

Effect of Spacing in 14-26 Inch Rows on Production of Fall Planted Sugarbeets¹

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The limitation in quality and availability of hand labor for thinning sugarbeets has forced many growers to use other methods to achieve stands. Generally, sugarbeets are either planted to a stand or seed is space planted and the seedlings are blocked mechanically. When these labor saving methods are employed, there is a tendency for plants in the final stand to be spaced closer together than when thinned by hand.

Numerous studies have been conducted on in-row spacing of sugarbeets; however, little attention has been given to very close or very wide spacings. In 1957 Ririe (6)³ reported that spacings as close as 4 inches in 14-26 inch rows (two rows spaced 14 inches apart on a 40-inch bed) did not reduce yields. More recently, studies with similar row spacings indicate in-row spacings closer than 6 inches may be too close (4, 5). At the other extreme, spacings of 15 to 18 inches generally have not resulted in large decreases in yield when used in combination with close row widths (e.g. 14-26 inches, 22 inches) (1, 2, 3, 4, 5). When the spacing was extended to 24 inches in 14-26 inch rows, losses in sugar yield of 12 percent were obtained (4).

The study reported herein was undertaken to determine the effect of very close and very wide in-row spacings on production of sugarbeets grown in 14-26 inch rows.

Materials and Methods

Sugarbeets were grown during the 1970-71, 1971-72 and 1972-73 seasons on Laveen clay loam at the University of Arizona Agricultural Experiment Station, Mesa, Arizona. The cultivar S-301H was planted in 1970, whereas US H9B, the hybrid currently being used commercially, was planted in 1971 and 1972. Each year, stands were established in late September on 40-inch beds with two rows of beets spaced 14 inches apart per bed.

Seedlings were thinned by hand in mid-October to achieve in-row spacings of 2, 4, 6, 10, 14, 16, 18 and 20 inches. Spacings generally

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³Numbers in parentheses refer to literature cited.

were close to those desired except for the 2-inch spacing. Unthinned stands were never thick enough to leave a plant every two inches. Actual plant spacings were determined from plant counts made one month after thinning. Spacing treatments were arranged in a randomized complete block design with five replications.

Phosphorus fertilizer (40 lbs. P/A) was broadcast on the experimental areas each year prior to seedbed preparation. The plantings received 200 pounds per acre of fertilizer nitrogen each season.

Bolting, while not a factor in 1971 and 1972, was excessive in 1973, ranging from 31% at the widest spacing to 93% at the closest spacing. This was attributed to the occurrence of winter and spring weather favorable for seed stalk production. Seed stalks were produced in April and early May.

Roots were harvested from approximately 28 feet of row per plot each year in late June. The actual area harvested was determined for each plot. Roots less than two inches in diameter were considered commercially unharvestable and were weighed separately.

Results and Discussion

1971 experiment

Harvestable root and sugar yields were significantly reduced when beets were spaced 4.6 inches or closer (Table 1). In addition, total fresh root production was reduced at these close spacings. When the spacing was increased to 6.4 inches the resulting root yield was lower than at several of the wider spacings; however, there were no significant differences in sugar yield.

Beets were able to utilize spacings of from 10 to 20 inches without a significant reduction in root or sugar yields. Sucrose content was highest at the closest spacing and generally decreased as the spacing

Table 1.—Effect of in-row spacing on gross sugar production, root yield, and sucrose content in 1971. Cultivar was S-301H.

| Ave. Plant Spacing Inches | Plants Per 100 Ft. No. | Yield | | | Sucrose Content % |
|------------------------------|---------------------------|--------------------------|--------------------|-------------------|----------------------|
| | | Harvestable ¹ | | Total | |
| | | Gross Sugar | Roots | Roots | |
| | | T/A | T/A | T/A | |
| 3.5 | 343 | 2.74 ^{a2} | 14.5 ^a | 21.0 ^a | 19.0 ^a |
| 4.6 | 261 | 3.57 ^b | 19.6 ^b | 25.5 ^b | 18.2 ^b |
| 6.4 | 188 | 5.06 ^c | 28.4 ^c | 30.4 ^c | 17.8 ^{bc} |
| 10.0 | 120 | 5.28 ^c | 30.5 ^{cd} | 30.9 ^c | 17.3 ^{bcd} |
| 14.3 | 84 | 5.79 ^c | 33.1 ^d | 33.1 ^c | 17.5 ^{bcd} |
| 15.0 | 80 | 5.62 ^c | 33.1 ^d | 33.1 ^c | 17.0 ^{cde} |
| 18.0 | 67 | 5.43 ^c | 32.6 ^d | 32.6 ^c | 16.6 ^{de} |
| 20.0 | 60 | 5.08 ^c | 31.2 ^{cd} | 31.2 ^c | 16.3 ^e |

¹Harvestable yields based on roots two inches or larger in diameter.

²Means within columns followed by the same letter are not different at the 5% level of significance, based on the Student-Newman-Keul Test.

was increased. Petiole analysis data indicated that plants at all spacings were deficient in nitrogen at harvest but plants at close spacings were deficient for longer periods of time than those at wide spacings.

1972 experiment

In 1972, yields declined when plants were spaced as wide apart as 6 inches (Table 2). The 6-inch spacing yielded 19 and 14 percent less roots and sugar, respectively, than a 9.7 inch spacing. Also, the total production of fresh roots was reduced at spacings of 6 inches or closer.

When 1971 and 1972 results are compared, the yield advantage of the wide spacings over the 6-inch spacing in 1972 appears to be due to increased production at the wide spacings rather than reduced yields at close spacings. Thus, it is possible that the known yield advantage of US H9B over S-301H may occur only when plants are spaced farther apart than 6 inches.

There were no significant differences among spacings 9.7 inches or wider in root or sugar yield. Plant spacing had no significant effect on sucrose content. Plants at all but the three widest spacings were deficient in nitrogen at harvest.

1973 experiment

Like the 1972 experiment, large yield reductions occurred when beets were spaced 6 inches apart or closer (Table 3). Although root yields at all spacings were lower in 1973 than in 1972, yields were disproportionately lower at close spacings where bolting was most severe.

For the third consecutive year, there were no significant differences in yield among spacings ranging from 10 to 20 inches. However, in two of the three years there was a trend toward lower sugar yields at

Table 2.—Effect of in-row spacing on gross sugar production, root yield, and sucrose content in 1972. Cultivar was US H9B.

| Ave. Plant Spacing | Plants Per 100 Ft. | Yield | | Total Roots | Sucrose Content |
|--------------------|--------------------|--------------------------|-------------------|-------------------|-------------------|
| | | Harvestable ¹ | | | |
| Inches | No. | Gross Sugar | Roots | T/A | % |
| 2.6 | 462 | 2.00 ^{a2} | 13.4 ^a | 22.8 ^a | 14.9 ^a |
| 4.0 | 300 | 3.33 ^b | 22.2 ^b | 28.0 ^b | 15.0 ^a |
| 6.0 | 200 | 4.61 ^c | 29.4 ^c | 31.8 ^c | 15.7 ^a |
| 9.7 | 124 | 5.35 ^d | 36.4 ^d | 36.4 ^d | 14.7 ^a |
| 14.0 | 86 | 5.44 ^d | 37.6 ^d | 37.6 ^d | 14.5 ^a |
| 15.2 | 79 | 5.55 ^d | 38.3 ^d | 38.3 ^d | 14.5 ^a |
| 16.6 | 72 | 5.38 ^d | 38.6 ^d | 38.6 ^d | 14.0 ^a |
| 19.8 | 61 | 5.18 ^d | 36.4 ^d | 36.4 ^d | 14.3 ^a |

¹Harvestable yields based on roots two inches or larger in diameter.

²Means within columns followed by the same letter are not different at the 5% level of significance, based on the Student-Newman-Keul Test.

Table 3.—Effect of in-row spacing on gross sugar production, root yield, sucrose content, and bolting in 1973. Cultivar was US H9B.

| Ave. Plant Spacing | Plants Per 100 Ft. | Yield | | | Sucrose Content | Bolters |
|--------------------|--------------------|--------------------------|-------------------|-------------------|--------------------|-----------------|
| | | Harvestable ¹ | | Total | | |
| | | Gross Sugar | Roots | Roots | | |
| Inches | No. | T/A | T/A | T/A | % | % |
| 3.0 | 400 | 0.61 ^{a2} | 4.6 ^a | 12.5 ^a | 13.2 ^a | 93 ^a |
| 4.6 | 261 | 1.30 ^a | 10.2 ^b | 15.7 ^a | 12.7 ^a | 93 ^a |
| 6.4 | 188 | 2.52 ^b | 18.2 ^c | 21.1 ^b | 13.8 ^{ab} | 70 ^b |
| 10.3 | 117 | 4.49 ^c | 30.5 ^d | 30.5 ^c | 14.7 ^b | 42 ^c |
| 14.3 | 84 | 4.47 ^c | 31.4 ^d | 31.4 ^c | 14.2 ^{ab} | 49 ^c |
| 16.2 | 74 | 4.56 ^c | 34.6 ^d | 34.6 ^c | 13.2 ^a | 42 ^c |
| 18.2 | 66 | 4.46 ^c | 34.0 ^d | 34.0 ^c | 13.0 ^a | 32 ^c |
| 20.4 | 59 | 4.76 ^c | 34.8 ^d | 34.8 ^c | 13.6 ^{ab} | 31 ^c |

¹Harvestable yields based on roots two inches or larger in diameter.

²Means within columns followed by the same letter are not different at the 5% level of significance, based on the Student-Newman-Keul Test.

the 20-inch spacing. Spacings wider than 12 inches are not recommended, primarily because poor emergence or stand losses could result in excessively wide spacing. For instance, Deming (1) showed that when stands of beets spaced 16 inches apart were reduced 30% a 10% loss in sugar yield resulted compared to a 4% loss for beets spaced 12 inches apart. Normally there is also a decrease in the purity as the spacing increases.

Sucrose content tended to be lowest at very close and very wide spacings in 1973. The reduction in sucrose concentration at the close spacings may have been due, in part, to the effects of heavy bolting. Petiole analysis data, obtained only for spacings where bolting was not overly severe (less than 50%), indicated that plants at the 10.3- and 14.3-inch spacings were deficient in nitrogen at harvest whereas those at wider spacings were not.

Summary

The influence of very close and very wide in-row spacings on sugarbeet production in 14-26 inch rows was studied for three consecutive seasons under central Arizona conditions.

Spacings of 4.6 inches or closer consistently resulted in reduced root and sugar yields. When the cultivar US H9B was grown, yields were decreased at a spacing of 6 inches. Bolting, when it did occur, was most severe where beets were spaced 6 inches apart or closer. Root and sugar yields were statistically the same for spacings ranging from 10 to 20 inches.

Plant spacing did not have a consistent effect on sucrose content. However, there was a tendency for sucrose content to decrease as the spacing was increased.

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