

Hybrid Combinations Among Mother Line Progenies

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Local adaptation is an important factor to be considered in securing maximum production in a given area. Mass selection has been commonly used to obtain adaptation but this method has very definite limitations. A more intense method of selection should push production to a level above that obtained by mass selection. One such method is the testing of progenies of individual plants. The best progenies are grouped for a seed increase of a new superior variety. Doxtator² improved upon this method by making and testing all possible single crosses among the selected lines. From this information, lines which perform poorly in hybrid combination may be discarded. The results of such a procedure are reported in this paper.

Materials and Methods

In 1946 a group of 130 roots of Holly 13, breeder's stock of commercial seed for the Sheridan-Hardin area, were selected at Sheridan, Wyoming. These roots were stored in the root cellar, analyzed for sucrose, and reduced to a group of 56 roots on a weight-sucrose basis. Seed was harvested individually from 31 of these plants in 1947. In 1948, 17 plants which produced the most seed, along with two checks, were tested in a randomized block of five replications. Plots were 2 rows by 25 feet long. Remnant seed of each of the 17 lines was planted in selection blocks.

Significant differences were obtained in the test. Six of the 17 lines tested produced more sugar per acre than the check and, except for 2 lines, showed increases over the check in both sucrose and tonnage. Approximately 250 roots of each of these 6 lines were taken from the selection blocks and stored in the root cellar for use in making hybrid combinations. After a storage period of 67 days, 50 roots of each line were set out in 8-inch pots in the greenhouse. Temperatures between 50° and 60° F. were maintained until flowering, and supplemental light was used during the night. Branches were bagged with No. 14 paper bags just prior to flowering. Bag switching technique, as described by Doxtator², was used in making the crosses. Forty crosses (including reciprocals) of each of the 15 crosses, as well as each of the sibbed lines were made. Seed was harvested on May 3. Sufficient seed of all hybrids and sibbed lines was produced to plant a yield test of 6 replications, with plots 2 rows x 25 feet in size. The test was planted May 10, 1949.

Results and Discussion

The 1948 test performance of the 6 selected mother lines, together with the check variety from which they were selected, is given in Table 1.

¹ Plant Breeder and Chief Agronomist respectively Holly Sugar Corporation.

² Some Crossing Experiments with Sugar Beets, C. W. Doxtator and A. W. Skuderna, Proc. Amer. Soc. Sugar Beet Tech., 1942.

Table 1.—Production of 6 selected mother lines and variety check, 1948 data, Sheridan, Wyo.

	Acre Yield		Sucrose	Beets per 100' row
	S/A	Tons		
705-4	5,973	16,537	1 8.05	114
705-14	5,617	15,465	18.16	105
705-22	6,461	18,646	17.80	111
705-26	5,646	15,337	18.41	108
705-31	5,783	16,144	17.92	97
705-32	5,927	16,696	17.76	98
Holly 13	5,569	15,796	17.64	97
LSD (19:1)	611	1,673	.58	16

The 6 lines were selected for superiority in production of sugar per acre. Greater emphasis was placed on sucrose content than tonnage in selecting the lines.

Table 2 presents the 1949 test results. In this table the production of the 6 sibbed lines, all possible hybrids among the 6 lines, and the variety-check are given.

Table 2.—Acre production of 6 sibbed mother lines, all possible hybrid combinations, and variety check, Sheridan, Wyoming, 1949.

	Sibbed	% Sucrose					705-32
		705-4	705-14	705-22	705-26	705-31	
705-4	17.25		17.36	17.26	17.50	17.14	17.24
705-14	17.62			17.20	17.88	17.59	17.36
705-22	16.70				17.27	17.17	16.98
705-26	17.70					17.46	17.59
705-31	17.16						17.02
705-32	17.34						
Holly 13	16.76						
		LSD (5%) : .37					
	Sibbed	Tons/Acre					705-32
		705-4	705-14	705-22	705-26	705-31	
705-4	12.810		15.088	18.610	15.362	17.918	15.389
705-14	14.259			17.233	14.535	15.734	
705-22	16.528				16.840	15.444	17.568
705-26	13.039					14.371	14.145
705-31	13.692						15.519
705-32	13.189						
Holly 13	14.473						
		LSD (5%) : 1.878					
	Sibbed	S/A					705-32
		705-4	705-14	705-22	705-26	705-31	
705-4	4,424		5,242	6,423	5,368	6,136	5,308
705-14	5,020			5,933	5,188	5,534	5,491
705-22	5,524				5,817	5,302	5,965
705-26	4,620					5,020	4,974
705-31	4,700						5,281
705-32	4,569						
Holly 13	4,856						
		LSD ((5%) : 665					

The average production in sugar per acre of the 6 mother lines was nearly the same as the parent variety. However, the 15 hybrids among the 6 lines exceeded both parents in production except for one case. Four hybrids significantly exceeded both parents and 7 hybrids significantly exceeded one parent.

In percent sucrose the 6 mother lines averaged .54 percent above the parent variety, reflecting the emphasis placed on sucrose at the time the mother lines were selected. No hybrid vigor was evidenced in any of the hybrids in percent sucrose.

The 6 mother lines yielded slightly less than the parent variety in tons per acre but the average yield of all 15 hybrids was significantly greater than the parent variety. Here again all hybrids except one exceeded both parents.

A synthetic variety using all 6 of these lines should show a theoretical 11.44 percent increase in production over the parent variety from which these lines were selected.

Conclusions

Better than average mother lines produced hybrid combinations which were significantly better sugar producers than the parent line. A judicious choice of the mother lines to be used in forming a new variety, considering the possible hybrids among those lines, will produce a better variety than had the various possible hybrid combinations not been taken into consideration.