Single-Germ Seed

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A single-germ seedball is of obvious and immediate interest to the sugar beet industry. Mechanization of the thinning operation demands small, uniform-sized seed units, this demand having resulted in the mechanical cracking or segmenting operation. While this has greatly aided the mechanization program, it is a costly operation. The recovery of commercial segmented seed based on the original is low and there is a considerable percentage of seed units with damaged germs which are irrecoverable by any seed cleaning or screening process, the true germination of the seed being thereby proportionately reduced.

Single-germ seed units are not uncommon since there is a very great variation on most normal plants from one to many germs. Plants having a high degree of single-germness are so scarce, however, that they are almost non-existent. Perhaps this is not surprising since the single-germ seed are rather flat and as a result do not roll off the drape which has been universally used for cleaning seed from broken leaves and sticks. As a result, they have been consistently discarded with the trash. Any inherited character would tend to disappear under these conditions.

An extensive attempt made as early as 1903 by the U. S. Department of Agriculture to develop a strain of sugar beets characterized by single-germ seedballs was unsuccessful.

A most encouraging report of progress in this connection was made by M. G. Bordonos (*1*)[2] who reported the single-germ character to be "recessive" in nature and the F_1 generation to have "multilocular seedballs with a varying number of single-germ seeds among them." In F_2 he found "the number of segregated unilocular forms varies from 20 to 30 percent." He stated further that this figure included unilocular types which did not bloom the first year. Bordonos described the "unilocular" or single-germ plants as being "characterized by vigorous vegetative development and a peculiar type of seed bush," the latest maturing forms being "trotzers.'' Table 1 is taken from his paper:

The discovery of one plant having a high percentage of single-germ seedballs in some of the breeding material at Billings, Mont., by R. R. Wood in 1944 revived hopes for the existence of an hereditary single-germ character in the Great Western seed stocks. This plant (4436-13) was quite normal in appearance and time of maturity

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[2] Italic numbers in parentheses refer to literature cited.

Table 1.—Segregation of F_2 hybrids of single-germ beets by number of flowers and dates of flowering (Bordonos).

Dates of Flowering	Number of flowers per seedball (average)													
	0	1.0	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	Tot.
May 15-30	–													
June 1-15								1						1
June 15-30		11	4	13	101	331	65	64	28	22	2	4	4	649
July 1-15	--	89	1	1	41	150	30	27	3	11	–	2	–	349
July 15-30	--	49	–	–	1	2	2	1	1	--	2	–	–	58
Aug. 1-15	--	17				1								18
Aug. 15-30		1												1
Sterile	100													100
"Protzers"	39													39

except that the seedballs were 70 percent single, 29.9 percent double, and 0.1 percent triple in germ or locule units. It occurred in an open-pollinated breeding group, the seed in all probability having resulted from pollination with many (164 roots in group) apparently normal plants. Single-germ seed units from this plant were planted in the greenhouse under artificial lights in December 1944. The F_1 plants, which were allowed to sib-pollinate, had mostly double-flower clusters[3] and consequently double-germ seedballs. The seed was harvested in time to plant to the field in April 1945. An unselected lot of 405 F_2 roots was planted in the greenhouse November 9, 1945. Some 386 of these F_2 individuals reached the early inflorescence stage. at which time they were indexed for flower-cluster condition, the data[4] for which are presented by dates of indexing in table 2.

While there are some vegetative types of plants in the population, the two single-flowered plants are quite normal in appearance and there does not appear to be any correlation of the vegetative condition with the number of flowers in the cluster, such as was reported by Bordonos. It appears doubtful from this segregation if the single-germ character can possibly be a simple recessive in inheritance; there would, however, seem to be little doubt that it is hereditary in nature.

Further encouragement regarding the hereditary basis for the single-germ character was occasioned by the discovery in 1945 at Longmont, Colo., of one inbred line (selfed one generation) with four

[3]After this report was written another population came into seedstalk in the Longmont greenhouse under apparently more favorable growing conditions, the plants being very vigorous, and there appears to be a greater tendency for multiple-germness than was evident on the plants grown in the same house the previous winter.

[4] The data included in this table were completed after the original report was prepared and delivered to the Society meetings. •

Table 2.

Date 1946	Singles*	Doubles**	Triples (Percentage) 25	50	75	100	Quadruples (Percentage) 25	50	75	Tot.
1-25	1	53	8	12	25	22	1	2	2	121
2- 1	1	41	2	11	14	5	2	0	0	76
2- 5	0	27	3	4	10	6	4	2	0	56
2-11	0	34	0	5	6	8	2	1	1	57
2-18	0	11	2	3	0	0	0	1	1	18
2-21	0	5	3	2	2	3	1	1	0	17
2-27	0	12	1	3	3	4	0	1	0	24
3- 6	0	7	4	2	1	2	1	0	0	17
Total	2	190	18	42	61	50	11	8	4	386

*Estimated at not less than 75 percent single-flowered.
**Estimated at not less than 90 percent of double-flowered clusters on any plant so indexed.

plants, each of which matured single-, double- and triple-seed units as follows:

Root No.	Percentage singles	Percentage doubles	Percentage triples
4538-489	87.2	12.4	0.4
-487	63.1	36.9	0
-490	18.0	80.4	1.4
-488	7.0	86.2	6.8

These four plaids were quite normal in appearance and they seem to provide excellent material for a study of both the single-germ and double-germ characters.

The highly double-germ condition of the F_1 generation (see footnote 4) from plant No. 4436-13 and also the double-germ sister plants 4538-490 and 4538-488 indicated the possibility of this condition being associated with segregation for single-germness. In a careful study of some 5,180 growing plants at Longmont and 7,940 plants at Billings in 1945, just 3 at Longmont and 4 at Billings were found which matured only single- and double-germ seedballs. The seed from these plants varied from 8.0 percent to 30.8 percent, singles and from 69.2 percent to 92.0 percent doubles. An additional 18 plants were recorded in the field at Longmont out of 5,180 studied as "mostly doubles," the seed on these varying from 2.6 percent to 23.8 percent singles, 75.8 percent to 94.8 percent doubles, and 0.2 percent to 3.2 percent triples.

The purpose of this paper is to report what appears to be some significant progress toward the isolation of an hereditary single-germ character. The five single-germ plants so far obtained vary

some toward double-germ units ; perhaps as much as 15 to 30 percent double-germness may be expected. The results would suggest the possibility of the single-germ character being a recessive with perhaps three genes being involved, and the double-germ condition being an intermediate in the segregation for single- and multiple-germ characters. Such hypotheses at this time are intended only to be of some possible assistance in further searches for the single-germ character in the sugar beet.

Literature Cited

1. Bordonos, M. G. Unilocular Types of Sugar Beets. Proc. Lenin All-Union Acad. Agr. Sci. U.S.S.R. 11: 3-4. 1941. (In Russian Translation by Eugenia Artschwager. On file at Bureau *oi* PI. Ind. Library, U.S.D.A.).