Population and Distribution of Sugar Beets and Table Beets as Related to Seed Production[1]

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Introduction

Climatic conditions in western Oregon are particularly favorable for seed production of both sugar beets and table beets. In view of these favorable conditions some detailed studies have been made of the space relations for sugar beets where grown by the overwintering method and some preliminary studies made with respect to table beets transplanted for seed.

In some previously reported work (1)[3] it was found that with plantings made Sept. 3, about one-third of the plants in the unthinned stand failed to bolt, although in the thinned stand all plants bolted satisfactorily. In this trial slightly better seed yields were obtained from the thinned stand. In a dry land planting in 1943 with 24-inch rows, a continuous stand made 25 percent more yield than hills spaced on 24-inch centers. A trial in southern Oregon in 1947 involved irrigated beets with 20-inch rows. Spacings within the row varied from 1 to 8 plants per foot. In this test no difference in seed yield due to the spacing variables was obtained.

Other evidence demonstrates that time of planitng is an important factor. Sugar beets planted in early August or even more so in June or July gave more uniform and complete reproduction than those planted in September. However, in early plantings winter injury may be a hazard. Where spacing permits large individual root development in early plantings, the larger plants will suffer more from freezing than smaller plants in more crowded conditions.

No doubt many other factors will influence sugar beet seed yields. The question of optimum spacing will need exploring with several varieties and under different growing conditions before generalizations can be made.

Table beets for seed in this area are grown mainly by the transplanting method. Roots are grown in the summer and fall, then dug and placed in storage either in controlled temperature warehouses or in field pits during the winter and then transplanted in early spring. Relatively few are grown by the field-overwintering method. Usually the rows for the seed crop are spaced at three to four feet apart with roots 18 to 24 inches in the row. Operators have difficulty placing the planjts closer than about 18 inches with present transplanting equipment. Some new developments in transplanting machines may change this situation.

Experimental Methods

In the 1949-50 season a study was made at Corvallis to test the effect

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[3] Numbers in parentheses refer to literature cited.

of spacing sugar beets both as to within-row variations and between-row variations. In a split plot, randomized block arrangement beets were planted in rows 12, 16, 20 and 24 inches apart. Spacings within the rows were 1. six-inch singles, 2. three-inch singles, and 3. unthinned which averaged about one plant per $1^1/_2$ inches. This provided five replicates of the row-width blocks and 15 replicates of the within-row spacings for a total of 60 plots. For convenience of planting, cultivating and harvesting, it was desirable to vary the width of the plots so as to provide a definite number of rows. The 12 and 16-inch rows were planted to 12-row plots and the 20 and 24-inch rows to 9-row plots, all 90 feet long. The soil was a Chehalis sandy loam fertilized with a mixture of ammonium sulfate and sodium nitrate to supply a total of 300 pounds of N per acre, 100 in the fall and 200 in the spring. They were well irrigated. Beets were planted Aug. 3, 1949.

In the trial reported here with table beets for seed, the row width was limited to 3.5 feet. Within-row spacings were 8, 12, 24 and 48 inches. Plots were single rows 50 feet long with two levels of nitrogen and four replications of each. Nl nitrogen level was fertilized with ammonium nitrate to supply 60 pounds of nitrogen per acre. N2 nitrogen level had, in addition to that of Nl, 60 pounds of N in the form of a mixture of ammonium sulfate and sodium nitrate. Only one irrigation was applied and the beets suffered from shortage of water. The soil was Chehalis silt loam.

Sugar Beet Seed Production

Fall growth was good and only a few of the single plants in the wider row spacings were killed by winter freezing. The seed was harvested the latter part of July, 1950, and the yields of clean seed calculated to an acre basis are given in Table 1.

Table 1.—Effect of Spacing on Sugar Beet Seed Yield in Pounds of Clean Seed Per Acre.

	Within-row spacings			
Row width	**6 inches**	**3 inches**	**Unthinned**	**Mean**
24 inches	3,895	3,718	3,923	3,845
20 inches	3,558	3,706	3,483	3,582
16 inches	3,885	3,889	3,896	3,889
12 inches	3,852	3,695	3,548	3,697
Mean	3,798	3,752	3,711	

Treatment differences all non-significant at 5% level.

Within the range of the plant population, which varied from about 47,000 per acre to about 238,000, there was no difference in seed yields under the conditions prevailing. In these relatively early fall planted beets the smaller individual plants of the thick stand had sufficient opportunity for induction of flowering that nearly all made seed.

Beet seed growers in this area have decided from their own observations that it is preferable to obtain moderately thick stands. There may be some advantage to this. For one thing, there may be considerable less hazard of winter injury in thick stands. Another point is that the weeding problem is somewhat less with relatively thick stands. In a previous study of the relative amount of hand labor for weeding, it was found that beets

spaced as 12-inch singles required five times as much labor for weeding as an unthinned stand and beets spaced as 6-inch singles required twice the labor of unthinned stands. These were in 20-inch rows.

Sugar Beet Seed Quality

The germination test of these samples was all good, averaging 93 percent with no significant difference due to the spacing treatments. There was a significant trend toward smaller sized seed from the closer spaced plants. The average weight per 100 seed balls is given in Table 2.

Differences in seed ball size of the magnitude shown in Table 2 would not be clearly defined in a screening test. Sugar beet seed passing through a 12/64ths screen and held on an ll/64ths average about 2.04 grams per 100 seed balls. Seed l/64th larger size averaged 2.50 grams and seed l/64th smaller averaged 1.70 grams per 100 seed balls. Different seed lots might vary due to the severity of rubbing during threshing operations. In this seed lot, the germ portion averaged 22.4 percent of the total seed ball weight.

Table 2.—Effect of Spacing on Seed Ball Weight in Grams Per 100^.

	Spacings within-rows			
Row width	**6 inches**	**9 inches**	**Unthinned**	**Mean**
24 inches	**2.24**	**2.18**	**2.26**	**2.22**
20 inches	**2.08**	**2.26**	**2.00**	**2.12**
16 inches	**2.16**	**2.16**	**1.96**	**2.10**
12 inches	**2.02**	**2.12**	**1.92**	**2.02**
Mean	**2.12**	**2.18**	**2.02**	

Difference for significance of row width means at 5% level—.134.
Difference for significance of within-row means at 5% level—.116
For convenience in conversion 2.00 grams per 100 seed balls is equivalent to 22,680 seed balls per pound.

Remaining Plant Population at Harvest

The spacings and plant population as reported above refer to the stand remaining after thinning in the fall. The significant stand would be that remaining at harvest time. Where the plants were thinned to six-inch singles and rows 24 inches apart, some winter freezing loss occurred and only about 80 percent of the original stand remained. In the other row widths the thinned stands showed good survival and at harvest survival was essentially the same as at thinning time. On the other end of the scale the unthinned stand resulted in some crowding in the 12-inch rows with a subsequent loss of about 30 percent of the plants, leaving 5.5 per foot of row; similarly, there was a lesser loss from crowding in the 16-inch row, leaving 6.8 per foot in this unthinned stand. The 20- and 24-inch rows showed good survival where they were not thinned, with the stand about as at thinning time wtih eight plants per foot.

From the standpoint of number of plants per square foot of land area, the counts showed 5.5, 5.1, 4.8 and 4.0 respectively for the 12, 16, 20 and 24 rows unthinned and down to only 1.09 average per sq. foot for the thinned stand in 24 inch rows. Over a range of five-fold difference in total plant population remaining at harvest, there was no measurable difference in seed production.

Table 3.—Effect of Spacing on Root Weight in Tons Per Acre.

Row width	Within-row spacings			
	6 inches	3 inches	Unthinned	Mean
24 inches	7.40	7.23	6.58	7.07
20 inches	7.80	8.10	8.49	8.13
16 inches	9.24	8.23	8.40	8.62
12 inches	10.93	9.15	8.36	**9.48**
Mean	8.84	8.18	7.96	

Size of Roots

Where sugar beet seed is being grown by the overwintering method and the byproduct of roots is not used after seed production, the size of roots produce is of only secondary importance. However, it seemed desirable to take sufficient samples of roots from these spacing plots to get a fair estimate of the total root production. Root weights of representative samples of the plots were taken at harvest time and are shown in Xable 3.

In this trial the variance in tonnage of roots produced was not large. The spread between the greatest and least population amounted to only about one ton per acre.

Table Beet Seed Production

Yields of table beet seed calculated to pounds per acre are given in Table 4.

Table 4.—Table Beet Seed Yields as Pounds Clean Seed Per Acre.

Nitrogen Level	Spacings with rows				
	8 inches	12 inches	24 inches	48 inches	Mean
N1	2,365	2,589	1,742	1,556	2,056
N2	2,489	2,116	1,718	1,182	1,874
Mean	2,427	2,350	1,730	1,369	

Diff. for significance of spacing at 5% level—336 pounds.

As shown in Table 4 seed yields from the 8 or 12-inch spacing were about equal, averaging 38 percent better than the 24-inch rows and 75 percent better than the 48-inch rows. Under the conditions of moisture deficiency, the added nitrogen was of no benefit. Spacing had no effect on the seed size.

There was some mortality and the stand at harvest time averaged about 80 percent for the 8-inch, 75 percent for the 12-inch, 85 percent for the 24-inch and 92 percent for the 48-inch spacings. Harvest weight of roots per acre was somewhat in proportion to the seed weights. The 8-inch spacing produced about 6,500 pounds roots, the 12-inch produced about 5,400 pounds, the 24-inch produced about 3,900 pounds, and the 48-inch produced about 2,800 pounds or average weights per beet root ranging from .110 for the 8-inch to .246 for the 48-inch spacing.

Summary

The relation of spacing and total plant population of sugar beets to seed yields was investigated. Row widths were varied at 12, 16, 20 and 24

inches, and spacings within the row were varied at 1. 6-inch singles, 2. 3-inch singles, and 3. unthinned, which averaged about one every $1^{1}/_{2}$ inches.

Under the conditions prevailing in this experiment, with seed yields ranging from 3,600 to 3,900 pounds per acre, there was no difference in seed yields attributable to the spacing treatments.

The closer spacing resulted in slightly smaller seed but did not affect germination.

Total weight of roots produced ranged from 6.6 tons per acre for the unthinned plants in 24-inch rows to 11 tons per acre for the 6-inch singles in 12-inch rows.

The effect of spacings for transplanted table beets for seed was tested in a row width of 3.5 feet and spacings within the row of 8, 12, 24 and 48 inches. The seed yields were about equal from the 8- and 12-inch spacings and were 75 percent higher than the 48-inch and 37 percent better than the 24-inch spacings. Neither size nor germination of the table beet seed was affected by the spacings.

Literature Cited

(1) PENDLETON, RAY A.
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