

SUGAR BEETS.

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Only two varieties of sugar beets were grown on the station grounds last year (1890), namely, the White Improved Vilmorin and the Klein-Wanzleben. Data on these are given in tabular form below.

In November last, when about to commence the analysis of the station beets, one of us caused to be published in various papers an offer on the part of the station, authorized by the director, to analyze all samples of beets sent in by residents of the state, accompanied by a record of the kind of soil on which they were grown, the manuring, cultivation, and variety name of seed.

Responses came in more numerous than expected; the interest shown was gratifying; but the records of soil and culture were not in all cases as complete as desired. These data, together with descriptions of samples and results of analysis, are presented in the subjoined tables.

These, while not of interest to the general reader, will, it is hoped, be of interest and even of value to the *special* reader, who wishes to *study* the subject of sugar beet growing in Iowa:

IOWA SUGAR BEETS, 1890.

Description of Samples.

Sample No.	Sent in by	Grown by	Locality.	No. of Beets in sample.	W'ts of beets trim'd.	Av. w't trimmed.	Reported Variety
					Oz.	Oz.	
1	.....	Station.	Ames, Story Co.	6	28 to 60	42	Vilmorin.
2	Another sample of same beets, stored in trench and analyzed five weeks later—Dec. 10.		do	3	26 to 42	35	do
3	.....	Station.	do	6	22 to 50	40	Klein Wanzleben.
4	Another sample of same beets, stored in trench and analyzed five weeks later—Dec. 10.		do	6	32 to 50	42	do
5	.....	Station.	do	6	27 to 50	39	Vilmorin.
6	Another sample of same beets, stored in trench and analyzed five weeks later—Dec. 12.		do	6	24 to 50	32½	do
7	.....	Station.	do	6	32 to 48	41	Klein-Wanzleben.
8	Another sample of same beets, stored in trench and analyzed five weeks later—Dec. 12.		do	6	25 to 40	33	do

Sample No.	Sent in by	Grown by	Locality.	No. of Beets in sample.	Wts. of beets trim'd. Oz.	Av. wt trim'd Oz.	Reported Variety
9	G. F. Selleck.	J. Schronde.	Altoona, Polk Co.	3	.....	19	Germ'n seed from U. S. Dept. of Ag.
10	do	do	do	4	23 to 40	30	do
11	do	M. H. Miller.	Des Moines, Polk Co.	4	24 to 65	36	do
12	do	do	do	5	9 to 14	11	Klein-Wanzleben.
13	do	do	do	5	9 to 15	13½	Florimond Des- prez.
14	W. Bowen.	W. Bowen.	Marshalltown, Marshall Co.	16	7 to 8	7½	Vilmorin.
15	do	do	do	7	11 to 28	18	do
16	G. W. Wattles	Geo. W. Paine.	Carroll, Carroll Co.	1	98	98	do
17	do	do	do	2	36 to 41	38½	do
18	S. F. Martin.	T. P. Brulington	Atlantic, Cass Co.	5	21 to 36	27	Germ'n seed from U. S. Dept. of Ag.
19	do	do	do	10	13 to 14	13	do
20	C. A. Searls.	C. A. Searls.	Akron, Plymouth Co.	4	21 to 42	32	Klein-Wanzleben, fr. U. S. Dept. Ag.
21	M. W. Kiddoo	M. W. Kiddoo.	Cromwell, Union Co.	6	6 to 14	9½	Seed fr. Oxnard Co. Grand Is. Neb.
22	O. Browning.	O. Browning.	Newton, Jasper Co.	6	32 to 90	64	Vilmorin, seed put. at local store.
23	N. K. Fluke.	N. K. Fluke.	Davenport, Scott Co.	5	31 to 42	32½	Seed from U. S. Dept. of Agr.
24	C. C. Platter.	L. P. Pike.	Red Oak, Montgomery Co.	7	7 to 17	11	Freeh Sugar, seed pur. at local store.
25	Ed. Barnard	Jno. Barnard.	Muscatine, Muscatine Co.	6	9 to 27	17½	Lane's Imperial.
26	Royal Canning Company.	S. Humphreys	do	6	7 to 52	23	Unknown.
27	do	P. Murphy.	do	6	7 to 25	14½	Unknown.
28	do	C. Lelendecker	do	6	15 to 37	26½	Lane's Imperial.
29	Granger & M.	?	Ft. Dodge, Webster Co.	8	34 to 9-	59	Unknown.
30	Bardwell & H.	?	do	6	42 to 73	54	"Yellow German Sugar."
31	do	?	do	6	33 to 86	54	White Silesian.
32	J. Edgerton	J. Edgerton.	Nassau, Keokuk Co.	6	66 to 102	88½	Long White Im- perial.
33	J. H. Conley.	Mrs. L. Willis.	Perry, Dallas Co.	8	3 to 5	4	Seed fr. C. Spre kles' factory, Calif
34	do	O. Thornburg.	do	6	12 to 40	20	do

The table of Analyses shows not only the results of analysis, but also (in order to exhibit their relations, if any, to sugar content) the average weight of the beets analyzed, character of soil, culture and varieties as far as reported.

ANALYSES.

[The sucrose figures marked with a star (*) were obtained on hot water extracts—Pellet's method—a method which is liable to give results a trifle high, the error, however, rarely if ever exceeding .5 of a per cent. In all other cases the extractions were made with alcohol.]

Number.	Av. w't of beets trimmed. Oz.	Reported Variety.	Reports on Soil and Culture.	IN THE BEETS.	IN THE EXPRESSED JUICE.			Locality.
				Sucrose by Polariz't'n	Solids, Brix.	Sucrose by Polariz't'n	Purity Coef. ficient.	
1	42	Vilmorin.	Blk sandy loam, old ground; manured the year previous. Rows 23 in. apart; beets 9 in. apart in rows; well cultivated.	*13.3	17.7	13.9	78.4	Ames, Story Co.
2	35	do	do	10.8	15.8	11.8	74.8	do
3	40	Klein-Wanzleben.	do	*12.5	16.9	12.8	75.8	do
4	42	do	do	11.0	16.3	12.5	76.3	do
5	39	Vilmorin.	Blk sandy lo'm; new ground; second crop; wheat in '89. No manure; rows 40 in. apart, beets 9 in. apart in rows; well cultivated.	*11.9	17.6	13.2	75.4	do
6	32½	do	do	11.9	16.6	12.8	76.9	do
7	41	Klein-Wanzleben.	do	*12.5	16.8	12.7	75.4	do
8	33	do	do	11.8		13.6		do
9	19	do	Blk heavy sandy loam; manured lightly; planted May 15.	15.2	18.4	15.8	86.0	Altoona, Polk Co.
10	30	do	do	13.5	18.4	14.5	78.6	do
11	36	do	Rich prairie soil, with clay subsoil; manured lightly; planted May 15.	10.5	14.5	11.6	80.0	Des Moines, Polk Co.
12	11	Klein-Wanzleben.	Black prairie soil; not manured; planted June 20.	10.6	16.6	11.4	69.9	do
13	13½	Florimond Desprez.	do	5.3	11.4	5.8	52.0	do
14	7½	Vilmorin.	Sandy knoll; very dry; beans grown alongside failed, from lack of moisture.	*12.0	17.3	12.3	70.2	Marshalltown, Marshall Co.
15	18	do	do	*11.2	16.2	11.3	69.7	do
16	98	Vilmorin.	Heavy clay loam; planted May 1; harvested Oct. 11; hoed twice.	5.3				Carroll, Carroll Co.
17	38½	do	do	*9.4	14.1	9.9	70.0	do
18	27	Germ. seed fr. U. S. D. of Ag.	Black sandy loam; planted May 25.	11.3	16.7	12.2	73.0	Atlantic, Cass Co.
19	13	do	do	*9.8	13.6	10.0	74.0	do

Number.	Av. w't of beets trimmed. Oz.	Reported Variety.	Reports on Soil and Culture.	IN THE BEETS.		IN THE EXPRESSED JUICE.		Locality.
				Sucr'se by Polariz't'n	Per cent.	So'ids. Brk.	Sucrose by Polariz't'n		Purity Coef- ficient.
20	32	Klein-Wanzleben.	Newly broken pasture; bottom land; no manure; planted May 22; 3 ft. between rows; 8 in. between beets in row; some of beets weighed 7 lbs.	12.2	19.6	13.6	70.2	Akron, Plymouth Co.
21	9½	Seed from Oxford Co., Gr'd Island, Neb.	Garden soil; black loam; no manure, for 2 years; planted June 1.	8.0	15.0	9.3	61.6	Cromwell, Union Co.
22	64	Vilmorin seed purchased at local store.	Garden soil; clay upland; heavily manured.	9.2	13.4	9.3	69.7	Newton, Jasper Co.
23	32½	Seed from U. S. Dept. of Agriculture.	Old prairie soil, in orchard; not rich; no manure.	11.5	17.4	12.9	74.4	Davenport, Scott Co.
24	11	French Sugar beets; from local store.	Sandy loam; no manure; planted June 20; hoed once, not thinned.	10.5	15.0	11.3	75.3	Red Oak, Montgomery Co.
25	17½	Lane's Imperial.	No report.	10.9	17.3	12.3	71.4	Muscataine, Muscatine Co.
26	23	Unknown.	"Hazel brush land" with yellow clay subsoil; been long tilled; no manure; hoed 3 times.	11.3	18.0	12.9	71.8	do
27	14½	Unknown.	do	10.8	17.9	12.2	73.6	do
28	26½	Lane's Imperial.	do	10.0	15.7	10.9	69.5	do
29	59	Unknown.	Beets grown for stock; no special culture.	8.7	14.2	9.7	68.9	Ft. Dodge, Webster Co.
30	54	Yel Germ Sugar beets; (yel. mangels. (G. E. P.)	High black sandy loam; well manured.	4.4	10.5	5.2	49.5	do
31	54	White Silesian	do	10.0	14.8	10.7	72.3	do
32	8 8½	Long White Imperial.	Black loam; very rich; a spot where cattle had lain much in previous years.	7.1	13.6	8.5	62.5	Nassau, Keokuk Co.
33	4	Seed from C. Spreckles' factory, California	Sandy loam.	13.4	24.3	16.3	69.4	Perry, Dallas Co.
34	20	do	do	16.3	24.0	16.7	69.7	do
Mean	33.1			10.7		11.8	71.4	

Determinations of marc were made on 33 of the samples. Results ranged from 2.25 per cent. to 6.50 per cent. with a mean of 4.36. The marc is the fibrous or cellular part of the beet—all of the beet, in fact, that is not juice; therefore, as would be expected, the higher figures for marc, indicating a rather dry beet, were obtained on samples richest in sugar. To what extent such dryness, and consequent enrichment in sugar, can be brought about by exposure of the beet to dry air (without causing marked withering or shrivelling) we are unable to say; but it is a point of interest, if not of importance, in comparing analyses of beets whose previous treatment is unknown. "Crude Ash," by simple ignition, was determined on 30 of the samples, results ranging from .55 per cent. to 1.85 per cent., with a mean of 1.33.

The above recorded results are not altogether gratifying ; nor can they said to be altogether discouraging.

In many cases the record reveals sufficient cause for the poor, or unsatisfactory quality of the crop. Too rank a growth, caused by too rich a soil (in vegetable mould) or by recent application of barn manure, appears to be the foremost cause. Next to this, perhaps, is the extreme dry weather that prevailed in early summer ; in a few cases the planting was altogether too late ; in others the seed was plainly at fault. So much for the unsatisfactory results—the bad ; how about the good ?

Anything above 13 per cent. sucrose in the beet may be considered *good* ; anything above 12 per cent. *encouraging*.

The figures show just eight samples, of the thirty-four, to have contained over 12 per cent., and only four with surely over 13.

Of the fourteen counties represented it happens that Polk and Dallas are the only ones sending samples going over 13 per cent ; I say “happens” because the evidence is far too scant to justify the inference that equally good beets cannot be grown in many other parts of the state.

Of almost equal importance with the sugar content is the purity of the juice, and in this respect very wide variation is observed, ranging from 49.5 to 86.0. The beets showing the highest purity were from Polk county, (Nos. 9, 10 and 11) ; those from Dallas. (Nos. 33 and 34), while rich in sugar were of much lower purity.

[By the terms “purity ;” “purity co-efficient,” “purity quotient,” “sugar quotient,” or simply “quotient,” as applied to juices or other saccharine liquids, is meant the percentage part of the total solids (in the liquid) which consists of sucrose or cane sugar.]

As Nebraska has already acquired an enviable reputation as a beet sugar state, it seemed desirable to secure samples of beets grown there for comparison with those of Iowa. This we were able to do through the kindness of Mr. G. W. Wattles, of Carroll, Iowa, and Mr. Charles Leiendecker, of Muscatine, Iowa. The former caused to be sent to the station, from Neligh, Neb., thirteen samples of beets grown by as many different farmers of that vicinity ; and the latter sent us a sample grown at Grand Island, Neb., by Mr. J. D. Moore. Following are the results :

ANALYSES OF NEBRASKA BEETS, 1890.

Sample No. 1 was grown at Grand Island, Neb.; Nos. 2 to 14 inclusive, at or near Neligh, Antelope county, Neb. Those from Grand Island were of the Vilmorin variety; those from Neligh, Vilmorin and Klein-Wanzleben.

Sample No.	No. of beets in sample.	Weights of beets, trimmed. Ounces.	Aver. w't. trimmed Oz.	IN THE BEETS.	IN THE EXPRESSED JUICE.		
				Sucrose by polarization.	Solids, Brix.	Sucrose by polarization.	Purity coefficient.
1	6	8 to 15	11	Per Cent. 20.1	P-F Ct. 29.1	Per Ct. 22.9	78.9
2	2	20, 22	21	9.0	15.0	9.5	63.7
3	2	12, 13	12½	14.0	19.2	15.1	78.9
4	2	26, 26	26	10.0	17.0	11.1	65.3
5	2	16, 20	18	15.5	21.8	17.2	78.9
6	4	9 to 34	17½	12.0	18.2	12.9	70.9
7	3	12 to 21	16½	14. ?	21.0	15.5	73.8
8	5	12 to 18	15	14. ?	22.4	15.6	69.9
9	3	8 to 15	12	15.5	22.9	16.0	69.9
10	3	15 to 20	17½	14.4	21.0	14.5	68.8
11	2	11, 11	11	13.3			
12	2	63, 70	66½	10.3	17.5	10.8	61.7
13	2	15, 17	16	10.6	17.3	11.8	68.2
14	2	12, 13	12	12.8	20.4	15.6	76.7
Mean.			19½	13.2		14.5	71.2

The Grand Island beets far surpassed in richness all other samples analyzed, from whatever locality. Those from Neligh, while barely, if at all, surpassing the *best* Iowa samples, were more uniform and therefore *average* higher than do any like number from the Iowa list.

Comparing the average result on all the Nebraska samples (14) with the average on all from Iowa (34), we find 2½ per cent. sugar in favor of the Nebraska beets—13.2 per cent. for Nebraska, against 10.7 for Iowa; with purity almost the same in both—71.2 against 71.4.

Of interest in this connection is the following letter from the President of the Oxnard Sugar Company, of Grand Island, which we copy from a recent bulletin of the Minnesota Experiment Station:

GRAND ISLAND, NEBRASKA, JANUARY, 13, 1891.

Mr. D. N. Harper, Minneapolis, Minn.

DEAR SIR: The highest percentage of sugar in the beets this year was a little over 21 per cent., and the average 16 per cent. The yield varies from 10 to 20 tons. We have bought all our beets from farmers during the past year. Owing to the excessive drouth in this section last year, the cultivation of beets has not been entirely satisfactory.

Yours, very truly,

HENRY T. OXNARD, *President.*

IOWA'S PROBLEM.

But all of the above figures fall far short of settling the question: Are the soil and climate of Iowa, or any part of it, suitable for the profitable production of beet sugar?

This problem demands solution. To solve it is the work *mainly* of the *agriculturist*; the chemist's work is but trivial in comparison.

Farmers of Iowa, will you, with our aid, solve it?

If each one who is so circumstanced that he can easily take part in the work will consider this as a personal appeal, and join with us, exercising care and thought in the work, we can one year from now have a large stock of FACTS in place of our present boundless store of SPECULATION.

Assuming the reader agrees to join in the work, let us address him personally.

YOUR WORK—THE FARMER'S PART.

1. Make the work experimental—by which we mean till only a moderate sized plot, in any one piece, *giving it the very best known treatment for the desired end*; and in two different plots *vary only one condition*, leaving all other conditions alike. [See paragraphs 2, 6 and 8 below.]

2. Select the land with care. Discard "stiff" or "heavy" soils—clayey soils—also any land having a clay sub-soil within reach of the tap-root of the beet. Select a *deep* sandy loam, if possible one in which lime is abundant. This can be recognized by its effervescing when moistened with a little muriatic acid. The sub-soil and immediately underlying deposits should be readily permeable by water, to allow free drainage, and ready passage upward of the soil-water; this is very important.

Select land that has been long tilled ; virgin soils, or comparatively new soils, rich in nitrogenous organic matter, produce beets of rank growth and poor quality.

The plot should be well exposed to air and light—should be if possible on rather elevated land, lying toward the sun, and not shaded by hills, trees or buildings.

If possible try two plots of ground filling the above requirements, one a light and the other a dark or black sandy loam.

3. Prepare the ground as early as possible. *Apply no manure in the spring.* Unrotted and therefore (to a large extent) “unavailable” nitrogenous manures applied in spring, becoming “available” by degrees throughout the summer, promote growth too late in the season and thus hinder ripening and sugar formation. [For another year, if the land to be then used for beets needs fertilizing, apply well rotted manure *early in the fall*, and plow in not too deep. But it is probable that in our rich soils beets following any well manured field crop will not need manure. Some authorities say beets do best after grain crops.]

4. Prepare the soil *thoroughly*. “The preparation of the soil is one of the chief factors for a good crop.” *Deep* tillage is very important, facilitating the downward growth of the root, also rendering the lower soil permeable. But the sub-soil should not be brought to the surface *in the spring* ; where this needs to be done—and on many old soils it certainly is needed—it should be done during the *summer or autumn* preceding the sowing of beets.

The sugar beet needs its food (especially the nitrogenous part) already prepared and “available” in the early stages of growth; and a sub-soil but recently brought to the surface has its fertility largely in “unavailable” forms.

Therefore, in preparing the soil the coming spring plow quite deep, say 8 or 10 inches ; and if possible follow with a *sub-soil plow* to loosen the sub-soil to a depth of 4 or 5 inches more, without throwing it to the surface. As but few farmers have sub-soil plows, the long-bladed spade may in these plot experiments be made to serve the same purpose.

Harrow thoroughly, rolling if necessary to break up clods, until the condition of a well prepared garden is attained.

[The preparation for sugar beets another year should be begun in the autumn by plowing rather deep—the depth depending upon the nature of sub-soil and upon depth of previous culture—leaving the soil as much as possible in ridges during the winter, to expose it to air and frost. Follow in the spring

with the thorough tillage above described ; the sub-soil plow may be used either in the fall or the spring.

If barn manure is applied (this in autumn if at all, see paragraph 3) it should be turned under by a much shallower plowing than advised for the autumn when manure is *not* applied, which simply means that to quickly decompose and become available to plants, manure should not be deeply buried.]

5. Obtain seed of known reliability and of the best varieties. White Improved Vilmorin and Klein-Wanzleben are among the very best. For Iowa soils the former is especially to be recommended, since European practice and experiments indicate that it resists "better than any other variety the unfavorable influence of certain characters of soil and of certain manures. In black soils, rich in organic matter, it will give great industrial results, while most other varieties of beets become watery or saline in excess." *

If possible try these two varieties side by side (in adjacent plots or rows).

The Station will furnish seed to applicants so far as it can. Seed can also be obtained, we believe, by applying to Secretary Rusk, Department of Agriculture, Washington, D. C.

6. Plant as early as the soil has sufficient warmth to induce germination. Early seeding is very important, for reasons obvious.

In Europe the custom prevails of soaking the seeds for 24 or 48 hours in water, or more commonly in a mixture of half water and half urine, at a temperature of about 100 degrees Fahr., then mixing them with ashes and drying in order to sow. This treatment reduces by several days the time required for sprouting, and as a consequence is said to improve the crop. It should certainly be done if the ground is very dry at seeding time.

Sow the seed in rows not over 18 inches apart, even in soil of but moderate fertility ; and in rich soils reduce the distance to 16 or even 14 inches. See paragraph 8, below.

Sow thick, expecting to thin out, [15 lbs. seed per acre is commonly advised.] Cover not more than one inch, as a rule; one-half inch is often deep enough.

7. Commence cultivating and hoeing as soon as the plants are visible. With horse implements, guard against covering the young plants.

Cultivate often, especially if the soil is dry ; the object being not only to kill weeds, but also, by keeping a layer of

*Dr. W. H. Wiley, Bulletin 27, U. S. Dept. of Agr.

loose soil at the surface, to prevent loss of soil-moisture as far as possible.

By this means a fair crop (of any kind) can be secured, despite a very considerable drought. "The oftener the plants are hoed the better will be the crop as regards quantity and quality." Cultivate as long as the leaves will permit.

8. When the young plants have developed 3 or 4 leaves, thin out enough to leave them about 6 inches apart. In very rich soil this distance may be reduced to 5 inches, in poor soil increased to 7 or 8—the object being to produce beets weighing one to one and one fourth pounds after topping. It would be well to try two different distances—within the above limits—on adjacent plots, or in parts of the same plot.

If comparisons on this point are made, have the beets nearer together where the smaller distance between rows is tried, and farther apart where the rows are more widely separated. See paragraph 6.

The importance of distance between the plants cannot be over estimated. So great is it that one well informed writer says :

*"Experiments show that this influence is greater than that due to manuring, or even choice of variety." With certain limitations this is doubtless true.

At time of thinning, fill vacant spaces in the rows with superfluous plants from other spots.

9. At the last hoeing—or earlier if appearances indicate the need—"hill up" the rows, throwing dirt well up around the necks of the beets. This is simply to keep the entire root covered, since if the crown or part of the body is exposed, this part will be of inferior quality.

10. Harvest when the beets are fully ripe, but not before. The leaves are then turned yellow or yellowish green, and the outer ones are withered and fallen. [Harvest before a second growth of leaves sets in—probably superfluous advice for Iowa.] *Light* frosts do no harm, but the beets must not be allowed to freeze. In digging, avoid cutting the roots. Cut off only the leaves, not any of the crown or the root. [If to be worked immediately for sugar, about $\frac{3}{4}$ of an inch of the crown would be removed.]

11. Immediately after harvesting select two sample lots of the beets *from each plot, or each experiment*, to send to the Station for analysis.

*Com'd Agr. Howes, on Sugar Beet Culture in Bohemia, Reprint from Consular Report in Bulletin No. 27 U. S. Dep't of Agr.

For the first sample select 6 beets of such (various) sizes that they will fairly represent the entire crop. If you cannot do this with 6, select 12 or any satisfactory number.

For the second sample select 6 symmetrical, tapering beets, each weighing (without top) about one pound. This sample will show the possibilities of a crop with size of beets fully controlled. It will show, probably the *best quality* of beet you have grown in that plot.

Send the samples, properly labelled and with your name attached, to the Station by American Express, at the same time mailing letter advising us of the shipment.

Preserve the remainder of the crop in a trench, covered with moist earth to a safe depth, until advised of the results of analysis. This because another sample may possibly be wanted.

OUR WORK—THE STATION'S PART.

1. As stated above, the Station will as far as possible furnish seed, of good varieties, to applicants who express a desire to join in the work and agree to faithfully carry out their part, as outlined above.

2. The Station will pay express charges on samples of beets sent in by any person who shall, before May first, notify the Station Director of his intention to join in the work, and shall agree to faithfully perform his part, as outlined above.

3. The Station will faithfully and promptly analyze all samples sent in under the above stated plan, will report results to the senders as soon as obtained, and finally, will make full and complete report to the public of all results obtained and all data furnished by those doing the agricultural part of the work.

By the plan here proposed the capabilities of the state as a whole, and of different parts of the state, in the line of beet sugar production can be learned more quickly than by any other method ; and it is the earnest hope of the writer that a large number of farmers will join with us in the undertaking.