Harvest stand from mechanical blocking only= 75 percent of that from hand thinning.

Hoe thinning only	11.1	10.47	16.82	15.8	13.54
Hand blocking and thinning	11.4	12.00	17.63	18.5	14.88
Loss from hoe thinning vs. hand thinning—percentage	2.6	12.7	4.6	14.6	

Average loss, 8.6 percent.

Harvest stand from hoe thinning only=97 percent of that from hand thinning.