Inbred Seed Production in Progeny Classification For Type O Plants in Open-Pollinated Varieties

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A large number of self-pollinations in normally self-sterile open-pollinated varieties was made at Sheridan, Wyoming, in the seasons of 1950 and 1951. These self-pollinations were made at the same time that the individual plants were crossed to male sterile plants in an effort to identify type O segregates in the population. It was hoped that the S_1 plants which would subsequently be classified as type O could be maintained by self-pollination. The purpose of this paper is to report on the seed production of these self-pollinated plants as well as the F_1 progenies classified as type O.

Procedure

Approximately 800 roots of MW 381, a non-resistant type, and 200 roots of 40308-0, a leaf-spot-resistant type, were planted in the field in the summer of 1950. Roots produced from seed harvested from open-pollinated male sterile plants from these same two varieties were planted in the same field in such a manner that male sterile roots of MW 381 would be in a row adjacent to the normal pollen-producing plants of MW 381, and likewise for the variety 40308-0. The male sterile segregates in alternate rows were then used as female parents in crosses with the pollen-producing plants from adjacent rows. Three white bleached Kraft paper bags were placed on each pollen-producing plant and all male sterile plants were bagged as heavily as possible. When the flowers on the male sterile plants had opened sufficiently (about two weeks after bagging) , one of the bags from the male parent was removed and immediately replaced with a new bag. A bag was then removed from a male sterile plant and replaced with the pollen containing bag from the pollen parent. Thus, for each F_1 seed lot produced, using one bag exchange, a total of three bags was used to produce self-pollinated seed of the male parent involved in the cross.

In the variety MW 381, 717 crosses and selfs were made, 674 of which produced enough seed of both types to be planted for steckling production. In the variety 40308-0, 189 crosses were made and seed lots of 174 crosses and selfs were obtained in sufficient quantity to be planted. Seed lots were planted only when there were at least two grams of the F_1 seed and at least .1 of a gram of inbred seed. The amount of inbred seed ranged from 0 to as much as 38 grams per lot.

All seed lots were planted at Phoenix, Arizona, in the fall of 1950. The stecklings produced there were harvested in January of 1951, shipped to Sheridan, Wyoming, for thermal induction in the root cellar and then transplanted to the field in the spring. Plantings were made in such a manner that the inbred line stecklings were placed with their related F_1 progenies, so that those progenies classified as 100 per cent male sterile could be backcrossed to the inbred line.

Results

It was expected that a portion of the inbred seed produced would not be viable; therefore, rather than report inbred seed produced by weight or number of seed balls, it was decided to report the number of plants actually

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produced from each lot of inbred seed. Table 1 divides the number of inbred seed lots according to the number of plants produced in intervals of five plants each. Percentage values for each class are also given.

Table 1.—Inbred Seed Lots Produced at Sheridan, Wyoming, in 1950 Grouped According to Number of Plants Produced at Phoenix, Arizona, in the Winter of 1950-51.

	Number of Plants Produced								
Variety	0	1-5	6-10	11 15	1620	21-25	2630	Over 30	Total
MW 381	78	88	128	163	121	58	28	10	674
%	11.6	13.0	19.0	24.2	18.0	8.6	4.2	1.4	100
40308-0	15	33	42	40	30	9	3	2	174
%	8.0	19.0	24.1	23.0	17.2	5.2	1.7	1-2	100

In the variety MW 381, 78 seed lots, or 11.6 percent, of the total seed lots planted, failed to produce plants to carry on the line. The percentage figure for variety 40308-0 was 8 percent. Approximately 90 percent of the inbred seed lots produced plants to perpetuate the line. It is realized that some of the plants produced, especially where only one or two plants were obtained from a lot of seed, may have resulted from off pollinations. However, on the chance that they were true selfs, these single plants were carried along and used where completely male sterile progenies were found.

All F_t progenies were classified for pollen production. No attempt was made to identify the number of semi-male steriles in segregating populations. Only those progenies which were 100 percent male sterile were marked and then backcrossed to their respective inbred parents. In Table 2 the number of progenies completely male sterile are grouped according to the number of selfed plants produced by the paternal inbred line.

Table 2.—Number of Fi Progenies Classified as 100 Percent Male Sterile at Sheridan, Wyoming, in 1951.

	Number of S_1 Plants								
Variety	0	1-5	6-10	11-15	16 20	21-25	26 30	Over 30	Total
MW 381		5	7	6	7	2	1	1	29[1]
40308-0		3	6	12	6				27[2]

[1] Out of a total of 674, or 4.3%
[2] Out of a total of 174, or 15.5%

Of the 674 MW 381 F_1 progenies planted, 29, or 4.3 percent, were classified as 100 percent male sterile. Of the 174 40308-0 F_1 progenies planted, 27, or 15.5 percent, were classified as completely male sterile. It was expected that a much larger number of type O plants would be found in the 40308-0 line because male sterile plants occurred in greater number in the open-pollinated isolation where seed of the open-pollinated male sterile plants was obtained. Since no F_1 groups were planted where selfed plants were lacking, there were, no doubt, a few lines lost which may have been type O. This figure would probably be near the 10 percent value of the O column (where no plants were obtained) of Table 1.

In 1951 the same procedure described above was used in producing 756 F_1 and S_1 lots of seed involving 12 different varieties as pollen parents. One exception was that in 1951 the male sterile parent used in all crosses was SL 6106, which is highly male sterile. In addition, 348 crosses were produced

involving the 56 F_1 progenies, identified as completely male sterile, backcrossed to their respective paternal parent inbred lines. Because of the small size and necessarily close spacing of these plants, only one bag could be placed on each plant—both F_1 and S_1 types. The S_1 plants were again selfed to produce S_2 seed. Again, all this material was planted at Phoenix, Arizona, this fall for steckling production.

Stand counts on the S_1 and S_2 line lots of seed which contained five plants or less were made and are summarized in Table 3.

Table 3.—Number of Plants Produced at Phoenix, Arizona, from 1,104 Lots of Inbred Seed Produced at Sheridan, Wyoming, in 1951.

	Number of Plants			
	0	1-5	More than 5	Total
S_1	103	95	558	756
%	13.6	12.6	73.8	
S_2	94	89	165	348
%	27.0	25.6	47.4	

In Table 3 it is readily seen that S_1 seed lots producing no plants in 1951 were 13.6 percent of the total and that this figure compares favorably with the average of 10 percent in 1950. Nearly 90 percent of the S_1 self-pollinations produced plants to perpetuate the line. The results obtained with the S_2 seed were not nearly as good since 27 percent of the lots failed to produce plants.

This is probably due to two factors: First, since the stecklings planted were very small and were planted close together as compared to the larger-sized roots and wide spacing of the plants used for S_1 seed production, only one bag could be placed on each plant. Second, in order to spread out the pollinating season, the S_2 stecklings were planted at a later date than the S_1 roots. Thus, the pollinations were made when the mean temperatures were higher, which may have accounted for lower seed set.

However, it is gratifying to note that, of the 56 original F_1 completely male sterile progenies, only four were completely lost because of the failure to obtain S_2 seed to carry on the line.

It would seem then that under environmental conditions similar to those at Sheridan, Wyoming, type O plants isolated in self-sterile varieties may be maintained by self-pollination.

Summary

A total of 848 self-pollinations in two varieties was made at Sheridan, Wyoming, in 1950. Approximately 90 percent of these self-pollinations produced seed which gave rise to a varying number of plants. The same number of F_1 crosses between male sterile plants and the plants which were selfed were classified for pollen production and a total of 56 were identified as being entirely male sterile.

In 1951 a total of 756 self-pollinations in twelve varieties was made. Again, 87 percent of these self-pollinations produced seed which produced plants. In addition, 348 S_2 self-pollinations were made in connection with a series of backcrosses. Of this group, 73 percent produced viable seed. This lower figure is probably due to time and manner of planting.