1947 Mechanical Thinning Tests

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Mechanization of the sugar beet crop has developed rapidly during the past 5 years. However, mechanization of the harvest has progressed more rapidly than has mechanization of the spring work. Spring mechanization is dependent on many factors, some of the more important ones being the development and use of processed seed, the proper preparation of the seedbed, the development and use of precision planters, the control of spring weeds and the use of mechanical methods for thinning and subsequent weed control. This study deals with the factor listed last, namely, the use of mechanical methods for thinning and subsequent weed control.

Future steps toward spring mechanization will deal with procedures which will provide for increased uniformity of initial stands and the control of spring weeds. Procedures will be developed no doubt which will give control of spring weeds while beet populations are reduced mechanically.

Mechanical thinning tests conducted in 1946 showed some reduction in yield for treatments handled mechanically. The complete mechanical thinning treatment gave a yield of 8 percent less than the customary hand-block and thin treatment. The mechanical thinning treatment, however, cut down the spring labor requirement by 43 percent as compared to the hand-block and thin treatment.

The 1947 tests were designed to evaluate the effect of initial seeding rates on various methods of thinning. The objectives were: (1) to determine the seeding rate best adapted to various methods of beet thinning; (2) to determine the best spacing for various methods of beet thinning and (3) to determine the seeding rate and spacing most adaptable to complete mechanical thinning.

The treatments set up for common use in these experiments were:

1. Hand thinning at the 10 to 12 leaf stage (considered as average time of hand thinning).
2. Hoe thinning at the 4 to 6 leaf stage.
3. Cross-thinning with 8-inch centers at the 4 to 6 leaf stage.
4. Cross-blocking with 8-inch centers at the 4 to 6 leaf stage.

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5. Cross-thinning with 12-inch centers at the 4 to 6 leaf stage.

6. Cross-blocking with 12-inch centers at the 4 to 6 leaf stage.

7. Cross-thinning with 16 to 14-inch centers at the 4 to 6 leaf stage.

8. Best mechanical thinning and weed-control treatment that each area can devise.

It should be noticed with these treatments that emphasis was placed on timely mechanical thinning work as contrasted with the more or less common practice of waiting and using mechanical means as a last resort. It might seem that disadvantage was placed on treatment No. 1 by delaying thinning until the 10 to 12 leaf stage. It should be kept in mind that due to available labor, hand thinning is sometimes accomplished when beets have grown beyond the 10 to 12 leaf stage. It was felt that the 10 to 12 leaf stage would strike a happy medium and it would, therefore, be a fair treatment to use as the check to be representative of commercial practice. A little explanation is desirable on cross-thinning and cross-blocking. Cross-thinning is the term used to imply mechanical work to the final stand while cross-blocking infers leaving a mechanically treated stand which is in excess of that ultimately desired, then trimming out excess plants by long-handled hoe.

Each of the previously listed treatments was made on three seeding rates--3 to 4 seeds per foot, 7 to 8 seeds per foot, and 10 to 12 seeds per foot. Probably the 7 to 8 seeds per foot rate most nearly represents the average of commercial seeding rates.

Plots were replicated six times and tests were conducted in six different areas by five different sugar companies. The locations and companies responsible for the tests are:

1. Twin Falls, Idaho--Amalgamated Sugar Company
2. Saginaw, Michigan--Farmers & Manufacturers Beet Sugar Association
3. Longmont, Colorado--Great Western Sugar Company
4. Rocky Ford, Colorado--American Crystal Sugar Company
5. Idaho Falls, Idaho--Utah-Idaho Sugar Company
6. Salt Lake City, Utah--Utah-Idaho Sugar Company.

A test at Rocky Ford, Colorado, had to be discarded because small areas were later discovered to be affected by nematodes. In another test near Saginaw, Michigan, due to extreme unfavorable spring conditions, only one seeding rate was found possible.

The individual test results are shown, giving the location of each, in tables 1 to 5. Summaries have been computed for "Tons Per Acre," "Percent Sucrose," "After Thinning Stand Counts" and "Time Per Acre." Table 6 shows a combined summary of the tests where all three seeding rates were used (tables 1, 3, 4, 5).

Discussion and Summary

If we are to maintain a balance in the mechanization of the sugar beet industry, spring labor requirements must be brought in line with fall labor requirements as rapidly as possible. Mechanical thinning tests conducted through The Foundation during the past two seasons demonstrate that this objective can be obtained.

General summary statements from the tests are:

1. The average yield in tons of beets per acre is increased as the seeding rate is increased. This is true for all treatments and becomes an important factor in the mechanical treatments.

Table 1.—Mechanical Thinning Test, 1947, Twin Falls, Idaho.

Treatment	Tons per acre Seeding rate 3-4	7-8	10-12	Average	% sucrose Seeding rate 3-4	7-8	10-12	Average
Hand	16.40	16.86	20.07	17.77	17.2	17.1	17.1	17.16
Hoe	16.07	18.39	19.40	17.95	17.3	17.0	17.0	17.10
*C. T. 8"	14.36	16.42	15.22	15.33	17.2	17.4	17.4	17.33
**C. B. 8"	14.74	17.16	17.85	16.58	17.3	17.3	17.1	17.23
*C. T. 12"	15.62	18.31	16.64	16.86	17.0	17.1	17.4	17.16
**C. B. 12"	14.07	15.60	17.38	15.68	17.3	17.1	17.5	17.30
*C. T. 16-14"	13.48	15.77	16.71	15.32	17.2	17.2	17.6	17.33
***Other	14.42	15.85	17.13	15.80	17.2	17.3	17.6	17.36
Average	14.99	16.75	17.55	16.41	17.21	17.19	17.34	17.25

	After-thinning stand-count Number beets per 100 feet Seeding rate 3-4	7-8	10-12	Average	Time per acre (hours) Seeding rate 3-4	7-8	10-12	Average
Hand	76	61	94	77	23.6	26.6	29.7	26.63
Hoe	72	88	99	86	20.9	23.8	32.3	25.67
*C. T. 8"	99	115	139	118	15.3	17.0	20.9	17.73
**C. B. 8"	72	67	82	74	21.1	22.1	24.5	22.57
*C. T. 12"	96	130	114	113	15.3	17.0	20.9	17.73
**C. B. 12"	60	78	69	69	18.7	24.8	25.4	22.97
*C. T. 16-14	104	120	122	115	15.3	17.0	20.9	17.73
***Other	122	106	166	131	15.3	17.0	20.9	17.73
Average	88	96	111	98	18.19	20.66	24.44	21.10

*Cross-thinning.
**Cross-blocking.
***Twin Falls Weeder.

Table 2. Mechanical Thinning Test, 1947, Saginaw, Michigan. 10-12 Seeding Rate

Treatment	Tons per acre	% sucrose	After-thinning stand-counts—beets per 100′	Time per acre (hours)
Hand	11.43	15.58	97	18.53
Hoe	11.49	15.60	106	18.30
*C. T. 8"	10.52	15.80	93	13.96
**C. B. 8"	10.23	15.45	72	12.58
*C. T. 12"	10.89	15.35	91	16.24
**C. B. 12"	10.62	15.58	102	16.47
*C. T. 16"	8.23	14.38	52	12.13
***Other	10.74	15.68	97	13.27
Average	10.52	15.43	89	15.19

*Cross-thinning followed by weeder trimming.
**Cross-blocking and hoe trimming.
***Dixie followed by weeder trimming.

Table 3. Mechanical Thinning Test, 1947, Idaho Falls, Idaho.

Treatment	Tons per acre Seeding rate 3-4	7-8	10-12	Average	% sucrose Seeding rate 3-4	7-8	10-12	Average
Hand	21.26	22.22	21.19	21.56	17.74	17.82	17.94	17.83
Hoe	20.51	21.38	20.75	20.90	18.00	17.80	17.60	17.80
*C. T. 8"	19.64	20.00	19.59	19.74	17.90	17.70	17.76	17.78
**C. B. 8"	20.07	19.67	20.49	20.08	17.34	17.57	17.72	17.54
*C. T. 12"	17.69	19.59	19.62	18.96	17.62	17.86	18.02	17.83
**C. B. 12"	18.75	20.00	19.85	19.53	17.43	17.77	17.77	17.66
*C. T. 16-14"	19.35	19.31	20.76	19.80	17.39	17.87	17.79	17.68
***Other	19.25	19.12	20.01	19.46	17.59	17.63	17.41	17.54
Average	19.57	20.16	20.28	20.00	17.63	17.75	17.75	17.71

Treatment	After-thinning stand-count Number beets per 100 feet Seeding rate 3-4	7-8	10-12	Average	Time per acre (hours) Seeding rate 3-4	7-8	10-12	Average
Hand	87	96	100	94	18.00	20.60	22.50	20.37
Hoe	90	110	125	108	17.70	20.20	20.50	19.47
*C. T. 8"	101	114	119	111	6.50	6.60	7.80	7.00
**C. B. 8"	90	99	111	100	11.70	12.30	13.80	12.60
*C. T. 12"	82	122	123	109	6.90	6.70	6.20	6.60
**C. B. 12"	77	90	97	88	10.80	11.10	11.70	11.20
*C. T. 16-14"	88	108	131	109	6.20	6.20	5.90	6.10
***Other	73	78	96	82	11.10	12.00	11.70	11.60
Average	86	102	113	100	11.11	11.96	12.51	11.87

*Cross-thinning.
**Cross-blocking then hoe trimming.
***Cross-blocking with 16-14" centers then hoe trimming.

Table 4. Mechanical Thinning Test, 1947, Salt Lake City, Utah.

Treatment	Tons per acre Seeding rate 3-4	7-8	10-12	Average	% sucrose Seeding rate 3-4	7-8	10-12	Average
Hand	28.80	30.15	30.86	29.94	15.22	15.66	16.09	15.66
Hoe	28.63	29.86	30.79	29.76	15.71	15.93	15.65	15.76
*C. T. 8"	25.93	27.49	29.39	27.60	15.22	15.31	15.44	15.32
**C. B. 8"	28.34	27.98	30.08	28.80	14.85	15.50	15.13	15.16
*C. T. 12"	27.07	26.91	31.13	28.37	15.48	15.33	15.38	15.40
**C. B. 12"	27.00	28.01	29.13	28.04	15.09	15.25	15.00	15.11
*C. T. 16-14"	26.60	28.50	30.05	28.40	14.78	15.14	15.35	15.09
***Other	25.80	29.86	29.77	28.48	14.95	15.18	15.24	15.12
Average	27.27	28.60	30.15	28.67	15.16	15.41	15.41	15.33

Treatment	After-thinning stand-count Number beets per 100 feet Seeding rate 3-4	7-8	10-12	Average	Time per acre (hours) Seeding rate 3-4	7-8	10-12	Average
Hand	83	99	106	96	19.82	23.31	25.63	22.92
Hoe	87	101	115	101	12.20	14.30	16.32	14.27
*C. T. 8"	79	77	97	84	10.26	6.84	6.37	7.82
**C. B. 8"	69	70	81	73	9.95	11.66	11.19	10.93
*C. T. 12"	78	78	87	81	9.95	9.01	5.13	8.03
**C. B. 12"	70	72	76	73	11.03	12.74	14.15	12.64
*C. T. 16-14"	75	85	91	84	9.32	6.06	8.39	7.92
***Other	62	69	73	68	11.03	12.28	13.67	12.33
Average	75	81	91	83	11.70	12.03	12.61	12.11

*Cross-thinning.
**Cross-blocking then hoe trimming.
***Cross-blocking with 16-14" centers then hoe trimming.

Table 5.—Mechanical Thinning Test, 1947, Longmont, Colorado.

Treatment	Tons per acre Seeding rate 3-4	7-8	10-12	Average	% sucrose Seeding rate 3-4	7-8	10-12	Average
Hand	12.26	12.33	13.72	12.77	11.9	12.8	13.0	12.57
Hoe	12.70	12.49	12.23	12.47	12.6	12.9	13.2	12.90
*C. T. 8"	11.98	11.77	11.17	11.64	12.8	13.0	12.3	12.70
**C. B. 8"	10.86	10.83	12.37	11.35	11.9	12.6	12.4	12.30
*C. T. 12"	10.79	11.70	11.27	11.25	12.5	12.7	12.5	12.57
**C. B. 12"	12.11	11.08	10.99	11.39	12.1	12.8	12.3	12.40
*C. T. 16-14"	10.72	11.38	11.12	11.07	12.8	12.7	12.2	12.57
***Other	10.88	10.80	12.12	11.27	12.5	12.5	13.4	12.80
Average	11.54	11.55	11.87	11.65	12.39	12.75	12.66	12.59

Treatment	After-thinning stand-count Number beets per 100 feet Seeding rate 3-4	7-8	10-12	Average	Time per acre (hours) Seeding rate 3-4	7-8	10-12	Average
Hand	69	85	84	79	30.4	31.6	32.6	31.5
Hoe	83	97	100	93	25.5	27.1	27.8	26.8
*C. T. 8"	88	91	98	92	23.2	22.3	18.9	21.5
**C. B. 8"	75	82	90	82	26.3	22.5	19.5	22.8
*C. T. 12"	77	101	109	96	26.7	19.1	19.8	21.9
**C. B. 12"	84	93	83	87	26.6	22.6	24.3	24.5
*C. T. 16-14"	90	77	91	86	28.1	19.3	18.2	21.9
***Other	80	93	109	94	27.0	24.1	22.4	24.5
Average	81	90	96	89	26.73	23.58	22.94	24.43

*Cross-thinning.
**Cross-blocking.
***Harrow.

Table 6.—Mechanical Thinning Tests, 1947, Summary Averages. (Based on 4 tests of 6 replications each)

Treatment	Tons per acre Seeding rate 3-4	7-8	10-12	Average	% sucrose Seeding rate 3-4	7-8	10-12	Average
Hand	19.68	20.39	21.46	20.51	15.52	15.85	16.03	15.81
Hoe	19.49	20.53	20.79	20.27	15.90	15.91	15.86	15.89
*C. T. 8"	17.98	18.92	18.84	18.58	15.78	15.85	15.73	15.78
**C. B. 8"	18.50	18.91	20.20	19.20	15.35	15.74	15.59	15.56
*C. T. 12"	17.79	19.13	19.67	18.86	15.65	15.75	15.83	15.74
**C. B. 12"	17.98	18.67	19.34	18.66	15.48	15.73	15.64	15.62
*C. T. 16-14"	17.54	18.74	19.66	18.65	15.54	15.73	15.74	15.67
Other	17.59	18.91	19.76	18.75	15.56	15.65	15.91	15.71
Average	18.32	19.28	19.97	19.19	15.60	15.78	15.79	15.72

Treatment	After-thinning stand-count Number beets per 100 feet Seeding rate 3-4	7-8	10-12	Average	Time per acre (hours) Seeding rate 3-4	7-8	10-12	Average
Hand	79	85	96	87	22.96	25.53	27.61	25.36
Hoe	83	99	110	97	19.08	21.35	24.23	21.55
*C. T. 8"	92	99	113	101	13.82	13.19	13.49	13.51
**C. B. 8"	77	80	91	83	17.26	17.14	17.25	17.23
*C. T. 12"	83	108	108	100	14.71	12.95	13.01	13.57
**C. B. 12"	73	83	81	79	16.78	17.81	18.89	17.83
*C. T. 16-14"	89	98	109	99	14.73	12.14	13.35	13.41
Other	84	87	111	94	16.11	16.35	17.17	16.54
Average	83	92	102	93	16.93	17.06	18.13	17.38

*C. T. —Cross-thinning.
**C. B. —Cross-blocking.

2. Variation in block center has little or no effect on yield or labor requirement.

3. Based on these results growers should be cautioned on the real low rates of seeding as has been advocated in some sections. The long-handle hoe is increased by slightly more than 1 ton per acre as the seeding rate is increased from 3 to 4 seeds to 7 to 8 seeds per foot. This increased yield more than offsets the decreased labor requirement under the light seeding rate.

4. Except for the 8-inch centers, there is no advantage in cross-blocking over cross-thinning. It should likewise be kept in mind that labor required for cross-blocking exceeds that of cross-thinning by approximately 4 hours.

5. It appears that the heavier seeding rates are the best adapted to mechanical thinning. It should be noted that this seeding rate of 10 to 12 seeds per foot which approximates 5 to 6 pounds of seed per acre, in 20-inch row widths, is the seeding rate now recommended in the Red River Valley of Minnesota, where mechanical cross-blocking has been used commercially.

6. The reduction of labor requirement follows the same pattern as last year for mechanical work. Cross-thinning on 12-inch centers shows a time reduction of 46 percent over hand-block and thin in 1947 and 43 percent in 1946.

7. The seeding rate has a direct reflection on the distribution pattern left after thinning. As the seeding rate is increased the number of blocks containing no beets is decreased. The after-thinning plant distribution is reflected in yield per acre—the better the distribution, the higher the yield.

8. There is a relationship between time requirements and condition of field for hand thinning and hoe thinning. A field which is relatively free of weeds will show a greater saving in labor for hoe thinning over hand thinning than a more weedy field. Little reflection of field condition and time requirement is observed with the straight mechanical treatment, in either case time requirement is cut almost in half by the mechanical work. Where hoe trimming is required after cross-blocking, the more weedy fields again show greater time requirement.

9. Inasmuch as the 1947 tests have indicated that block centers are relatively unimportant, then the type of tool should be used for mechanical thinning which will give the maximum of weed elimination in conjunction with the removal of the excess beets.

10. The use of mechanical tools permits the job of thinning to be finished in a minimum of time. It also permits planting the entire field at the earliest date possible rather than staggering the dates so as to make beets come up at different times, thereby fitting into the slower pattern of hand thinning. This practice of planting so as to have only a small acreage of beets ready for hand thinning at any given time is common

practice in some areas. Experiments generally show that the early planted beets outyield those planted at later dates.

11. Thinning time requirement is not altered materially as initial seeding rates are increased in the case of the cross-thinning treatments. With treatments requiring hoe trimming or all hand work, thinning time requirement increases as seeding rate increases.

12. It is logical to assume that cross-thinning will affect a greater weed reduction than cross-blocking minus the hand trim. This is of importance inasmuch as the method which has the greatest saving in labor likewise has the greatest possibility at weed reduction and yet does not reduce the final yield of sugar beets.

13. Generally, after-thinning stand-counts for cross-thinning treatments exceed the counts for cross-blocking treatments by 20 beets for each 100 feet of row. A logical assumption is that the cross-thinning treatments would leave a larger number of two or more beet-containing blocks. This assumption is confirmed by a careful analysis of the after-thinning stand-counts (detailed data which is not published in this report). It is apparent, therefore, that a limited number of double and multiple hills will not impair the final yield.

14. Sufficient work on spring mechanization has now been done to point out the main possibilities and procedures. The main job now facing the industry appears to be one of education and salesmanship.