

# Methods of Utilizing the Male Sterile Factor in Sugar Beet Seed Production

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The information contained herein reports the experiences of West Coast Beet Seed Company in the production of seed from plantings of alternate strips of male sterile material and pollinator. Only a very small amount of the acreage of our company has been devoted to plantings in which this "strip planting" arrangement has been used. The plantings have been confined almost entirely to the production of stock seed. There are indications, however, that in the near future sizable quantities of commercial seed will be produced by this method.

In 1948 and 1949 rather large amounts of commercial seed were produced from stock seed comprised of a mixture of male sterile material and pollinator. Production by this method of planting presents no particular problem as the fields are planted and harvested in the usual manner. Proper fertilization of the male sterile seed should occur due to the frequency of pollinating plants in the row.

The production of seed in fields where the "strip planting" method is used presents a number of problems. At planting time precautions must be taken to insure that seed of each of the two strains will not become mixed in any way. The seed of each strain is planted separately in alternate strips through the field. Each planted strip is set aside from the other by an unplanted area of several feet to insure that branches of the two strains will not become entwined and cause mixing of the seed at harvest time.

In planting, we have found it advantageous to use two drills, each containing seed of the two strains to be planted. If only one drill is used, it is necessary to clean it thoroughly following the planting of each strip. The use of two drills eliminates the cleaning up process and saves a great deal of time.

Care of the seed crop during the growing season requires no different cultural practices than usual, other than keeping the unplanted areas between the strains clean cultivated.

In the Pacific Northwest, where the overhead type of irrigation is used, the strip planting arrangement offers some advantage in the irrigation of the crop. The movement of lateral sprinkler pipe across a field at a time when the seed stalks are 6 to 7 feet high, and heavily entwined, has long been one of the most difficult jobs in growing seed. These lateral lines usually are placed at 60-ft. intervals. With growers, whose irrigation systems are such that the lateral lines run with the beet row, it has been possible for us to arrange the spacing of the planted strips so that an unplanted area will occur where the sprinkler line is to be placed. The open space afforded by the unplanted area will greatly facilitate the movement and coupling of the sprinkler line.

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In harvesting the crop, the windrowing of all strips of one of the strains is completed before starting on the other. A self-propelled windrower, which cuts and windrows the seed directly over the same rows cut, keeps the windrows separated by the unplanted area. The threshing of the strips is performed in the same manner as the windrowing in that all strips of one strain are threshed before starting on the other. The seed is usually delivered to the warehouse about as fast as it is threshed so that there is very little chance that the bags will become mixed in the field. The two strains are given different lot numbers and all bags are tagged as they are threshed. Close supervision, however, is required in the harvest and delivery of seed from these fields.



Figure 1. View of field in which seed of the male-sterile variety and of the pollinator were planted at a ratio of rows, 6:1. Salem, Oreg., Mar. 24, 1949.

Probably the most important factor to be considered in the production of seed by the strip planting method is the maximum utilization of the ground area of a given field in the planting of the male sterile strain, yet have sufficient pollinator for proper crossing. The seed produced from the pollinator may or may not have much commercial value. If the pollinator is eliminated, following the flowering period, the ground area represented by it, plus the unplanted areas, amounts to a considerable portion of the field from which there is no seed production. In our agreements with growers who have produced seed by this method we have paid them for the non-producing areas of their fields on the basis of the amount of seed these areas would have produced had they been planted or harvested. This amount

is calculated by applying the average yield of seed from the area actually producing seed to the area which produced no seed. Under this method of settlement with growers, it can be seen readily that the cost of seed actually produced is increased significantly by applying to it costs incurred by the non-producing areas.

In all our field plantings to date, we have arranged the spacing so as to include a pollinator strip on the side borders of the field. We have no particular reason for doing this other than that it would appear that if the male sterile material were almost surrounded by pollinator, the chances are better for proper fertilization. The planting of both side borders, however, increases the percentage of land area in pollinator and unplanted strips with a corresponding reduction in the percentage of the land area in male sterile.

In two fields harvested in 1948 and 1949 there was a rather wide variation in the ratio of rows of pollinator to rows of male sterile. In one field of 17 acres, the planting consisted of 12-row pollinator strips and 48-row male sterile strips or a ratio of 1 : 4, not including one border. In the other field of 5 acres, 4-row pollinator strips were planted to 48-row male sterile strips indicating a ratio of 1 : 12, not including one border. The unplanted strips in both fields were 10 feet in width or the equivalent of 4 rows. In two fractional acre plots, the ratio of pollinator to male sterile was 1 : 5 in one case and 1 : 10 in the other. The separating strips in both cases were 1 row. The effect of the different ratios on the percentage of land area utilized for each of the components and the results of production are shown in Table 1.

It will be noted that the yield of male sterile seed from both the larger field plantings and the fractional acre plots is exceptionally good. The germination of the seed was higher in all instances, except one, than the over-all average germination for the year in which this seed was produced.

An item of interest which the table reveals is that where the row to row ratio is the same, as in the fields for 1950 production, the percentage of land area in male sterile increases as the size of the field increases. Likewise, the percentage of land area in pollinator increases as the size of the field decreases.

The 48-row male sterile strip has been considered by some breeders to be too wide for proper crossing. The thought in this connection is that with male sterile lines which are not completely male sterile, selfing will occur to a greater extent where the source of pollen is too far removed. The only means we have of checking this is to take samples from different locations in a male sterile strip to see whether any significant differences in germination will occur. In the field shown in Figure 1 samples were taken from windrows on each side of a male sterile strip and also from a windrow in the center of the strip. Germination of the sample from the center windrow, which was approximately 55 feet from the nearest source of pollen, was 94.75%. Germination of the samples from the windrows on each side of the male sterile strip, or approximately 12 feet from the nearest source of pollen, were, respectively, 95.25% and 93.50%. The results of this test are encouraging but probably do not prove that the germination of the seed from the center strip was not the result of selfing.

All male sterile strips in fields for 1950 production have been reduced to 24 rows. Four-row pollinating strips have been used entirely, and the separating area has been reduced to 6 feet or the equivalent of 2 rows. Under field conditions the number of pollinating rows in a strip should probably be no less than four. The tendency toward lodging and breaking off of seed stalks appears to be greater when fewer rows are planted. Although

**Table 1.**—Rate of seed production from male-sterile plants of a number of fields in which the rows of male-steriles were planted in alternation and at various ratios to the rows of the pollinator variety. Oregon 1949, 1950.

Field	Acres	Rows Per Strip			Approximate Percentage of field			M.S. Yield	Germ.
		Pollinator	Blank	Male-Sterile	Pollinator	Blank	Male-Sterile		
					Percent	Percent	Percent	Pounds	
A	17.0	12	4	48	22.2	10.6	68.2	3223	95.50
B	5.0	4	4	48	9.8	12.8	77.4	3770	87.00
C	0.1	1	1	5	12.5	25.0	62.5	4560	91.00
D	0.6	1	1	10	9.4	15.1	75.5	2338	83.00
For 1950 Production:									
E	12.0	4	2	24	13.8	12.3	73.9		
F	8.0	4	2	24	14.7	12.2	73.1		
G	1.5	4	2	24	18.2	15.2	66.6		

we have not harvested any fields where the planted strips are separated by a 6-foot area, we believe this is the minimum distance which should be used. Even at this distance some of the seed stalks will fall against each other across the unplanted area and it will be necessary to set them up in place by hand prior to the harvesting of the crop.

As far as production in the Northwest is concerned, we believe the 4-row pollinating strip and the 6-foot separating strip will become more or less fixed, but the proper width of the male sterile strips has yet to be determined for the best practical results.

#### Summary

The utilization of the male sterile factor in sugar beet seed production is relatively new. Methods of production include both the planting of a mixture of male sterile strain and pollinator, and the planting of alternate strips of male sterile strain and pollinator.

The alternate strip planting arrangement involves a number of factors which are not common to the method of planting the mixture. Precautions must be taken to insure that the planting stock of the two strains, and the resulting production, will not become mixed in any way. This is accomplished by planting the two strains separately, leaving an unplanted area between each strain. At harvest time the two strains are harvested separately.

The most important factor in the production of seed by the strip planting method is the maximum utilization of a given ground area in the production of the male sterile strain, yet have sufficient pollinator for proper fertilization. The percentage of pollinator used in fields has varied from about 9.4% to 22.2% while the percentage of male sterile has varied from about 68.2% to 77.4%. Under all distribution methods used, yields of male sterile seed seemed to be normal and the germination was average or above.

Further trials and studies will be required before the optimum ratio of the amount of pollinator to the amount of male sterile can be determined.