

## VARIETY TESTS AND BREEDING CONSIDERATIONS

H. E. Brewbaker, H. L. Bush, and R. Ralph Wood<sup>1/</sup>

The principal objectives of the varietal improvement work conducted by the Research Dept. of The Great Western Sugar Co. include: (1) the development of adapted varieties for the various districts in Colorado, Nebraska, Wyoming, and Montana served by the Company; (2) incorporation of resistance to leafspot into the commercial varieties for most areas, to curly top for rather limited areas, and to both diseases for others; (3) development of varietal resistance to Fusarium conglutinans for certain districts; (4) determination of the relative value of the character of cold resistance; and (5) finding out if continued selection is necessary to maintain the productive ability of any adapted commercial open-pollinated variety.

To these ends various methods have been and are being used, including mass selection, extensive family selection and progeny testing, inbreeding by selfing, and various combinations of these including multiple hybrids. To date practically all of the improvement has taken place by the method of family selection and progeny testing.

A wide source of basic strain material has been introduced in recent years. Included in this are several European types, considerable wild blood particularly B. maritima (North Sea biennial type) and B. lomotogona. The possible value of polyploids is being investigated.

This report is intended, more specifically, to present certain results pertinent to various phases of this improvement program with the thought that they might contribute something of value to other breeders and that they might further provide some basis for fruitful discussion of objectives and methods.

### Adaptation

The principle of specific varietal adaptation is generally accepted. Certain varieties, however, appear to be so endowed with genetic factors that they become recognized as rather widely adapted. It is certainly unsafe, however, to attempt to predict how any variety will produce under any new set of conditions; the variety test must be relied upon for this answer. Certain rather outstanding cases of specific adaptation may be mentioned.

---

<sup>1/</sup> Agronomist, Statistician, and Asst. Agronomist, respectively, The Great Western Sugar Co.

The closely related varieties, B57 and GW72, appear to be relatively better producers of total sugar at Scottsbluff than at Longmont as compared with GW59-42W, as follows (1943 data):

	<u>Longmont</u>	<u>Scottsbluff</u>
B57	5965	6339
GW72	5479	6309
GW59-42W	6119	6001
<hr/>		
lsd 5% pt.	481	633

Two leafspot-resistant varieties, GW83 and GW85, were compared at five locations in 1943 with results in total sugar production which indicate GW83 to be adapted to Longmont, Morgan, and Scottsbluff while GW85 produced much better at Hysham and Holdredge. The summarized results are as follows:

	<u>GW83</u>	<u>GW85</u>	<u>Diff.</u>	<u>lsd 5% pt.</u>
Longmont	6032	5386	646	481
Morgan	6668	6414	254	385
Scottsbluff	5728	5102	626	638
Hysham	4972	5666	-694	686
Holdredge	5005	5569	-564	432

The curly-top-resistant U.S. 22 appears to be better adapted to the Northern areas including Shell Creek, Billings, Hysham, and possibly also Huntley than to Colorado (Morgan and Longmont), comparison being made with the standard, GW18-41. These varieties appear to be equally susceptible to leafspot which occurred at both Longmont and Morgan. Curly top was in evidence only at Shell Creek, as a very light attack. Results as follows:

	<u>GW18-41</u>	<u>U.S.22 (Imp.)</u>	<u>Diff.</u>	<u>lsd 5% pt.</u>
Longmont	5762	5341	421	481
Morgan	6184	5338	846	385
Hysham	5874	5621	253	686
Billings	5101	5036	65	635
Huntley	6229	5783	446	565
Shell Creek	5758	6006	-248	492

Environmental effects during seed production as related to sugar production in the commercial crop.

In a previous report <sup>2/</sup> to this Society some evidence was presented which indicated real differences in performance between seed lots representing the same generation but grown at different locations. Results are given as follows for two seed lots which

<sup>2/</sup> See 1942 Proceedings of the ASSBT.

represent respective increases from the same seed in two different years at the same location, Windsor, Colorado, the variety tests being conducted at 7 locations in 1942 and 1943:

	1942			1943		
	<u>GW59-41W</u>	<u>GW18-41</u>	<u>Diff.</u>	<u>GW59-42W</u>	<u>GW18-41</u>	<u>Diff.</u>
Longmont	7124	6580	544	6119	5762	357
Morgan	5301	4709	592	6113	6184	- 71
Scottsbluff	5761	5373	388	6001	6024	- 23
Billings	9149	9110	39	4881	5101	-220
Huntley	7120	6873	247	5468	6229	-761
Hysham	7627	7281	346	6276	5874	402
Lovell	7184	6583	601	6549	6197	352
Average			394	Average		5

It appears obvious from these data that by comparison with the same standard, GW18-41, for the two years, the GW59-41W increase is probably a better producer than GW59-42W. However, a possible inter-action between years and varieties should be recognized in this case although this does not appear at all likely since these varieties do not differ materially in origin.

The effect of leafspot on performance

Studies previous to 1943 have indicated leafspot to have a relatively greater effect upon root weight than upon sugar content. For each unit change in leafspot rating on a scale of 0- none to 10= heavy, calculated regression figures (using data from replicated family trials) were obtained as follows:

<u>Year</u>	<u>Location</u>	<u>Root Wt.</u>	<u>% Sugar</u>	<u>Total Sugar</u>
1937	Longmont	3.62	.80	approx. 4.42
1938	Ft. Morgan	4.22	1.33	approx. 5.55
1940	Ft. Morgan	1.72	.59	approx. 2.31

In 1941 similar regression values were calculated for each class based on leafspot rating as follows:

<u>LS rating</u>	<u>Root Wt.</u>	<u>% Sugar</u>
1	1.70	1.77
2	3.89	2.93
3	5.36	1.11
4	3.81	.91
5	2.08	.62
6	1.53	.74
7	1.46	.68

Leafspot developed rather early in August for each of the years 1937, 1938, and 1941, and it is during August that root growth is generally greater than during any other month. In 1940 leafspot developed late and the regression was proportionately less for both root weight and percent sugar.

In the years 1942 and 1943 a comparison of the performance of the susceptible variety GW18-41 with resistant GW65 is of interest:

	Tons Beets per A.		% Sugar	
	<u>GW18-41</u>	<u>GW-65</u>	<u>GW18-41</u>	<u>GW65</u>
Longmont 1942	20.69	20.86	13.5	13.5
Morgan 1942	16.83	16.95	14.0	14.3
Longmont 1943	17.84	17.86	16.2	16.6*
Morgan 1943	20.45	20.11	15.1	15.9*

\* - significantly higher

In 1942 leafspot developed late and the variety test was harvested before there had been any real opportunity for it to affect either tonnage or sugar. For that year the performance for these two varieties was almost identical in both tonnage and percent sugar. In 1943, leafspot also developed late and was rather severe at Morgan, but only moderately so at Longmont. Harvest was delayed to take advantage of the possible differential varietal effect of the disease. Root weight was again almost identical for both varieties but the sugar was definitely higher for the resistant GW65 at both locations. It seems fairly safe to conclude that under conditions as they existed in 1943, sugar content may be affected more than weight of root by leafspot.

In extensive replicated trials at Morgan and Longmont using breeding strains which varied rather widely in reaction to leafspot the categorical ratings (scale 0 to 10 as given above) for leafspot at Morgan were found to be not correlated with weight of roots and percentage sugar at Longmont in 1940 when the disease did not develop at Longmont. The calculated  $r$  value was  $-0.0516$  for leafspot with weight of roots, and  $0.0830$  for leafspot with percentage sugar. These results were taken to indicate complete lack of correlation in inheritance of the major factors involved for these characters. These conclusions were verified by results obtained in 1943 in which two new highly resistant strains, B135 and B142, rank high in total sugar production both under leafspot and non-leafspot conditions at several locations. This same material, when crossed with U.S. 22, resulted in an  $F_1$  hybrid which ranks high in production at several locations, one of which was exposed to moderate curly top infection.

Reduction of bolting tendency by selection in early spring plantings.

Recognizing a natural selection tendency in the warmer

seed producing areas, which tends toward some increase in bolting incidence in commercial fields of beets, several strains were subjected to a very early (Jan. 10, 1941) planting at Longmont, which stimulated bolter production. These bolters were discarded and the remainder of the population increased, the bolting test for the succeeding generation being made at Hysham, Mont. Results for the 1941 planting are included with the 1943 results as follows:

Var.	Jan. 10, 1941 planting at Longmont (%)	Bolters	
		Original lot No.*	Hysham, 1943 After sel. No.*
B152	33.0	0	0
B153	10.2	0	0
B151	48.8	1	0
B156	21.6	1	0
B155	27.7	2	0
B148	47.0	5	1
B154	34.5	6	0
B150	25.0	20	8

\*In about 600 to 650 plants.

Conditions in 1943 at Hysham were not as conducive to bolters as some years at that location but the results indicate a general reduction in bolting tendency as a result of the selection for non-bolting tendency.