

What Is the Practical Spacing Pattern For Sugar Beets Grown in the Red River Valley, Minnesota Area?

A. W. SKUDERNA¹

A LARGE AMOUNT of work has been done on space relationship between beet plants, population and distribution studies with sugar beets, effect of single- and multiple-beet hills on yields, effect of variety and soil-fertility levels upon space requirements, and effect of environment on beet populations. Practically all of these studies have been conducted with beets thinned in normal manner, with little or no mechanization involved, either in cross-blocking or in cross-cultivating the field, or in strictly mechanical thinning. In the Agronomy section of The American Society of Sugar Beet Technologists, several papers were presented on this subject and are printed in the 1946 Proceedings, pages 154-184, inclusive. With few exceptions in the irrigated areas, the highest sugar-per-acre yields, quality stressed, were obtained from acre populations in excess of 20,000 beets per acre uniformly distributed in the row, and with row widths averaging 20 to 22 inches.

Experimental tests conducted by Immer (2)² in the Red River Valley, Minnesota, area, with acre populations ranging from 12,960 beets to 24,502 beets in row spacings of 22 to 16 inches, reported increased yields from the higher acre populations. Similar results were obtained by Doxtator and Skuderna (1) from experiments conducted in the same area, with the higher yields coming from the 12- and 15-inch spacings in the row, and row width plantings 18 inches apart.

Field tests involving width of row plantings and spacing of beets in the row have been conducted in this non-irrigated area for more than 20 years. The general trend of results supports the present practice of planting sugar beets in 18-inch row widths, and then cross-blocking them on 18-inch centers, thus making an 18 by 18-inch pattern, which lends itself well to cross-cultivation. In years of more generous rainfall, higher populations per acre than those obtained from this spacing pattern can be profitably supported. Considering, however, that this is a marginal rainfall area, where the annual precipitation averages below 20 inches, moisture limitations dictate the acre population of beets which can be maintained. Generally, 18,000 beets per acre are obtained after thinning, resulting in a harvest stand of about 16,000 beets per acre. With the rapid changes brought about by mechanization in methods of growing, thinning, hoeing and

¹General Agriculturist, American Crystal Sugar Company.

²The numbers in parentheses refer to literature cited.

harvesting beets, changes in row width and spacing in the row for this area seem warranted.

Beginning with 1930 and extending over an 8-year period, field comparisons were made between cross-blocked and hand-blocked beets, with approximately the same acre populations. The results obtained were very much in favor of the cross-blocked beets, indicating the value of a more uniform distribution of plants in the row, the beets being of more even size, and fields much cleaner than in the hand-blocked fields.

From 1938 to 1946, field tests were continued to determine the value of cross-cultivating for purpose of maintaining a soil mulch, preventing cracking of soil and loss of soil moisture thereby, and a more effective control of weeds. A total of 193,204 acres of beets was involved in these comparisons, of which 140,268 acres were cross-cultivated, 11,208 acres cross-blocked only, and 41,728 acres hand-blocked. All fields were hand-thinned. Practically the entire acreage was planted in 18-inch width rows, the cross-blocked and cross-cultivated acreage being cross-blocked on 18-inch centers; the hand-blocked beets were spaced 12 to 14 inches in the row resulting in about an 8 per cent higher population in after-thinning stands but less than 3 percent more beets at time of harvest than those obtained from either the cross-cultivated or cross-blocked acreage. The results obtained are as follows:

Table 1.—Average yield tons beets per acre obtained in Red River Valley, Minnesota, area, years 1938-1946, inclusive.

Year	Cross-cultivated beets (tons)	Cross-blocked beets (tons)	Hand-blocked beets (tons)
1938	9.30	8.32	8.79
1939	9.38	8.31	8.68
1940	10.56	9.08	10.49
1941	12.19	12.06	11.51
1942	12.59	13.12	12.04
1943	10.10	10.05	9.05
1944	12.44	11.26	11.04
1945	10.46	11.29	9.42
1946	11.19	10.68	10.68
Averages	10.91	10.46	10.19
Number of acres	140,268	11,208	41,728

The results obtained from this 9-year comparative study strongly emphasize the need of maintaining a soil mulch between beets. Any change-over from present practice to full mechanization must take cognizance of this factor as it is of paramount importance to successful beet growing in this area. It is worthy of note that in each of the 9 years the cross-cultivated acreage outyielded the hand-blocked acreage by fairly substantial margins, the over-all average difference amounting to .72 ton beets per acre or about a 7-percent increase yield in favor of this practice.

Anticipating possible changes in row widths and also spacing between beets in the row, experimental work was undertaken on this phase of investigation in 1939 and continued to the present time. It is of interest

to note (table 2) that in 1939, a year of less than 18 inches precipitation, the trends in results were the same as those obtained in 1941 when fully 50 percent more total precipitation was had.

Table 2.—Comparison of row widths holding spacings in the row constant, East Grand Forks, Minnesota.

Year 1939			
Spacing (inches)	Tons beets per acre	Percent sucrose	Pounds sugar per acre
18x15	9.85	17.08	3,365
22x15	9.96	16.97	3,380
26x15	9.37	16.44	3,081
30x15	9.44	16.20	3,059
Year 1941			
18x15	12.67	15.12	3,831
22x15	13.82	15.08	4,168
26x15	12.79	14.83	3,794
30x15	11.86	14.61	3,465

Increasing the row width beyond 22 inches generally depressed not only tonnage yields of beets but also the sucrose percentage in the beet. While changes in width-of-row planting may be necessary to avoid crowding effects on beet rows because of heavy equipment usage, and to accommodate a program of mechanizing fully the spring, early summer and fall operations in the beet field, it is apparent from results obtained to date that row widths should not exceed 22 inches and preferably remain at 18 inches until such time as more information is accumulated on mechanical thinning to warrant a change to wider rows.

Beginning with 1942, experiments on varying the row widths and the spacing of beets in the row were undertaken to determine the effect of these variables upon tonnage yield of beets and percentage of sucrose in the beet. The combined results from a 5-year test, 1942 to 1946, inclusive (table 3), in which tests approximately the same soil area per beet block was maintained, the following trends were observed:

Table 3.—Comparison of row width and spacings within the row combined results years 1942 to 1946, inclusive, Red River Valley, Minnesota, area.

Soil area per beet block (square inches)	Spacing pattern (inches)	Tons beets per acre	Percent sucrose in beet	Pounds sugar per acre
324	18x18	10.64	15.90	3,365
330	22x15	11.63	15.89	3,688
312	26x12	10.19	16.02	3,265
300	30x10	9.61	15.78	3,042

The results favor the 22-inch width row with a 15-inch spacing of beets within the row. Increasing row widths beyond that point and reducing spacings within the row so as to maintain equal acre populations of beets did not result in an improvement of yields of beets or in pounds sugar per acre.

Discussion

Tests conducted in the Red River Valley area over a 20-year period definitely point to the most productive use of a width row planting not exceeding 22 inches. Present mechanization trends may dictate a change from the conventional 18-inch row width planting and possibly also a change in present spacing width between beets in the row. Preliminary tests conducted in 1947 with 20- and 22-inch width row plantings in which three 16-inch and five 14-inch spacings between beets in the row were employed, cross-blocked and cross-cultivated, produced satisfactory tonnage yields and sucrose percentage in the beet in both hand and fully mechanical thinning. It is quite obvious from results obtained that the type of spacing pattern employed has a considerable influence on more effective utilization by the plant of the feeding area in the soil. A 15-inch average spacing between beets (such as results from a combination of 16-inch and 14-inch spacing in the row to accommodate tractor wheels and efficient use of tools for cross-cultivating) gives every indication of being the best spacing for this area, providing row widths do not exceed 22 inches apart between beet rows. All of the work reported herein is on spacings in the row in which beet-containing-blocks ranged from 3 inches to 4½ inches in width. This width block is entirely too wide for strictly mechanical thinning in which 1½-inch wide blocks are to be employed. Therefore, definite recommendations for a wider width row than the present 18-inch planting must necessarily await the outcome of planned large-scale field tests in 1948. One fact is certain; namely, sugar-per-acre yields for this area are sharply reduced when row width plantings more than 22 inches apart are employed.

Summary and Conclusions

Comparative field tests conducted over a 9-year period in the Red River Valley, Minnesota, area have conclusively shown the value of cross-blocking and cross-cultivating beets, the average increases being .27 ton and .72 ton more beets per acre, respectively, than were obtained from hand-blocked beets. These comparisons were made on 193,204 acres of beets, all of which were hand thinned.

Width-of-row spacings beyond 22 inches apart conclusively show a reduction in tonnage yield of beets per acre, and a depressed sucrose percentage in the beet regardless of spacing within the row.

Spacing patterns approaching a square pattern are apparently more productive of more efficient utilization by the plant of the soil feeding area.

With a change from hand thinning to mechanical thinning, and use of mechanical beet harvesters, a change from present 18-inch row width planting may be dictated, but not to exceed 22-inch width row planting.

The spacing within the row which gives promise is a 16-inch and 14-inch combination; 16-inch spacings between beets in the row to provide sufficient space between beets to permit tractor wheel travel in cross-cultivation, and

14-inch spacings between the tractor wheels so as to maintain the acre population of beets near the 20,000 mark. Regardless of spacings used, these must be sufficiently wide to permit cross-cultivation for conservation of moisture, maintenance of soil mulch to prevent checking of soil, and for effective control of weeds. Further large-scale field tests are planned for strictly mechanical thinning of beets in $1\frac{1}{2}$ -inch blocks instead of the customary 3- to $4\frac{1}{2}$ -inch width block presently employed in hand thinning. With the establishment of these narrower blocks at time of cross-blocking to make effective mechanical thinning possible, and widespread use of 2-row beet harvesting equipment in 1948, information will be forthcoming shortly relative to a change, if any, in the present 18-inch row width planting practice for this area.

Literature Cited

- (1) DOXTATOR, C. W., AND SKUDERNA, A. W.
1946. Beet population studies. Proc. Amer. Soc. Sugar Beet Tech., p. 163-165.
- (2) IMMER, F. R.
Spacing distance in relation to cross-cultivation of sugar beets. Sugar Beet 8 (5-6) 10-13.