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J.H. Shepard

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AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

CHEMISTRY DEPARTMENT

GROWING PEDIGREED SUGAR BEET SEED IN SOUTH DAKOTA 1910

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GROWING PEDIGREED SUGAR BEET SEED IN SOUTH DAKOTA

SEASON OF 1910.

A Continuation of Bulletin 121

DEPARTMENT OF CHEMISTRY.

JAS. H. SHEPARD, Chemist.

The work recorded in this Bulletin is a continuation of the co-operative work on sugar beets by this Station and the Bureau of Plant Industry of the United States Department of Agriculture.

The work has proceeded under the same terms and supervision as that recorded in Bulletin 106, 117, and 121. But in the Spring of 1910 Dr. Townsend resigned his position with the Department of Agriculture and Mr. W. A. Orton succeeded him and immediately took charge of the work for the Department. The work in hybridization was under the care of Mr. H. B. Shaw. Mr. Middleton continued the cultural work and Messrs. Youngberg and Cool-edge made the sugar determinations.

From the results obtained heretofore it became evident that one feature of our experimental work had been answered in the affirmative. That is that sugar beet seed of high vitality and capable of producing beets of a high and uniform sugar content could be readily grown in this state. So at the beginning of the next year other experimental features are to be introduced.

Heretofore the selection of mother beets has been controlled by the type of the roots and the high sugar content. That this method has produced very great results can not be questioned. The results obtained this year are very striking. But there ought to be some correlation between the sugar content and the morphological structure of the beet. This subject has never been worked out as yet and it seems to present a valuable field for investigation. There are other phases to investigate, also, which will take much time and patient work.

Mr. Orton has detailed Mr. F. J. Pritchard to work in conjunction with this Station on some of these abstruse problems and a good start has been made on the question of morphology and sugar content.

Mr. Pritchard has gone over the four thousand mother beets analyzed and checked off the characteristics of each mother beet on cards, a copy of which follows:

MOTHER BEET

Variety No. Serial No.

ROOT

Shape
 cylindrical
 conical
 fusiform
 napiform
 pear shaped
 Crown
 flat
 rounded
 conical

FURROWS

Direction
 vertical
 spiral
 intermediate
 Depth
 deep
 shallow
 medium

Per cent sugar

Weight g

Total sugar g

FOLIAGE

Color

light green

dark green

medium green

Habit

erect

semi erect

flat

LEAF

Length

long

medium

short

Breadth

wide

medium

narrow

Surface

Smooth

wrinkled

Texture

fine

medium

coarse

Apex

obtuse

retuse

Base

auriculate

cordate

Margin

undulate

sinuate

curly

PETIOLE

Length

long

medium

short

Breadth

broad

medium

narrow

Groove

deep

medium

shallow

This will afford a vast amount of material for comparative purposes. It has also been decided to classify the mothers grown this year in three main groups doing away as far as possible with the large number of Station Numbers now needed to keep the records of the work. Our beets are all of the Kleinwanzleben type and have now had the benefit of growing here and also of a rigorous selection for root type and high sugar content.

The proposed classification will be as follows:—1st Class, large beets with a high sugar content. 2nd Class, The highest sugar content which is usually found in the

smaller roots only. 3rd Class, all beets carrying over 15 per cent sugar in the beet not embraced by the first two classes.

In regard to the first class it is best to notice that no attempt has been made here to grow large roots. It would be like groping in the dark to try this with seed of unknown quality, since it is evident that where both seed and spacing are under trial at once, it would be impossible to determine which factor was responsible for either a high or a low sugar content. Now that we have seed of known quality the subject of spacing must receive early attention. All our beets hitherto have been grown in rows 18 inches apart and the beets have been thinned to from six to eight inches in the row.

Precautions will also be taken to preserve small samples of seed from each variety grown for use in case the the different strains of seed, although of the Klein Wanzleben variety, may have through long cultivation developed into what may be tantamount to different varieties. If this has occurred it is evident that the main lots of seeds will be practically hybrids. Consequently singles will be selected and sacked.

CLIMATIC AND CULTURAL NOTES FOR 1910.

The month of March in 1910 opened warm and spring-like and this weather continued throughout the month. The trees and grasses were growing finely early in the month and so fine was the weather that all farm operations opened up at an early date. The sugar beet ground was fitted by March 4th, and seeding commenced on the 8th. All the seed was sown by April 14th. The weather then turned cold and blustery to a most unusual degree even for April. On the 25th of that month no seed had germinated. By the 3rd of May the seed was germinating freely. Two or three heavy frosts occurred with high, dry, cold winds in the day time and by the 8th of May the seedlings were practically all destroyed. It was then decided to re-seed, an operation that would have been unnecessary if the seed

had not been sown before the first week in May. In fact some of the hybrids and other seeds in small amounts were seeded on May 4th and none of these were lost.

May 19th the re-seeding was completed except for some varieties that we had previously sent to Garden City, Kansas and to Logan, Utah. The seed remaining of these varieties was returned to us and the re-seeding was finished by May 27th.

This date was too late for ordinary years, but as subsequent data will show from these plantings came probably the best lot of mother beets ever grown in the United States. June was a dry month and other crops suffered from the drouth. Some cut worms worked on the beets but there was a good stand and so little damage that after thinning which was finished June 27th nearly a full stand was obtained. From this time on the growth of the beets was phenomenal. Showers occurred sufficient for the needs of all crops in the State and the sugar beets kept up their end with the other crops that gave good yields.

The mother beets were planted early in May. They grew without interruption and although the yield of seed was light they matured seed of high germinating power.

The yield was reduced somewhat by the inadvertent planting of several main lots close together which necessitated sacking all but one. Sacked beets never seed so freely as those grown in the open. Ample seed was grown, however, for use on the home grounds. Of course this will cause more risk, owing to the fact that all our seed will be planted at one point. The value of having these highly pedigreed seeds planted at several points was exemplified last Spring. Mr. Shaw was able to send us some excellent Mother beets grown at Garland, Utah, of which the small amount of seed sown at this Station was lost by the wiles of a seductive March. The analysis of these beets is given later on.

So far as the hybrids were concerned no results are to be reported this year. As noted above sacked beets did not do well. Moreover some of the branches never healed after

the severe pruning necessary. Especially was this true where the side branches were stripped down instead of being clean cut with the pruning scissors. This loss is unimportant since hybridization up to this time has failed to give as valuable results as those obtained by selection. There may be a cause for this as previously noted in the inherent wildness of the sugar beet which requires the strictest restraints known to human skill and knowledge to prevent the plants from relapsing into their natural state of wildness. Hybridization sets loose a train of tendencies that may as easily work toward deterioration as towards amelioration. It is but fair to state in this connection, however, that one hybrid, 9k12 gave a higher per cent of sugar than any selected beet grown from any variety. Twenty-two and four-tenth per cent sugar in the beet looks attractive. It is true that the root was small but this may easily have been caused by close spacing.

It is needless to say that this hybrid will be guarded with zealous care. If it survives the vicissitudes of 1911 we shall have to determine whether this high sugar content is transmissible. Small beginnings may frequently result in large results. Accident may destroy potential possibilities beyond computation.

MOTHER BEETS GROWN IN 1910.

The mother beets were harvested from October 24th to the 27th. They were in fine condition and were placed in the cellar without any mishap. Four thousand of them were labelled and their morphological characteristics noted as previously explained.

During the analysis it became evident that the beets were very uniform in their sugar content and that the content was high. Consequently all having less than 15 per cent sugar in the beet were rejected. Table I gives the data obtained. In order to show what progress had been made the percent of rejects for 1910 is given and also the per cent rejected in 1908, the latter being grown from the

original seed from the growers, while the former came from home grown seed.

Nine numbers were returned to this Station from Garland, Utah. No data is at hand concerning the culture of these beets, therefore in reporting the results in Table II all six samples of each variety are included. These were certainly fine beets evidently grown with greater spacing and under irrigation. In planting however, all beets below 15 per cent will be rejected. The beets to be rejected in the different varieties are as follows: In variety 279 none are rejected. In 289 none; in 299 two; in 339 three; in 349 two; in 379 none; in 389 none; and in 409 none, while in 469 two will be rejected.

It will be noted when Tables I and II are compared in respect to the last column in which is given the average weight sugar per beet, that the Garland beets average much higher on account of their increased size. Attention is here called once more to the fact that no attempt has been made at this Station to grow large beets, only beets with a high and uniform percentage of sugar have been sought. The subject of spacing will receive attention later.

The small percentage of rejects is a very striking feature of Table I. We believe that even these small percentages would have been reduced were it not for the fact that some seed that was not planted quite deep enough came up after the thinning was finished. Some came up as late as early in July. Owing to the favorable weather these beets made a rapid growth and since it was impossible to recognize them during harvesting, it is certain that some of these were chosen for analysis. Of course such beets would be immature and find themselves in the reject column. But as the case stands the percentage means a very uniform sugar content for the entire crop.

In the case of the Utah grown beets the average per cent sugar would have been materially increased had we omitted those below 15 per cent in the table, in those cases where some individuals were rejected in planting.

The large size and high sugar content of these beets

point toward the fact that South Dakota grown seed may do exceedingly well in other localities.

TABLE I.
Mother Beets Grown in 1910.

Variety	No. Beets Anal.	No. Rejects	Per cent rejected on basis of 15 per cent.	Per cent rejected on original seed, 1908 on basis of 15 per cent	Average weight Beets grams	Average per cent sugar in mother beets	Average weight sugar per beet grams
359	980	41	4.1	59.4	443	17.4	77.1
409	743	28	3.7	67.8	500	17.7	88.5
429	598	17	2.8	59.8	444	17.8	79.0
439	740	7	0.9	50.0	405	17.3	70.1
449	374	14	3.7	53.9	493	17.2	84.8
459	118	2	1.7	76.9	482	17.3	83.4
479	457	32	7.0	60.7	460	17.8	81.9

TABLE II.
South Dakota Seed Grown at Garland, Utah. 1910.

Variety	No. Beets	Per cent rejected	Per cent rejected on basis of 15 per cent.	Per cent rejected on original seed, 1908 on basis of 15	Average weight Beets grams	Average per cent sugar in mother beets	Average weight sugar per beet grams
279	6	00	0.0	65.3	574	17.0	97.6
289	6	00	0.0	65.9	385	16.7	64.3
299	6	00	0.0	61.4	1355	15.5	210.0
339	6	00	0.0	75.4	780	15.7	122.5
349	6	00	0.0	82.9	766	15.5	118.7
379	6	00	0.0	87.6	1230	16.2	298.3
389	6	00	0.0	73.2	768	17.7	135.9
399	6	00	0.0	90.3	964	15.1	145.6
409	6	00	0.0	61.5	774	16.1	124.6

HYBRID MOTHER BEETS GROWN IN 1910.

From the hybrid seed grown in 1909 a number of mother beets were grown. These mothers were analyzed and the data secured appears in Table III. The Station Numbers are so given that the pedigree of each beet is indicated. By referring to Bulletin No. 121 the pedigrees of the beets from which the seed was grown in 1909 may be found

Table III.
Hybrid Mothers Grown in 1910.

Station No.	Weight grams	Sugar per cent.	Station No.	Weight grams	Sugar per cent.
9B	205	15.8	9N4	285	19.2
9D1	295	15.6	9N5	270	18.8
9D2	260	16.6	9N6	195	17.2
9D3	465	15.6	9N7	190	17.6
9D4	485	16.6	9N8	105	18.8
9F	290	16.2	9S	415	15.4
9G1	500	16.6	9T1	370	16.8
9G2	755	16.8	9T2	195	15.6
9G3	420	17.0	9T3	115	17.6
9J	370	18.6			
9K1	430	17.6			
9K2	525	16.2			
9K3	205	20.4			
9K4	370	18.2			
9K5	585	17.4			
9K6	670	15.8			
9K7	585	15.4			
9K8	175	19.0			
9K9	195	17.0			
9K10	205	19.2			
9K11	315	16.6			
9K12	180	22.8			
9M	770	17.6			
9N1	455	17.0			
9N2	470	15.4			
9N3	430	15.8			

PERENNIAL MOTHER BEETS.

While harvesting the seed in the Fall of 1910, it was noted that many of the mother beets did not dry up and wither as is usually the case. On the contrary they had increased enormously in size so that beets weighing around 250 grams had reached a weight around two kilograms. The increase was in the nature of a number of small beets arranged around the original mother beet as an axis. Upon

cutting the flesh was found to be firm and sweet. Consequently a number of them were harvested and analyzed. In table IV some interesting data may be found.

It will be noticed that while the sugar content of these huge mothers is usually less than that of the original beet planted, that is not always the case. In some instances the huge mothers very nearly equalled the original beet while in others not only had a crop of seed been produced, but the percentage of sugar had actually increased.

These mother beets will be divided into smaller sections and these sections will be planted for seed production in 1911. The table follows:—

TABLE IV.
Perennial Mother Beets which grew a crop of seed in 1910 and were saved to grow more seed in 1911.

Station No.	Weight after bearing seed, grams	Per cent sugar after bearing seed.	Per cent sugar before bearing seed.	Average weight before bearing seed, grams	Per cent sugar in parent.
28-7	2300	13.2	16.4	357	20.4
29-13	1650	13.4	15.6	357	20.4
29-14	1640	13.4	15.4	357	20.4
29-26	2370	10.4	14.4	357	20.4
29-30	2090	12.8	15.4	357	20.4
178-2	1295	12.8	14.0	331	20.6
178-7	2595	13.8	16.4	331	20.6
178-9	2495	12.8	15.6	331	20.6
178-15	1550	13.0	14.0	331	20.6
178-16	3920	14.2	16.4	331	20.6
188-7	2330	13.0	16.8	354	24.8
188-8	2000	14.2	15.8	354	24.8
188-9	1900	14.2	14.8	354	24.8
188-19	2230	14.0	14.8	354	24.8
188-25	2150	15.0	14.0	354	24.8
188-27	2975	15.0	15.8	354	24.8
219-5	2380	13.4	14.0	344	19.5
219-31	2550	12.8	14.4	344	19.5
219-37	750	12.0	14.4	344	19.5
219-44	2780	14.4	15.0	344	19.5
219-48	2560	12.4	14.2	344	19.5
219-58	2180	12.2	15.6	344	19.5
238-5	2680	13.2		365	19.0
238-21	3100	10.6	15.2		
238-24	2300	10.2	14.8		
23-8-16	1990	13.8	14.0	399	18.0 19.8
23-8-49	515	13.0	14.0	399	
23-8-55	675	9.4	14.4	399	
23-8-82	2750	13.8	15.4	399	
2-8-30	3010	13.0		388	15.0 19.8
2-8-73	2180	10.4			
2-8-75	4085	10.4			
2-8-82	1260	14.4			

SEED GROWN IN 1910.

As previously noted 1910 was not a good year for seed production. But notwithstanding fair quantities of seed were produced from the main lots. From the singles and hybrids also a number of seeds were obtained sufficient for next year's work.

Next year an effort will be made to secure small plats at widely separated points so that sacking will be unnecessary.

In assigning Station Numbers to the different varieties of seed the same plan is followed as in previous years. The figure 0 affixed denotes the year the seed was grown. By referring to Bulletin 117 the pedigrees of the strain may be learned. Thus, 10S0, indicates that this strain single No. 10 which came from Station No. 2, beet No. 97 carrying 19.4 per cent sugar in the beet.

Again SD0-9 indicates that the parent of this strain was a hybrid whose pedigree appears on page 604, Bulletin 117.

The question of commercial seed production in South Dakota is worthy of consideration and steps will be taken to do something with this problem the coming year. The material is now on hand in the shape of a large number of tested mother beets sufficient to plant about one half acre solid.

In the Table following the observer may note that the percentage of sugar in the parent beets from which the 1910 seed was grown is close around 14 per cent. It is best to call to mind again this low percentage was due to a lack of maturity.

An unseasonal storm swept over the whole Mississippi valley from the Canadian borders to the Gulf of Mexico October 11th and 12th. This storm was accompanied by about two inches of snow and the temperature fell to 11 degrees F. This so injured the sugar beet leaves that they were unable to profit by the two weeks of warm

sunny weather which followed. The same storm froze the sugar cane in Louisiana. The percentage given would have been at least 4 per cent greater barring this storm.

TABLE V.
Seed Grown in 1910.

Station No.	Average weight parents, grams	Per cent sugar in parent	Station No.	Average Weight Parents grams	Per cent sugar parents
1-0	372	14.4	20S0-7	359	15.8
2-0	388	14.9	20S0-11	359	14.2
4-0	406	14.7	21S0-53	344	14.6
5-0	390	15.0	21S0-54	344	14.4
23-0	399	14.7	21S0-9	344	14.0
120-61	350	14.4	21S0-60	344	15.2
220-2	357	14.0	22S0-21	375	14.6
220-9	357	15.6	22S0-22	375	14.6
420-7	372	14.2	8A0-3	402	14.2
420-14	372	15.0	8A0-11	402	15.0
420-24	372	14.0	8A0-14	402	14.0
520-12	301	15.0	8B0-1	425	14.4
520-24	301	15.0	8B0-4	425	16.2
520-31	301	15.4	8B0-12	425	14.2
620-15	308	14.2	8E0-12	302	14.4
820-24	438	14.2	8E0-14	302	14.6
1020-17	320	14.0	8F0-17	302	16.6
1120-22	370	15.2	8D0-9	327	15.6
1320-4	370	14.0	8D0-18	327	14.0
1320-18	370	15.0	8G0-10	424	15.8
1320-21	370	16.0	8J0-1	365	14.0
1320-28	370	14.4	8K0-4	306	14.2
1420-5	376	14.8	8L0-6	440	16.0
1420-6	376	14.0	8N0-6	413	15.8
1620-29	408	14.0	8N0-22	413	16.4
1720-5	331	14.8			
1720-9	331	15.6			
1820-37	354	17.4			
1820-40	354	15.4			
1820-43	354	16.6			
1820-44	354	17.0			

SOME NEW FEATURES OF THE SUGAR PROBLEM TO BE INVESTIGATED.

It is the intention of both the Bureau of Plant Industry and this Station to push investigation into all the details of sugar beet culture. Not only will the scientific side be investigated, but also the practical side along commercial lines. There are several problems that await early investigation. Among these problems are the following:

THE PROBLEM OF SPACING. In the earlier investigations made at this Station in all sections of South Dakota a standard width of row, 22 inches, was employed and the beets were thinned to six or eight inches in the row. This spacing gave good results, but there was one thing lacking and that was pedigreed seed of uniformly high sugar percentage. So the problem needs further investigation.

The space of 22 inches in the row is well adapted to small footed draft animals but with the increasing size of the draft horses used in this State it may be that 24 or even up to 30 inches in the row may be necessary. There is one thing certain and that is if we make sugar beet growing in this State a commercial industry, we must have seed adapted to the cultural conditions possible in the State. If as indicated in the results of 1910, the amount of sugar from our pedigreed seed is strictly proportional to the size of the roots, the necessity of wider spacing than that employed in our preliminary work to secure uniformity is most obvious.

Tests should be made up to a minimum width required for horse cultivation.

STECHLINGE. In the commercial production of sugar beet seed, it is impossible to analyze every mother beet. Consequently "stechlinge" are grown. These are small beets produced from highly pedigreed seed by planting very thickly in narrow rows. They average around an inch or such a matter in diameter and are used for the production of commercial seed in large quantities.

Sometimes from eighty to one hundred acres are planted to stechlinge and thus the production of sugar beet seed becomes an industry by itself. Stechlinge will be grown at this Station in 1911 from some of the highly pedigreed seed which produced the excellent mother beets in 1910.

SILOING. Stechlinge are siloed in the field where grown in order to reduce the cost of production. Some very interesting work along this line will be necessary here, owing to our low temperatures in the winter. These silos are usually built long, and on the top of the ground. The beets are covered with dirt and other nonconducting material such as straw. Experiments to show how deep the covering must be and how thin it may be will be in order.