

Use of Unit Block Selection Method for Yield, Sugar and Purity in Sugar Beets

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Low sucrose and low purities have been continuing problems in the California, Imperial Valley sugar beet producing area. Any varietal improvement to correct the problems would be most welcome and valuable to factory operation. In 1957, it was decided to act upon a suggestion of Dr. LeRoy Powers, Principal Geneticist, U. S. Department of Agriculture, to make a selection for high sucrose and high purity, utilizing the "Unit Block" selection method.

Materials and Methods

A field of beets planted to the commercial variety HC 1 on the Nelson Corral ranch near Brawley, California, was chosen for this work. The field was selected because of its apparent uniformity in stand, fertility and freedom from disease. About an acre was marked off into small blocks, each 20 feet long and 14 rows wide. The beets in each block were dug by hand and laid up on the ground. From each block 100 of the largest beets were selected for further testing. In all, 83 blocks were handled in this manner.

The 8300 beets were sent to Sheridan, Wyoming, to be tested for sucrose and purity. Mean sucrose and mean purity values were calculated for each block. Those roots whose sucrose and purity values exceeded their block means by the greatest percentage for both characters were selected for further testing. On this basis more than one root could be selected from a block or no roots could be selected from a block. Fifty-two roots were saved and put out in two groups for seed production at Sheridan in 1958. In group one the six roots that exceeded their block means by the greatest percentage for both sucrose and purity were included. The remaining 46 roots were planted in the second group.

Cuttings were made from each plant to retain the genotype of those which would be considered most desirable after appropriate field tests had been made.

Seed was harvested on an individual plant basis. Sufficient seed for field testing was obtained from 5 of the 6 plants in the first group and 28 of the 46 plants in the second group. Seed from these 33 individual plants, composite seed lots from each

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of the two groups, and a few hybrid combinations were planted in the Imperial Valley on the Nelson Corral ranch in September 1958. The test was of rectangular lattice design with six replications. Plot size was one row by 50 feet.

Good stands were obtained for most entries and the plants were vigorous during the growing season. The beets were harvested in June, 1959.

Experimental Results

It is readily apparent that the differences measured in this test are significant at the 1% level.

Table 1.—Calculated F Values and 1% Level F Values for Characters Measured.

	Tons Beets	Percent Sucrose	Percent Purity
Calc. F Value	3.47	6.56	3.28
1% Level F Value	1.68	1.68	1.68

Table 2 gives the yield data of the 33 plant lines from the two groups.

Considering percent sucrose, every selected line is significantly greater than HC 1. It is also apparent that all five plants in the first group are generally higher in percent sucrose than the 28 plants in the second group. All the lines are better than HC 1 for percent purity, over half of them significantly so. Again, the five plants in the first group will average higher than the 28 plants in the second group. Most of the lines do not differ from the check in tonnage. Several of the lines are significantly above the check in sugar per acre.

A comparison of the composited seed lots and the parental material is shown in Table 3.

The composited seed of the five individual plant lines in the first group is 8231-0 and 8232-0 is the composited seed of the 28 individual plant lines in the second group. HH 3 is one of our best hybrids in the area and HC 1 is the parental material from which the selection was made.

A substantial increase in sucrose was shown by both composite seed lots, this with an increase in tonnage in the second group and a decrease in the first group, although these differences are not significant. This sucrose increase is reflected in a large sugar per acre increase, about 25 percent in the case of the second group and 12 percent in the case of the first group. An increase in purity of nearly two points for the second group and nearly three points for the first group is indicated.

Table 2.—Individual Plant Performance of Lines Tested When Ranked by Sugar per Acre.

Line	Sugar/Acre Lbs.	Beets/Acre Tons	Sucrose %	Purity %	Beets/100 Ft. Row
2-19	11055	40.056	13.80	88.4	145
2-31	11024	41.103	13.41	89.2	128
1-1	10764	37.928	14.19	89.2	136
2-9	10582	38.120	13.88	88.9	135
2-21	10578	38.353	13.79	89.9	142
1-4	10268	35.803	14.34	90.2	125
2-30	10248	37.347	13.72	89.0	131
2.10	10245	36.538	14.02	88.4	134
2-6	10230	39.559	12.93	88.0	127
2-32	10171	38.908	13.07	88.7	108
1-5	10059	35.772	14.06	89.2	136
2-20	9953	38.223	13.02	87.0	120
2-13	9920	38.419	12.91	88.1	104
2-2	9717	33.738	14.40	90.2	135
2-29	9635	34.984	13.77	88.7	138
2-27	9464	35.183	13.45	88.4	138
2-5	9332	34.616	13.48	87.8	140
1-2	9283	32.803	14.15	90.4	85
2-25	9116	35.117	12.98	88.8	107
2-24	9049	33.689	13.43	89.0	130
2-22	9046	32.632	13.86	90.4	120
2-7	9026	35.201	12.82	87.0	128
2-3	9014	33.584	13.42	90.2	110
2-26	9003	32.737	13.75	88.2	130
2-8	8910	32.952	13.52	88.4	112
1-6	8787	30.638	14.34	90.8	97
2-14	8700	31.704	13.72	89.2	124
2-23	8347	29.166	14.31	89.6	84
2-15	8343	31.842	13.10	89.4	114
HC 1	8203	34.122	12.02	86.8	137
2-18	8088	29.221	13.84	87.6	110
2-4	7695	28.865	13.33	90.0	103
2-11	7211	26.414	13.65	88.9	88
2-28	6871	26.247	13.09	88.3	90
LSD (5%)	1517	5.3	.70	2.0	

Table 3.—Production Data for Four Entries in the Imperial Valley 1958 Field Test.

Variety	Sugar/Acre Lbs.	Beets/Acre Tons	Sucrose %	Purity %	Beets/100 Ft. Row
8232-0	10247	38.466	13.32	88.6	128
8231-0	9266	32.696	14.17	89.6	112
HH 3	9225	35.729	12.91	89.0	144
HC 1	8203	34.122	12.02	86.8	137
LSD (5%)	1517	5.3	.72	2.0	

From these results it is readily apparent that the selection pressure for sucrose and purity was highly effective by use of the "Unit Block" selection method. Both sucrose and purity were increased substantially without decrease in tonnage as is usual when heavy selection pressure is applied for these characters. In the first group where the selection pressure for sucrose and purity was the greatest, the increase in sucrose and purity was the greatest. This was accomplished by some reduction in tonnage although the difference is not significant. In the second group the selection pressure was not as great for sucrose and purity and the increases were not as great. An increase in tonnage was obtained in this group but here again, the difference is not significant. However, it may be that since a larger number of roots were used in the second group, a wider base was maintained and the increase in tonnage over that of the first group may be a real difference.

Summary and Conclusions

Fifty-three roots were selected for sucrose and purity on a "Unit Block" basis in the Imperial Valley in California.

A progeny test of 33 of these roots which had produced seed in two group plantings showed substantial increases in sucrose and good increases in purity for all the lines tested.

Composite seed lots from these two group plantings showed substantial increases in sucrose, purity and sugar per acre.

It would seem that an increase of the composite 8232-0 would produce a variety superior to the parent HC I from which it was selected.

Further seed increases to be made utilizing the cuttings obtained from plants shown to be superior in the test should show additional improvement in sucrose, purity and sugar per acre.
