

# Viabie Interspecific Hybrids Between Wild Species In the Section *Vulgares* and Species in the Section *Patellares* in the Genus *Beta*

R. K. OLDEMEYER<sup>1</sup>

The species in the section *Patellares* Transch. (2) " of the genus *Beta*\* possess several characters of great economic importance if they could be incorporated into sugar beet varieties. The species of this section, *B. patellars*, *B. procumbens* and *B. webbiana*, are all single germ, and highly resistant, if not immune, to sugar beet nematode, *Cercospora* leaf spot and curly top virus (1). All attempts to hybridize these species with the sugar beet have ended in failure with one exception because of the inviability of the F<sub>2</sub> hybrid seedling. Stewart (1) has discussed the problem of the inviability of sugar beet x *Patellares* hybrids fully and described one viable hybrid which was lost in subsequent generations.

This investigation was initiated to determine whether viable hybrids could be obtained between species in *Patellares* and wild forms of the section *Vulgares* Transch. which are cross compatible with sugar beet. If such hybrids could be produced, perhaps the transfer of the valuable germ plasm from the *Patellares* could be accomplished by crossing the hybrid with sugar beets. The possible use of bridge hybrids for the transfer of *Patellares* germ plasm to sugar beets is not a new idea. Gaskil<sup>2</sup> obtained a viable Swiss chard x *Patellares* hybrid in 1945, but its descendants were lost in succeeding generations.

## Materials and Methods

The material from the section *Vulgares* used in hybridization included two accessions of *B. macrocarpa*, three of *B. maritima*, one of *B. atriplicifolia* and one of a tetraploid sugar beet. One accession of *B. webbiana*, two of *B. procumbens* and two of *B. patellaris* were included in the *Patellares* material used. The parental material was obtained from the U. S. Department of Agriculture with the exception of two accessions of *B. maritima*—one from Israel, and one from the Imperial Valley in California—and the tetraploid Kleinwanzleben sugar beet from Germany.

Plants from the section *Vulgares* were used as pistillate parents and from the section *Patellares* as staminate parents in all matings. Crosses involved nearly all *Vulgares* accessions with all *Patellares* accessions.

All the *Vulgares* accessions were considered to be diploid ( $2n = 18$ ) with the exception of the tetraploid sugar beet ( $2n = 36$ ). Recent investigation by Helen Savitsky<sup>3</sup> indicates that *B. webbiana* and *B. procumbens* are diploid ( $2n = 18$ ) and *B. patellaris* is tetraploid ( $2n = 36$ ).

<sup>1</sup> Plant Breeder, Agricultural Experiment Station, The Great Western Sugar Company, Longmont, Colorado.

<sup>2</sup> Numbers in parentheses refer to literature cited.

<sup>3</sup> Coons, G. H., has chosen to call this section *Procumbentes* Ulbrich. Proc. Amer. Soc. Sugar Beet Tech., 1938, 74-76.

<sup>4</sup> Gaskil, John G., personal communication.

<sup>5</sup> Unpublished data. Collaborator, Division of Sugar Plant Investigations, U. S. Department of Agriculture in cooperation with the Beet Sugar Development Foundation, Salt Lake City, Utah.

Eight to ten flowers from each of the branches of plants to be used as pistillate parents were emasculated prior to anthesis by rolling the immature anthers from the bud with a sharp instrument. The branches with their emasculated flowers, after being washed with water, were enclosed in a small paper bag to prevent unwanted pollination. At the time the bracts of the flowers opened and the stigmas had become enlarged, pollen collected from several plants of a species in *Patellares* was applied to the stigma of the emasculated flowers with a clean camel's hair brush. At least one and in many cases five or six crosses were made for each mating.

The mature seed was scarified by shaving the pericarp of the seed with a razor blade until the germ was exposed. The seed was then germinated in a germination cabinet and transplanted to pots as it sprouted.

#### Results

No seeds were obtained from matings involving *B. patellaris* except when it was mated with tetraploid sugar beet. Only inviable hybrids grew from these seeds, however. Matings involving one accession of *B. maritima* and one accession of *B. macrocarpa* with *Patellares* species produced no viable seeds. The crosses of tetraploid sugar beet x *B. procumbens* and *B. webbiana* also resulted in no viable seed.

Eight relatively viable hybrids were obtained.

No. of Hybrid Plants	Mating
3	<i>B. macrocarpa</i> x <i>B. webbiana</i>
2	<i>B. macrocarpa</i> x <i>B. procumbens</i>
1	California dwarf wild ( <i>B. maritima</i> ) x <i>B. procumbens</i>
1	<i>B. atriplicifolia</i> x <i>B. procumbens</i>
1	<i>B. atriplicifolia</i> x <i>B. webbiana</i>

In addition to the viable hybrid plants produced from the above matings, other hybrid plants which died before secondary branching occurred, as described by Stewart (1), were produced from the same matings.

One hybrid plant from the mating, *B. macrocarpa* x *B. webbiana*, was extremely vigorous (Figure 1). The growth habit of this plant was intermediate between the parents. The flowers were borne in clusters of three or four similar to *B. macrocarpa*. Nearly all the stamens were vestigial, being composed of a filament only and rarely bearing anther sacs which when present were devoid of pollen. The embryo sacs of all flowers examined were brown and necrotic at the time of flowering. The stigmas appeared normal. No flowers showed ovary stimulation when the plant was exposed to sugar beet pollen.

Another hybrid which flowered from the mating California dwarf (*B. maritima*) x *B. procumbens* had normal stamens but the anther sacs were devoid of pollen. The embryo sac appeared normal at the time of flowering. This plant died from root rot shortly after it began flowering.

Another hybrid, *B. atriplicifolia* x *B. procumbens*, will flower; there is little chance that the other hybrids, listed above, will flower although they continue to grow slowly (Figure 2).



Figure 1.—Extremely vigorous *B. macrocarpa* x *B. webbiana* hybrid growing in a 12-inch pot.

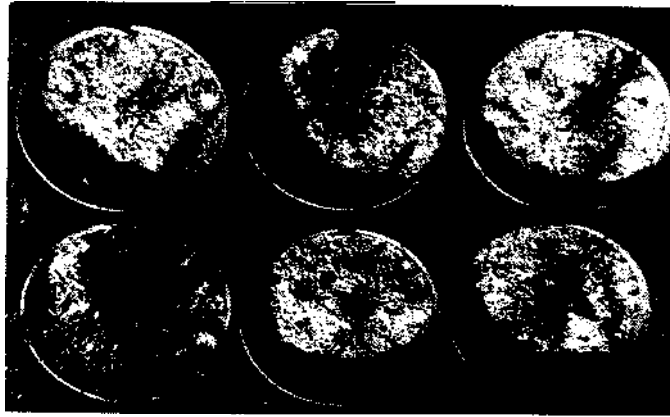


Figure 2.—Six-month-old *Vulgares* x *Patellares* hybrids in 8-inch pots. Top, left to right, *B. atriplicifolia* x *B. procumbens*, *B. atriplicifolia* x *B. webbiana* and *B. macrocarpa* x *B. webbiana*. Bottom, three *B. macrocarpa* x *B. procumbens* hybrids.

## Discussion and Conclusions

Viable hybrids of some strains of some species in the section *Vulgates* with *B. ivebbiana* and *B. procumbens* in the section *Patellares* can be produced. The production of fertile progeny from the mating of such hybrids with the sugar beet is the next step in the transfer of valuable characters from *Patellares* to sugar beet. It should be possible to develop basic breeding material having the desirable characters from *Patellares* following the segregation and recombination of genes in the progeny of such hybrids crossed to sugar beet.

The production of bridge hybrids should be confined to diploid ( $2n = 18$ ) species inasmuch as the introduction of triploidy sterility would only add to the sterility problem already present due to interspecific crosses.

## Summary

Matings of some strains of several species in the section *Vulgares* with species in the section *Patellares* were made. A failure of some matings resulted from embryo abortion, lack of fertilization and inviability of the F1 hybrid seedling. Viable hybrid plants resulted from the matings of *B. procumbens* and *B. ivebbiana* with *B. airiplicifolia*, California dwarf wild (*B. rnaritima*) and one accession of *B. macrocarpa*.

One hybrid plant, *B. macrocarpa* x *B. webbiana*, was extremely vigorous. Its growth habit was intermediate between the parents, but the flowers were borne in groups of three, four, or five, similar to *B. macrocarpa*. The flowers of this plant were not functional. Another hybrid plant, California dwarf wild x *B. procumbens*, died shortly after it began flowering. A *B. airiplicifolia* x *B. procumbens* hybrid will flower; others will probably die before flowering.

## Literature Cited

- (1) STEWART, DEWEY.  
1950. Sugar beet x *Beta procumbens*, the F<sub>1</sub> and backcross generations. Proc. Amer. Soc. Sugar Beet Tech. 176-179.
  - (2) ZOSSIMOVICH, V. P.  
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