

that the material represents only a very limited range of the biotypes of any species. Negative results from crosses, or failure to find desired characters, does not mean that the possibilities are exhausted. The evidence now at hand could be interpreted to mean that hybridizations between groups may be obtained as more extensive collections are employed.

What in the way of improvement in sugar beets may come from utilization of wild forms as a source of new genes is, of course, unpredictable. Immunity to curly top, to leaf spot, and resistance to draught and cold, and other highly desirable characters are shown by certain wild species. The utilization of these factors depends upon research which will develop methods for bringing them into the B. vulgaris complex. With other crop plants, recourse to new genes has been a fruitful technique. It is not too optimistic to believe such may be the case with the wild species of Beta.

SOME OBSERVATIONS ON WILD BEETS (BETA MARITIMA)

H. W. Dahlberg, Great Western Sugar Co.

For the purpose of discussion I shall use two main groups, as follows, to describe Beta Maritima:

1. Mediterranean
2. Atlantic (often called Beta Maritima Atlantica)
 - a. North Sea Type

The Mediterranean group contains many types which are either annuals or have a great tendency to bolt the first year. The plants are small, lower in sugar than the Atlantic type, very much sprangled as to root shape, and have a very high percentage of deep red or pink hypocotyls. A great many of them have multiple crowns. Some have a considerable redness factor in the seed balls before they mature.

Munerati, in Italy, has probably made a more thorough study of the Mediterranean types than any other plant breeder. I therefore think it would be well to include in this paper the following conclusions which he has made:

"THE CROSSING OF CULTIVATED BEETS WITH THE TYPE GROWING WILD ALONG THE COAST OF THE ADRIATIC"

"Observations for 20 years at the R. Experiment Station at Rovigo have permitted some conclusions which are judged to be definite.

1. It must be noted at first that the beets growing spontaneously along the coast of the Adriatic (around the mouth of the Po) comprise a population from which there have readily been separated several tens of bio-types having external characteristics, fixed and transmissible. (Some of these bio-types differ greatly from those which are separable among the cultivated varieties.)

2. Direct examination of the said wild forms has permitted the verification of the fact that a certain number of individuals, more or less noticeable depending on the year, are biennials (either actually, or due to a

tardy germination of the seed). This fact repeats itself with absolute parallelism when the wild type is placed under controlled cultivation. It is this subject of biennial equilibrium which we have set apart for our work.

3. In the first attempts at crossing with cultivated beets we have purposely chosen, among the wild types, the individuals of hereditary characteristics well fixed by selection, and the results have appeared directly so encouraging that we were induced to resolutely repeat the work with the aid of the most abundant material possible.

4. Among the many singular results immediately brought about by the crossing must be noted the great expansion and vigor of the aerial parts (demonstrated by us and also by Mm. Saillard and Villmorin). At the same time the leaves of the greater number of strains possessed a distinct resistance to drought and to two diseases (disease of the heart and *Cercospora* (leaf spot) which, in that region, very often attack beets during the autumn. In certain years of heavy attack by *Cercospora*, there has been recorded 4-5% more sugar in the crossed lines than in the ordinary beets cultivated under the same conditions.

5. In opposition to this important fact of heterosis must nevertheless be noted the characteristics of an absolutely undesirable top root, causing a tendency to the rooty type and to other characteristics peculiar to the wild beet.

6. The succeeding work of selection in the attempt to eliminate as far as possible the individuals having the characteristics of the wild type, showed that when the form of the root was improved there was a simultaneous decrease in the vigor and growth of the leaves, as if there existed a repulsion of antagonism between these two characters.

7. Among the large number (several thousands) of strains studied during 12 years, we have succeeded in separating and establishing lines which show a satisfactory growth of aerial parts, a great resistance to drought and disease, as well as a perfect root form.

8. The aforesaid lines were obtained in commercial quantities and in 1923 were planted on a large scale (several hundreds of hectares) in several Italian beet districts with results which encouraged continuation, because the crossed types, maturing late and having a great resistance to *Cercospora*, could be profitably harvested during the latter part of the campaign."

The wild beet is very fond of a moist, salty atmosphere and the name *Beta maritima* was well chosen. In a number of places I found beet plants about two months old and not in the seed stage, which were actually washed by salt water at high tide. One is impressed with the hardiness of the plant when one sees under what adverse conditions it will grow. At Cancale, France, I found a plant growing in a tiny crack in the vertical sea-wall where it had found a little soil. Near Weymouth, England, many plants were growing in gravel consisting largely of round rocks three inches in diameter, deep enough so the roots must have gone down three feet or more.

It was interesting to see Italian and North Sea types growing side by side in Dr. Tjebbes garden in Sweden, the same as we had them at Longmont in 1934. In both cases, with the great difference in climate between Colorado and

Sweden, the Italian type was an annual, producing seed, and the North Sea type was a biennial. The Swedish climate is very favorable to bolting, while ours is unfavorable, so this emphasizes the hereditary character of bolting.

Dr. Tjebbes has the following to say of the North Sea type of Beta maritima in a bulletin he published on the subject:

"ADAPTATIONS"

"The North Sea type of B. Maritima must be looked upon as an eco-type (Turesson 1922 a. 1925). Besides being morphologically well characterized it presents several physiological and anatomical traits that make it specially adapted to its surroundings. It is perfectly hardy (in many cases winter-green), and endures at least 18 centigrades of frost, thus being able to stand our winters, while all southern forms of beets are killed at about -5°. The very long, branched roots enable it to anchor and to establish itself on pebble- and sand-beaches and on rocky slopes. The prostrate stems, from which new secondary stems frequently arise, give the plant a most ideal shape to stand against pressure of air and water. If any part of the plant is covered by sand or sea weeds, some other part may be still free to take over its functions, some secondary rosette becoming a new centre of vegetation. The fleshy leaves are a typical halophyte-character. The root has a remarkably high sugar content, much higher than that of the south-European wild beets. This of course makes it more frost-hardy. The number of vascular cylinders is very high, which secures tough roots and is probably a condition for sugar content. The comparatively low ash-content of the root saps must be interpreted as a consequence of a special capacity of living in a soil that is very rich in salts. I have found the same capacity in certain races of sugar beet, that, remarkably enough, happen to have many morphological characters in common with the North-Sea wild beet."

PART 2

In our search for genes and for certain desirable gene combinations which may not be present in our cultivated sugar beet, we have for the last few years somewhat concentrated on the North Sea type, as this type looked more promising than any of the others. The wild beets grown at Longmont test about 10% to 14% sugar and 76 to 82 purity.

ANALYSIS OF PARENT HYBRID AND DAUGHTERS

Family	Dahlberg 4	544	546
Description	Dahlberg 4 Original	D ₁₁ grouped with D ₃ and 12028	D ₁₁ grouped with D ₃ and 12028
Weight per beet, ounces	23.0	-	32.2
Sugar, %	12.70	14.50	12.65
Brix Press Juice	15.0	17.5	15.0
Purity	89.1	90.2	88.7
Nitrate Nitrogen, %	0.0042	0.0022	0.0063
Total Nitrogen	0.0886	0.1019	0.1110

The next series of pictures and analyses show that while there is plenty of segregation for size and shape of roots, the analyses of the beets

show a much more satisfactory composition than would be indicated from the appearance of the roots.

RESULT OF BACK CROSS (NORTH SEA HYBRID x DOMESTIC BEET 12028)

	<u>Family #550</u> <u>(from 12028)</u>	<u>Family #546</u> <u>(from Dahlberg 4)</u>	<u>Family #521</u> <u>(from Dahlberg 3)</u>
Number of Beets	20	18	37
Avg. Weight in ounces	12.1	13.4	7.8
% Sugar	16.4	16.5	15.2
Apparent Purity (Brix)	89.3	90.4	89.9
Leaf Spot Reading Sept. 17	4.0	2.0	3.0
" " " for U.S.#217			3.1

WILD BEETS IN CALIFORNIA

Eubanks Carsner, U. S. D. A.

Annuals of the genus Beta occur in several coastal counties of southern California and also in the central part of the state near San Jose. These plants appear to be hybrids between cultivated sugar beets and wild forms of foreign origin. They persist without cultivation. They are subject to the same diseases as the sugar beet and may have some economic interest on this account.

A distinctly wild type of beet occurs in several scattered places in the Imperial Valley. It is dependent on irrigation water for survival. Presumably it was introduced with seed from Europe. At present it does not appear to be of economic importance.

GREENHOUSE OBSERVATIONS OF WILD BEET SPECIES

F. A. Abegg, U.S.D.A.

A demonstration of wild beet species.

POSSIBILITIES OF IMPROVING CULTIVATED VARIETIES
OF BEETS OF SUGAR BEETS BY HYBRIDIZATION WITH WILD TYPES

C. W. Doxtator, American Beet Seed Company

Intergeneric and Interspecific crosses in crops are, in general extremely difficult to make, and if successful the progeny is likely to show a high degree of sterility. The plant breeder, therefore, has been limited to a great extent in attempts to produce more suitable cultivated types, to hybridization