Spacing Sugar Beets for Seed Production[1]

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Spacing of beets for sucrose production has long been studied and optimum stands fairly well determined. Spacing of beets for seed production has received less attention. In America, sugar beets for seed have been mainly grown by the field-overwintering method, whereby from 10 to 20 pounds of seed per acre are planted in late summer or early fall and left unthinned. Close spacing is necessary in some of the seed-growing areas to shade the soil and keep it as cool as possible. Observed yields of seed under varying conditions in northern California, Oregon and Washington suggested the desirability of study to determine the optimum space relationship for highest seed yields. Such relationship involving both soil and light would be influenced by the plant distribution as well as the total population.

Widely spaced transplanted sugar beets have been grown which yielded well over a pound of seed per plant, providing heavy yields with relatively few plants. In contrast, similar high yields of seed have been produced with field-overwintered stands of 10 to 12 plants per foot of row. In the coastal climate of the Pacific Northwest the field-overwintered plants tend to start seedstalk formation as soon as the days get relatively long and spring growth starts, after which there is comparatively little more root enlargement.

Optimum plant spacing is no doubt influenced by soil fertility, moisture supply and time of planting. Close spacing to shade and keep the soil cool is not necessary under the climatic conditions where these studies were conducted.

Irrigated Conditions

Two trials under irrigated conditions may be cited. Other tests were conducted but vitiating factors rendered the results less satisfactory. Stand counts were taken at harvest time. In a 1941 trial in the Willamette valley of Oregon, with rows spaced 24 inches apart, a wide variation in plant population was noted. The lowest was 16,335 beets per acre based on a 75 percent stand of 12-inch singles, and the highest 348,480 beets per acre in continuous stand averaging 16 plants per foot. Included were two blocked stands, one with 87,120 beets per acre in hills spaced 12 inches apart averaging 4 beets each, and the other with 65,340 beets per acre in hills spaced 20 inches apart averaging 5 beets each. There were 12 replications of the spacing treatments.

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The 1947 trial was in the Medford area with rows spaced 20 inches apart. Plant populations varied from a low of 32,670 beets per acre in 12-inch singles and 24-inch doubles to a high of 261,360 beets per acre in continuous stand averaging 10 plants per foot. Included was one blocked stand with 104,544 beets per acre in hills spaced 24 inches apart averaging 8 plants each. There were six replications of these treatments.

The blocked stands averaged about one plant per inch of row within the block. The spacings tried, together with the approximate total plant population and seed yield, are given in table 1.

Table 1.—Seed yields with various spacings under irrigated conditions.

Spacing	1941[1] 24" rows plants per acre	Seed per acre	1947[3] 20" rows plants per acre	Seed per acre
		pounds		pounds
12" singles	16,335	1937	32,670	2405
6" singles	32,670	2191	65,340	2610
3" singles	----	----	104,544	2577
12" hills (averaging 4 beets)	87,120	2264[2]	----	----
24" doubles	----	----	32,670	2442
20" hills (averaging 5 beets)	65,340	2101	----	----
24" hills (averaging 8 beets)	----	----	104,544	2532
Unthinned	348,480	1934	261,360	2250
Significant difference (19:1 odds)	---	240		402

[1]Variety U.S. 200 x 215 planted September 3, 1940.
[2]Statistically higher yield than the unthinned.
[3]Variety U.S. 15 planted August 14, 1946.

The results of the 1941 test showed higher yields from the spaced beets than from the continuous dense stand except in the case of the singles 12 inches apart. In the last named treatment downy mildew was more of a factor than in the other spacings. The treatment with hills of 4 beets 12 inches apart gave 330 pounds of seed per acre more than the unthinned plots with 16 beets per foot. This difference is statistically significant at the 5 percent level. In the unthinned plots only 65 percent of the plants participated in seed production. About half the remaining 35 percent failed to bolt, while the other half bolted but produced no seed. Observations in other fields indicated that the late planting as well as the density of the stand influenced the performance of the unthinned beets.

The 1947 test near Medford gave average increases in the thinned over the unthinned check of 155 to 360 pounds of seed per acre but due to the wide variation in yields among the replications the differences did not reach statistical significance. A severe epidemic of *Ramularia* leafspot almost completely defoliated the plants in all treatments late in the spring and may have affected the yields of the different treatments unequally.

The trend of the yields indicates that stands of 2 to 6 plants per foot of row give the best yields with late summer and early fall plantings.

Some studies of rate of growth and sucrose content were made. The evidence suggests that the highest sucrose content is reached in early spring after which there is a gradual decline until harvest. Small beets in thick stands tend to have slightly higher sucrose than large beets in thin stands. In the Medford trial the roots tended to increase in size until May but in the Willamette Valley the roots usually reached maximum size by March.

Non-Irrigated Conditions

A number of trials have been conducted with non-irrigated beets in the Willamette Valley to determine optimum plant populations for highest seed yields. Plant populations have varied from a low of about 125 plants to a high of about 1,000 plants per 100 feet of row in 24-inch row spacings. Some have dealt with continuous stands and some with hills spaced at 12 and 24 inches. With one exception, in which the lowest plant population gave slightly lower seed yields, there has been no appreciable difference due to spacing variations. Further study of spacing under non-irrigated conditions is needed.

When beets were grown in hills, spaced at 24 inches with an 8-inch block left, maximum yields were obtained with 3 to 8 plants per hill with no appreciable difference within this range. There was no correlation between number of plants per hill and total weight of root per hill. The thinner stands tended to compensate for their greater space allotment by making more growth per plant. This study was conducted in 1944.

In 1945, an experiment was conducted to determine the optimum number of plants grown in hills spaced 24 x 24 inches. This was under irrigated conditions in the Willamette Valley. Results were similar to those with non-irrigated beets. Maximum yields were obtained with 3 to 8 plants per hill with little spread within this range. Less than three plants resulted in lower yields per hill. There was a high degree of correlation $r=0.702$ between total weight of root per hill and seed yield but no correlation between number of plants per hill and total root weight.

Summary

In continuous stands the optimum plant population in the Pacific Northwest seems to lie in the neighborhood of 2 to 6 plants per foot of row. Where beets are blocked the population may be increased to about 1 plant per inch of row within the block.

Under western Oregon conditions, the roots in June-planted fields reached their maximum growth by early spring before bolting started. Late August and September plantings, by contrast, showed additional root growth in spring. Varieties low in bolting tendency, those requiring extensive thermal induction, bolt better if planted in June than when planted in late August or September.

The maximum sucrose content is probably also reached in early spring, after which there is a gradual decline.

A high degree of correlation has been shown between total weight of root per unit area and seed yield. However, within moderate limits very little correlation has been shown between plant population and total weight of roots.