Parent-Progeny Tests for Sodium and Potassium Content

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The maximum extraction of sucrose from the sugar beet is very important to the industry. Although much depends on factory operations, it is necessary that varieties be grown for processing which are high in juice quality, and thus suitable for maximum extraction.

Early in 1949 plans were made by the American Crystal Sugar Company to study all varieties used in Company areas, for the purpose of determining whether differences existed for the two minerals, sodium and potassium, since these minerals cause lowered extraction of sucrose from the beet. Part of the 1949 results were reported by Doxtator and Carlton (1)[2] in which article large varietal differences were noted.

Reference was made in this article to a 500-mother-root selection obtained from the lowest sodium-potassium variety found. This paper reports the results of the 1950 and 1951 tests on progenies from some of the roots of this selection.

The 1949 selection of 500 roots was from eight rows 400 feet long on the Experimental Station at Rocky Ford, Colorado, from the American No. 1 Elite stock 7-40la. This Elite stock is a selection of American No. 1, a variety of hybrid origin. The selection was for size and shape in the field. In the laboratory individual weights were obtained along with data on percent sucrose, sodium and potassium. The latter two determinations were made with the Beckman flame spectrophotometer on a portion of the leaded filtrate used for the sucrose test. From these data, selections were made for (A) the 25 beets highest in weight and sucrose and lowest in sodium and potassium; (B) the 25 beets lowest in weight and sucrose and highest in sodium and potassium.

The two selections were planted *in* the greenhouses early in 1950 for winter seed production. The beets were bagged in pairs within each selection, using Kraft bags 16 inches x 25 inches in size, to produce sib progenies. It was hoped that this procedure would result in seed lots of adequate quantity to permit a replicated plot test planting in 1950. Bolting in the greenhouses was not uniform, however, and only a small number of "pair progeny" seed lots sufficient in quantity was obtained from each selection. The seed from four progenies of each of the two selections was planted for test in 1950 in single row plots, the length of the plots being determined by the amount of seed available. Alternate rows were planted to the parent variety 7-40la.

All roots were harvested in the fall of 1950 from both the parent variety and the pair progenies. Weight, sucrose, sodium and potassium data were obtained on all beets weighing over one pound. These beets were then planted in the greenhouses for seed production during the winter of 1950-51.

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[2] Numbers in parentheses refer to literature cited.

Four pair bagged progenies were obtained in satisfactory seed quantity to permit a two-replicate test of single row plots 20 feet long in 19551. As in 1950, alternate rows were planted to the parent variety. In the fall of 1951, all beets from the progenies and the parent were harvested and analyzed individually as in 1950, for the same four characteristics.

Experimental Results

The two 1949 beet selections had the following average characteristics:

Type of Selection		No. Beets Selected	Average Weight Lbs.	% Sucrose	% Na	% K
Best Selection	(A)	25	3.88	17.8	.015	.140
Poorest Selection	(B)	25	2.60	13.2	.107	.274

The four pair progenies from each selection which produced a satisfactory amount of seed and which were planted in 1950 were harvested as mother beets. Average data obtained from these individual beets from the eight lines along with the parent variety are given in Table 1.

Table 1.—Average Weights and Percentages of Sucrose, Sodium and Potassium Found in Eight Progeny-lines and the Parent Variety, 1950.

1949 Selection	1950 Progeny No.	No. Beets Tested	Average Weight Lbs.	% Sucrose	% Na	% K
A	393	10	1.23	16.1	.070	1.45
	395	15	2.75	16.5	.101	.156
	397	14	2.63	16.3	.071	.161
	399	10	2.68	14.9	.090	.208
B	392	15	1.37	14.5	.144	.224
	394	8	1.68	14.5	.104	.226
	396	14	2.83	12.7	.113	.275
	398	9	1.50	14.4	.108	.190
Average A Selection		49	2.32	15.95	.083	.168
Average B Selection		46	1.85	14.02	.117	.229
Average Parent Variety		62	1.71	14.80	.112	.215

The data in table 1 indicates a large difference in favor of the A selection over the B, and over the parent variety, for the four characters. However, due to the small number of roots available for comparison of lines it was decided to recheck the parent progeny relationship a second time. Accordingly, all analyzed roots of the eight lines were planted in the greenhouses in the winter of 1950-51 for seed production. Difficulties were again experienced in obtaining seed from the pair progeny bags, due to the fact that a late curly top infestation was obtained in the field in the fall of 1950. Most of the mother beets had to be discarded, with the result that only three pair progenies were available from the original A selection lines, and one from the original B selection lines for nursery plantings in 1951. All beets from the two replicates of single row plots 20 feet long from the lines, along with original parent variety from alternate rows, were harvested in the fall of 1951. Average data from the individual root analysis are given in Table 2.

In this test a somewhat larger number of beets was available for analysis from the original A selection. The stand in the plots averaged 14 beets per

20 feet of row, which was appreciably better than in the 1950 test.

The results of the 1951 tests indicate that the A selection progenies performed similarly to those of 1950 for sucrose and sodium percent, when compared with the B line, and the parent variety. Differences between all three for yield and percent potassium were extremely small, however.

Discussion

The 1950 data indicate rather large differences between progenies and the parent variety for all four characteristics even though number of beets tested was very few. The larger number of individuals tested in 1951 showed similar differences, as an average, on two characters, percentage of sucrose and sodium. Seed quantities were not available either in 1950 or 1951 for adequate plot test to determine whether differences in yield existed between progeny selections, nor of relationships between yield and other characters. Differences in percent potassium in these tests have been erratic. It is possible that breeding for lowered amounts of this chemical may be more difficult than for sodium.

Table 2.—Average Weights and Percentages of Sucrose, Sodium and Potassium Found in Four Progeny Lines and the Original Parent Variety, 1951.

Orig. 1949 Selection	1951 No.	No. Beets Tested	Average Weight Lbs.	Average % Sucrose	Average % Na	Average % K
A	528	20	2.46	15.18	.054	.384
	529	25	2.04	15.98	.045	.337
	531	22	1.89	14.63	.080	.310
Average A Selection		65	2.13	15.26	.060	.344
B	530	23	2.20	14.90	.086	.335
Average Original Parent (4 alternate rows)		77	2.12	14.67	.085	.347

Summary

The results of two years' testing of selected progenies obtained from a variety high in sucrose and low in sodium and potassium indicate that improvement in sucrose and sodium content is possible by simple breeding methods.

Improvement in yield along with sucrose and sodium was not clearly demonstrated.

Potassium content in the progenies tested in 1951 did not indicate appreciable change from the parent variety.

Literature Cited

(1) DOXTATOR, C. W. and CALTON, F. R.
1950. Sodium and Potassium Content of Sugar Beet Varieties Grown in Some Western Beet Growing Areas. Proc. Am. Soc. Sugar Beet Tech. pp. 144-151.