Beta Macrorhiza Stev.

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There is record of only one introduction of *Beta macrorhiza* Stev. to the United States prior to World War II. G. H. Coons (1)[2] reports that he received a sample of seed in 1936 from N. E. Vavilov, the famous Russian plant breeder. Plants were grown in the USDA greenhouse in 1937 and 1938, but this accession of *B. macrorhiza* failed to flower and was subsequently lost when the research work of the Sugar Plants Section of the USDA was transferred to Beltsville, Maryland.

Transfer of germ plasm to sugar beets from the section *Corollinae* Tr. of the genus *Beta* has not been successful using *B. lomatogona* F. & M.[3], *B. intermedia* Bunge or *B. trigyna* W. & K. (2). Apparently there is little homology of the chromosomes of species of *Corollinae* with the chromosomes of *B. vulgaris*; F_1 hybrids between them are highly sterile. Progeny resulting from backcrossing are of two classes: (a) those which resemble the recurrent parent and are fertile; and (b) those which are intermediate morphologically and sterile (2). This backcross behavior indicates, most probably, that the only viable gametes are ones containing a complete set of chromosomes from one or the other of the parental species.

There are no direct reports or descriptions of hybrids between *B. macrorhiza* and sugar beets. Zossimovitch (3) refers to such hybrids and indicates that their genetic behavior confirms his belief that *B. macrorhiza* of the *Corollinae* species is phylogenetically most closely related to *B. vulgaris*. This information indicates that if germ plasm of a *Corollinae* species is to be transferred to *B. vulgaris*, hybrids with the diploid ($2n = 18$) *B. macrorhiza* should offer the best chance of success.

Unsuccessful attempts to transfer germ plasm from *B. trigyna*, *B. lomatogoma* and *B. intermedia* prompted a search by plant breeders of Great Western Sugar Company for an accession of *B. macrorhiza*. In April, 1956, the Great Western Sugar Company received a few seeds of an accession of seed from the USDA which was indicated to be *B. macrorhiza*. These seeds came from Russia through Dr. Henrik Bögh of Bøgrkoy, Denmark. Plants grown from this seed did not resemble the taxonomic description of

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[2] Numbers in parentheses refer to literature cited.

[3] Personal communication from Dr. Helen Savitsky, USDA, Salinas, Calif.

B. macrorhiza, and after Dr. Gerald Coe[4] of the USDA indicated the plants had 36 chromosomes, further study of this accession was discontinued.

In March 1957, H. E. Brewbaker[5] wrote to the Director of the Tiflis Botanical Gardens, U.S.S.R., requesting seed of *B. macrorhiza.* The reply (in Russian) indicated that the species was not cultivated there.

The reply to another contact in June, 1957, to The Sugar Research Station at Keiv, U.S.S.R., requesting *B. macrorhiza,* (in English) from Dr. I. A. Sizov, Director of the Institute of Plant Industry, Leningrad, indicated that seed was being sent. Fifty grams of seed was subsequently received in December of that year. Translation of the shipping slip (in Russian) indicated that this race of *B. macrorhiza* had been originally collected in the region of the Karhas Mountains. (In the letter of transmittal, Dr. Sizov indicated they would be glad to receive seed of the *Patellares* species; seed of the three *Patellares* species was subsequently sent to Russia via diplomatic channels.) Small quantities of the *B. macrorhiza* seed were distributed to sugar beet breeders throughout the United States.

The seed was large, very horny and had the characteristics of the taxonomic description. Plants were grown from the seed, but it was soon evident that the parental plants had been badly outcrossed with other species; however, a few seedlings were typical of the description given for *B. macrorhiza.* The leaves are large, broad and obtusely ovate with the heartshaped base and the lobes curved upward. The left plant of Figure 2 is characteristic. The petioles in the center of the rosette are intensely red.

Plants were grown in pots in the greenhouse continuously from the fall of 1957 through the winter of 1958-59. The plants remained vegetative although conditions at times were proper for vernalization of *B. vulgaris.* Remnant seed from the USDA accession from Denmark was germinated and a few plants typical of *B. macrorhiza* were selected. All plants suspected of being *B. macrorhiza* and others were transplanted out of doors in the summer of 1959. In January 1960, the plants were chopped from the icy soil and were forced, in pots, in the greenhouse.

The plants flowered and the identity of the pure species was confirmed. After the pure species was positively identified, it

[4] Personal communication from Dr. Gerald Coe, USDA, Beltsville, Md.

[5] Former director of the Great Western Sugar Company Agricultural Experiment Station, Longmont, Colo.

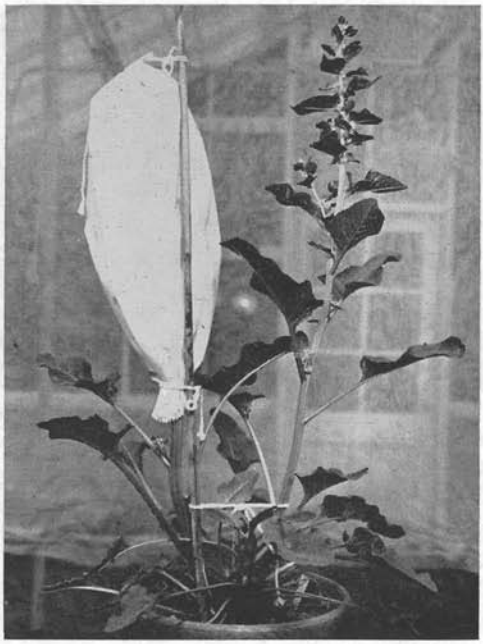

Figure 1.—A typical *Beta macrorhiza* plant in flower, growing in an 8-inch pot.

was obvious that *B. macrorhiza* would not easily be mistaken for other *Corollinae* species at any stage of development. Only the typical plants (see Figure 1) were fertile. Reciprocal pollinations were made between sugar beets and *B. macrorhiza* by introducing pollen into bags covering the flowering branches. Many seeds were harvested from mother plants of both species. A few seedlings were produced by the seeds from sugar beet but these were subsequently proven to have resulted from selfing. Scarification of seedballs from *B. macrorhiza* with a razor blade revealed that few embryos developed to normal seeds. The few plants produced had resulted from self-pollination.

Zossimovitch stated the roots of *B. macrorhiza* were white and not red as observed by Stevens in his original description. To check the descriptions, several seedlings which had resulted from sib or self-pollination were sacrificed and the pencil sized roots were split longitudinally. The roots are very dark pink fleshed from the crown down about two inches where there is an abrupt transition to white.

The *B. macrorhiza* plants were again transplanted out-of-doors and were brought back to the greenhouse in January 1962. To allow freer pollination, four individual plants of *B.*

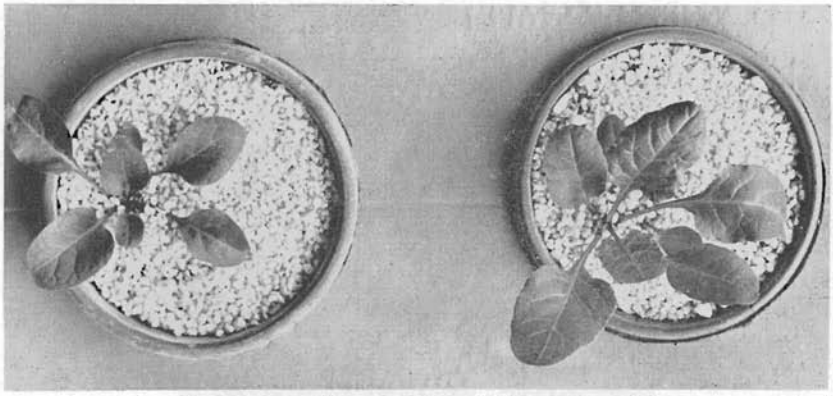

Figure 2.—*Beta macrorhiza* seedling, left, and seedling suspected of being a *B. macrorhiza* × sugar beet hybrid, right, both 4 months old and growing in 6-inch pots.

macrorhiza in flower were placed in four different greenhouses in which sugar beet plants were blooming. Seed was collected from each wild plant individually. After the seed was scarified, about 30 plants resulted, of which only one may be a hybrid (right pot, Figure 2).

The one seedling suspected of being a hybrid was not originally thrifty but became more vigorous with age. At four months it resembled a sugar beet plant grown under the same conditions. However, the leaves of the hybrid were shorter and perhaps thicker and much lighter green than the *B. macrorhiza* plants the same age.

Hybridization between *B. macrorhiza* and *B. vulgaris* appears difficult. It remains to be seen if germ plasm can be transferred to sugar beets even after hybrids are produced.

Summary

Seed of *Beta macrorhiza* was received directly from Russia by The Great Western Sugar Company. After a number of attempts at hybridization, only one plant was produced which is suspected of being a hybrid.

Literature Cited

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(3) ZOSSIMOVITCH, V. P. 1940. Wild species and origin of cultivated beets, p. 17-44. *In* Biology, Genetics and Selection of Sugar Beets, All-Union Scientific Institute of the Sugar Industry, Vol. 1, 918 p. Keiv, U.S.S.R., translation.