

The Wild Species of Beta

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The increased interest in the wild species of Beta as a source of new genes for improvement of the cultivated beet and the availability of seed of many of these forms for use by plant breeders make it desirable to supply a roster of the species arranged to show their natural affinities (Table 1). Some comments on the various species also are made.

Transchel (4) in 1927 established three sections for the genus Beta. Ulbrich (5) seven years later assigned the species to four sections, amending two of Transchel's, accepting one (Coroilineae), and establishing a new one, "Nanae," for *B. nana*. Ulbrich changed Transchel's section Patellares to Procumbentes and placed *B. atriplicijolia* within this group, clearly an error. Accordingly, in the arrangement of the genus proposed here, Ulbrich's classification is followed in large part but Transchel's clearly defined and valid section Patellares is restored.

The natural distribution of the sections and species of Beta indicates the probable centers of origin. The section Vulgares centers in the eastern Mediterranean region with *B. maritima* occurring in Asia Minor, in the central and outer Asiatic steppes and desert areas and extending eastward to outer India. From the Mediterranean area it extends westward to the Cape Verde and Canary Islands and northward along the Atlantic Coast to the North Sea. It occurs in the Channel Islands and along the coasts of England, Scotland and Ireland.

Other wild species of this section have a more restricted distribution within this broad area. The section Coroilineae centers in Asia Minor, its species extending eastward to Iran and westward to eastern Europe. The section Nanae represented by one species is known only from the mountain heights of Greece; especially Mt. Olympus, Mt. Parnassus and Mt. Taygetus. The section Patellares occurs only in the western and outer Mediterranean region and on the Cape Verde, Canary, Salvage and Madeira Islands. *B. patellaris* occurs over this entire region, whereas *B. procumbens* and *B. webbiana* are restricted to the Canary Islands, the latter having been collected only from Las Palmas and Fuerteventura Islands.

Usually the Beta species occur where their salt tolerance and ability to withstand drought give them some advantage over the competitive species. Some of the species occur only sparsely and away from cultivated areas, whereas a few species are more or less troublesome weeds. *Beta maritima* is usually restricted along the Atlantic sea coast to the zone where the salt spray reaches. It occurs as a weed in the salt marshes in Portugal and southern France. Zossimovitch (6) reports it as occurring as a weed in the steppes of USSR, especially in depressions where alkali and salt content is high. *B. patellaris* Moq. was found as a weed in one small garden patch in the Canary Islands, but it usually occurs sparsely among the rocks near the sea shore. *B. atriplicijolia* was found in cultivated fields in southern Spain and was reported to be a troublesome weed.

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- Numbers in parentheses refer to literature cited.

Table 1.—Species of *Beta*.

I. Vulgares	II. Corollinae	III. Nanae	IV. Patellares
<i>vulgaris</i> L.	<i>macrorhiza</i> Stev.	<i>nana</i> Boiss. et Held.	<i>patellaris</i> Moq.
<i>maritima</i> L.	<i>trigyna</i> Wald. et Kit.		<i>procumbens</i> Chr. Sm.
<i>macrocarpa</i> Guss.	<i>foliosa</i> Hausskn.		<i>webbiana</i> Moq.
<i>patula</i> Ait.	<i>lornatogona</i> Fisch. et Mey		
<i>atriplicifolia</i> Rouy			

In Turkey, *B. lornatogona* and *B. trigyna* occurred in wheat fields and occasionally as roadside plants. It is reported that farmers scatter the seeds in the wheat fields to provide themselves with a spring salad plant. Once introduced, the species undoubtedly would persist in the small parcels of land where only wheat is grown, and whose cultivation is only a shallow stirring of the soil. Zossimovitch (6) states that *B. macrorhiza* is commonly found close to villages and that its leaves are prized as a source of food.

The other species of the genus as seen by the writer occur sparsely in such habitats as crevices in rocks, or rather sterile and rather dry soils where competition of grasses and other plants is not serious.

Vulgares

This section of the genus is best known to sugar beet breeders because of the greater attention that has been given in the past to the close allies of the cultivated beet, especially to the sea beet, *Beta maritima*. The other species of this section, *Beta patula*, *B. macrocarpa* and *Beta atriplicifolia*, have also been subjects of study and have been used to some extent in hybridizations.

The type species of the genus *Beta* is *B. vulgaris* L. In his *Species Plantarum*, Ed. I, p. 222 (1753), Linnaeus named only this species. Under it, as varieties, he listed *perennis*, *rubra*, and *cicla*, to which were assigned the nine forms of *Beta* that the old botanist Caspar Bauhin had recognized. Linnaeus makes his variety "*perennis*" synonymous with Bauhin's *B. sylvestris maritima*. As their names would indicate, the other varietal names apply to cultivated forms of beet.

The binomial *B. maritima* was first used by Linnaeus in 1763 in the second edition of *Species Plantarum*, Volume I, page 322. Here Linnaeus clearly gives *B. maritima* specific rank along with *B. vulgaris* and shows *B. sylvestris* as a synonym. The varietal name *perennis* disappears.

There has been a tendency to consider *B. maritima* L. as simply a form of *B. vulgaris* or that *B. vulgaris* was the cultivated form derived from the sea beet. The thick leaves, sprangled roots with the laterals arising at right angles to the tap root, distinctive growth habit and numerous other characters of *B. maritima* are as distinctive as those characters by which other members of the section are separated as species from *vulgaris*. No useful purpose seems to be served by classing *B. maritima* as a variety or subspecies of *B. vulgaris* unless all the other members of this section are similarly classed as subspecies.

The species of the Vulgares section all hybridize readily with the cultivated forms of beet and some of them with each other. The latter has made

it difficult to obtain and maintain certain species entirely pure. Thus seed of *B. patula* Ait. was collected on Madeira Island in 1935 and plants were grown in the greenhouse. The seed stocks soon became contaminated by outcrossing, especially with *B. maritima*, and new collections from the Madeira Islands are needed. *Beta patula* is an annual or perennial form known only from Madeira Islands and is characterized by its sessile, strap-like leaves.

B. macrocarpa Guss. is an annual form characterized by its extremely large seed balls. This species also apparently hybridizes readily with *B. maritima*. Its distribution is along the Mediterranean coastline and on the Canary Islands. In Spain it was found growing in close proximity with *B. atriplicifolia* but seemed to be entirely pure probably due to differences in the periods of flowering of the two species.

B. atriplicifolia Rouy is a perennial species which is certainly distinct from any others of this section. It is characterized by its small size, its graceful growth habit, its linear-lanceolate leaves and its long spindle-shaped root free from sprangles. The plants have striking red coloration, often shown as streaks on the seed stalk. The stem is not always triangular in cross section as stated. *B. atriplicifolia* was collected by the writer in 1935 and again in 1951 in southern Spain. It occurs there as a weed in the fields. This species has been hybridized with the sugar beet but, so far, does not seem to have conferred any particularly desirable characters.

Corollinae

The species assigned to this section seem to form a good natural group. The characteristic development of a corolla-like perianth makes the flower spikes rather conspicuous.

B. macrorrhiza Stev., a characteristic species of this section, was obtained from USSR through the courtesy of N. I. Vavilov in 1936 and was grown in the Arlington greenhouse in 1937 and 1938. The plants were characterized by their very coarse, heavy veined leaves resembling in texture *B. trigyna* more than any other type. The leaves were obtuse at their apices. None of the plants as grown in the greenhouse produced flower stalks. Under inoculation they were shown to be susceptible to both *Cercospora beticola* and to curly top. During the removal of research work on sugar beets from Arlington Farm, Va., to Beltsville, Md., the stocks were lost; when attempt was made to grow the plants from seed, it was found that the seed remnant had lost its viability. It has not been possible to obtain additional material from the USSR.

The writer's recollection is very clear respecting the very large seed balls of this species. Many were very much larger than any of the seed-balls of sugar beet. The glomerule was globose and multigerm. Some seed balls had at least eight or more true seeds.

Our best information about the plant material as furnished to us by Vavilov comes from Zossimovitch (6) who collected the species in the Caucasus Mountains. He states that the species is characterized by large obtuse ovate leaves. These are obtuse at the tip and have a cordate base. The leaves are dark blue green, without wax, and their petioles are short.

The stem leaves are extremely large and those near the apex are either blunt or pointed. The flowers are of a normal type for this section, loosely grouped, several to a cluster. The lobes of the perianth are white and terminate in a hood. The flowers grow to form a seed ball which is very large, having six to eight true seeds, especially those seed balls located at the base of the lower branches. Zossimovitch stresses that flower bracts are large, up to three centimeters in length, the size and shape of the bracts as well as the large size of the stem leaves, giving plants a peculiar appearance.

This description is strikingly at variance with the terse one given by Stevens which characterizes the plant as a perennial with fusiform, multi-crown roots having red flesh; prostrate stems; ovate leaves, mostly obtuse; top most leaves sub-rotund; simple spikes, leafless at top, and with flowers occurring in three's. Zossimovitch states that the red flesh mentioned by Steven must be in error for no such roots were found in his collections in the Caucasus. He further states that he has verified Transhel's studies of plants of *B. foliosa* from Armenia in which Transhel stated that *B. foliosa* of Haussknecht was in fact *B. rncrorrhiza*. Aellen's (1) description of the species *B. rncrorrhiza* was apparently based on *B. foliosa* material available to him and does not fit Zossimovitch's description. This nomenclatorial tangle can best be resolved when our collections of *B. foliosa* can be compared with authentic *B. rncrorrhiza* material. We hope such may be made possible by collections of *B. rncrorrhiza* in either eastern Turkey or in Iran.

B. foliosa Hausskn. is known chiefly from the original collections made at Salachlu near Egin, Turkey, a place which on modern Turkish maps is Salihli near Kemalye. Scheibe (3) stated that he had found *B. foliosa* near Erzinjan, Turkey, at an altitude of 2,020 meters above sea level. As stated, the description given by Aellen may largely have been drawn from Hauss-knecht's collections. Aellen accepting Transhel's statement that *B. foliosa* and *B. rncrorrhiza* are the same species.

The writer visited the place of Haussknecht's type collection and found plants which certainly were not in accordance with *B. rncrorrhiza* as grown from the Russian material sent us in 1936 or the same as Zossimovitch's description. Hence the name *B. foliosa* is retained to refer to these par-ticular collections pending additional studies. No botanical description of the species has as yet been published.

B. lomatogona Fisch. et Mey. is characterized by its single-germed seed-ball and a leaf shape and growth habit which are distinctly different from those of *B. trigyna*. The species occurs in abundance in Asia Minor and probably eastward. A number of collections were made of this species in Turkey where it occurs as a common weed in wheat fields, usually along with *B. trigyna*.

B. trigyna Wald. et Kit. was first collected in Hungary near the western-most points of distribution of the species. The form which was found is believed to have been of the hexaploid type with 54 chromosomes. The distribution of the species, according to Aellen, is around the Black Sea with a center of distribution in Turkish and Russian Armenia and Georgia. It also occurs around the Caspian Sea and in Persia. Collections have been

made in Crimea and southern Ukraine. The species radiates eastward toward Hungary, Roumania, Slavonia and elsewhere in the Balkan area, Macedonia, and eastern and western Thrace.

Zossimovitch has proposed that the name "trigyna" be restricted to the hexaploid form as found in Hungary and the Crimea and that the tetra-ploid form ($2n = 36$ chromosomes) be named *B. corolliflora*. No good purpose is served by such a separation within this species.

B. intermedia as proposed by Bunge and described by Boissier is not accepted as a species. Many botanists have questioned whether this group differed from *B. trigyna* enough to warrant specific rank. There has also been speculation that *B. intermedia* represents a cross or a segregation from a cross between *B. trigyna* and *B. lomatogona*. Zossimovitch in 1934 (6) considered "intermedia" a sub-species of *B. lomatogona*, apparently ignoring the single seed character in *B. lomatogona* and the multigerm seed character in *B. intermedia*. The only positive differentiating character from *B. trigyna* is the ovate shape of the basal rosette leaves. These are reported as cordate at the base and as having long thin petioles. Later Zossimovitch (7) considered *B. intermedia* should be retained as a separate species.

Many collections were made in Turkey of Beta forms in which the basal rosette leaves were oval rather than pointed; these resembled *B. trigyna* far more than *B. lomatogona* and would seem to fall within the general range of variation of *B. trigyna*.

Nanae

This section is represented by the single alpine species, *B. nana*. The plants of this species are small, seldom having a rosette of leaves more than 4 inches broad. The solitary flowers occur in axils of small orbicular bracts of the unbranched prostrate fruiting stem. The flowers are single and the seed is single-germed, hard and nut-like. Collections were made in 1951 on Mt. Parnassus from two separate sites. Living roots were brought to the United States. These flowered in the greenhouse, but the seed produced was not viable. The plants proved very susceptible to *Cercospora beticola*. The reactions of the species to curly top and virus yellows have not been determined.

Patellares

This section forms a very clearly defined group characterized by its viny growth habit and single-germed, nut-like seeds. It may prove an extremely valuable source of desirable genes for beet improvement since none of the species of this section shows spots when exposed to heavy *Cercospora* infection, and these species have not shown signs of curly top when inoculated by means of viruliferous beet leaf hoppers. *B. patellaris* is susceptible to virus yellows, as was pointed out to me in the Netherlands by H. Riet-berg and J. A. Hijner. Abundant seed of *B. patellaris* should be available in 1954.

Studies of the Beta collections of various herbaria in the United States showed that this species (campanulate seed type) had been introduced in the United States with rock ballast from ships probably some time before 1870. The species apparently established itself and spread to a slight extent

from the points of introduction. Isaac Burk, a Philadelphia botanist, collected it in October, 1872, and in 1874 at Kaighns Point near Camden, New Jersey, and across the Delaware River at Girard Point, near Philadelphia, Pennsylvania. Burk reported the collection as "*Tetragonia* sp." in 1877 (2). Isaac C. Martindale also collected it near Camden in September, 1879. Attempts by the writer to find the plant in 1953 at the places of the old collections were unsuccessful, too many changes having taken place in the wharf area along the Delaware River.

B. procumbens Chr. Sm. and *B. webbiana* Moq. are interesting species. They are very restricted in their distribution and very distinctive in appearance. They have been grown in close proximity in greenhouses since 1925, and no intergrades or indications of hybridization have been observed, nor has there been any indication of hybridization with *B. paiellaris*.

Summary An arrangement of 13 species of the genus *Beta* into four major groups is suggested. Three of the sections, *Vulgares*, *Corollinae*, and *Patellares*, were originally proposed by Transchel. The fourth group, *Nanae*, was proposed by Ulbrich for the alpine form, *Beta nana*. This arrangement seems to put related species together and conforms well with the distribution areas of the species. Brief comment is given concerning the individual species.

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