

A STUDY OF SPACING EFFECTS WITH TWO VARIETIES OF SUGAR
BEETS ON A HIGH AND LOW LEVEL OF SOIL FERTILITY
(Demonstration Paper)

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A study on two varieties of sugar beets, one a high tonnage, the other a sugar variety was undertaken in 1938 at Rocky Ford, Colorado, on a soil of high and low levels of fertility.^{2/} The results of the study indicated that the tonnage variety responded to increased applications of fertilizer, the largest increase coming from a 600 pound per acre application of commercial fertilizer. On the other hand, applications of commercial fertilizer beyond 200 pounds per acre depressed the sugar per acre yields of the sugar variety. It was concluded, that information was needed as to whether a variety was a strong or weak feeder, in order that an adequate program of soil fertilization for sugar beets might be developed.

Results reported herewith are based on a study which is an outgrowth of last year's work. In this study it was strongly suggested by the results obtained that variation in spacing distances between beets in the row, combined with varying rates of fertilizer applied might uncover more information than were but one spacing interval employed. To that end, the present study was planned.

Materials and Methods

The soil type on which this study was conducted was classified as Rocky Ford fine sandy loam. In the fall of 1938, a 12 ton coating of cattle manure was applied per acre immediately prior to fall plowing. The field was worked down to a good seed bed in late March and planting was made during the second week in April. Two domestic varieties of sugar beets were used, one being a "sugar" variety and the other a "tonnage" variety. Both of these varieties were of the same uniformity as to type as those used in the 1938 tests.

The commercial fertilizer used was 4-16-4, at rate of 500 pounds per acre, applied with the seed at time of planting.

The plat arrangement was fully randomized and of such layout as to permit unbiased evaluation of interactions between varieties, treatments, and rates of fertilizer application. Each treatment was replicated seven fold, the plats being four rows wide and 100 feet long. The distance between rows was 20 inches. Fifty-six plats were included in the study.

The beets were thinned to a distance of 10 and 15 inches in the row and were grown to maturity under irrigation. The beets were harvested on a competitive basis and analyzed for sucrose by the usual cold water digestion method. The results in all cases represent an average of the seven replications. The data were analyzed by the variance method.

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^{2/}L. A. Hurst, A. W. Skuderna, C. W. Doxtator: A Study of High and Low Levels of Soil Fertility Response to Two Varieties of Sugar Beets. Journ. of Am. Soc. of Agron. 31:Page 649-652.

Results

The results of this study are shown in Table I. The statistical tabulation of interactions is shown in Table II.

Table I.--Results of Spacing Distance Between Beets, and Rate of Fertilizer Application With Sugar Beets. Rocky Ford, Colorado, 1939

	Sugar Variety		Tonnage Variety	
	Fertilized	Not Fertilized	Fertilized	Not Fertilized
		<u>Tons Beets Per Acre</u>		
10" Spacing	18.79	18.14	25.53	23.62
15" Spacing	17.12	14.42	19.45	18.25
Required for Significant Difference	1.52**			
		<u>Percentage Sucrose in the Beet</u>		
10" Spacing	17.04	17.16	14.64	14.66
15" Spacing	16.87	16.62	13.87	14.79
Required for Significant Difference	.57**			
		<u>Pounds Sugar Per Acre Yield</u>		
10" Spacing	1417	6338	7468	6919
15" Spacing	5781	4801	5413	5370
Required for Significant Difference	422**			

Table II. Values of F. Applied to Yield, Percentage Sucrose, and Sugar Production Per Acre for Two Spacing Distances, and Fertilizer Application Applied to Two Varieties of Sugar Beets

	Tons Beets	Percentage	Pounds Sugar
	Per Acre	Sucrose	per Acre
	F	F	F
Blocks	7.42**	5.97*	10.81**
Spacing x Blocks	N.S.	N.S.	N.S.
Varieties	84.07**	321.16**	8.58**
Spacing	72.00**	N.S.	78.09**
Amounts	10.48**	N.S.	7.07
Varieties x Spacing	8.87**	N.S.	5.21*
Varieties x Amounts	N.S.	N.S.	N.S.
Spacing x Amounts	N.S.	N.S.	N.S.
Varieties x Spacing x Amounts	11.31**	13.15**	11.35**

*Significance beyond 5% point.
 **Significance beyond 1% point.
 N.S. No significant difference.

Discussion

Spacings Disregarded

In the test, the "tonnage" and "sugar" varieties behaved true to designation. The "tonnage" variety outyielded the "sugar" variety 4.57 tons per acre for the no fertilizer treatment and 4.53 tons for the fertilizer treatment. 1.52 tons was the calculated amount required for a significant difference.

In percent sucrose, the "sugar" variety was 2.16% higher than the unfertilized "tonnage" variety and 2.70 percent higher sucrose than the "tonnage" variety fertilized compared to .57% required for significance.

In yield of sugar per acre, the tonnage variety produced 342 more pounds for the fertilized treatment and 575 more pounds for the unfertilized treatment respectively, than was produced from the "sugar" variety. A difference of 422 pounds was required for significance.

Spacings considered

For the 10 inch thinning, the "tonnage" variety (fertilized) produced 6.08 tons more beets than the 15 inch spacing. For the same treatment, the "sugar" variety produced but 1.67 more tons beets than from the 15 inch spacing. Evidently, the "sugar" variety utilized more efficiently the increased plant food in the wider spacing than did the "tonnage" variety. For the unfertilized treatment, the "tonnage" variety spaced 10 inches apart outyielded the 15 inch spacing by 5.37 tons. For the "sugar" variety the difference was 3.72 tons in favor of the 10 inch spacing.

An increase in distance of spacing generally depressed the percent sucrose in the beet. In general, the percent sucrose was .32 and .36 higher for the "tonnage" and "sugar" varieties respectively for the 10 inch spacing compared to the 15 inch spacing.

The increases in sugar per acre yield were likewise strikingly in favor of the closer spacing interval. For the "tonnage" variety the fertilized 10 inch spacing outyielded by 1055 pounds the 15 inch spacing. Similarly, the unfertilized 10 inch spacing outyielded its wider spaced comparison by 1549 pounds. For the "sugar" variety, there was a marked reduction in difference of sugar per acre yield for the fertilized treatment, the difference being but 636 pounds per acre in favor of the 10 inch spacing. This compares with 1537 pounds for the same comparison for the unfertilized treatment.

Conclusions

Under the conditions of this test, the effectiveness of fertilization and closer spacing of beets in the row is again demonstrated.

There was noted however, for the "sugar" variety, a marked increase in efficiency of utilizing additional plant food, when the interval of spacing was increased. This increase however was not sufficient to overcome the reduced yield of sugar per acre obtained from the wider spacings.