

EXPERIMENT STATION
OF THE
KANSAS STATE AGRICULTURAL COLLEGE,
M A N H A T T A N .

BULLETIN NO. 31 - DECEMBER, 1891.

CHEMICAL DEPARTMENT.

G. H. FAILYER, M. Sc., Chemist.

J. T. WILLARD, M. Sc., Assistant Chemist.

EXPERIMENTS WITH SUGAR BEETS.

In the spring of 1891, extensive experiments with sugar beets were planned. It was thought that more might be learned regarding the capabilities of our soils and climate by growing the beets in many portions of the State than by confining our trials to one or a few localities, even though the plats in this more extensive trial were quite small in size. Further, it was considered that the test would be more conclusive if the preparation of the soil and the methods of culture found most successful in the sugar-beet-growing countries of Europe were adopted.

To make the test, as above indicated, it was necessary to secure the cooperation of many farmers of the State, in growing the beets. Two distinct lines were pursued in securing this cooperation in such a way as to give satisfactory geographical distribution. Twenty-six localities were se-

lected by us because of the character and extent of the tillable soil as well as the geographical position. These sections were visited by a representative of the chemical department of the Station, and the plan explained personally to the farmers whose assistance was sought. Further than this, an offer was made to furnish seed to all who applied for it, and to analyze the beets sent in to the Station. The seed furnished was the best kinds of German and French sugar beets. In pursuance of the above plans, this seed was distributed to about 360 farmers and gardeners—about 250 of them in the selected localities. It will thus be seen that the farmers cheerfully responded, the number assisting in the several selected localities varying from 6 to 25. The farmers to whom the not inconsiderable number of packages of seed were sent on request were more or less isolated. There were 56 counties of the State reached in one or the other of these ways, 26 counties being represented by at least a half-dozen plats. The table of analytical results shows the distribution secured.

Below are given the instructions which were printed and given out with the packages of beet seed. While it was not expected that these would be rigidly followed in every case, they were intended as a model which should be followed as closely as circumstances would permit. Experience has shown that they should be modified somewhat for another year's use.

INSTRUCTIONS FOR GROWING SUGAR BEETS.

SIZE OF PLAT.

The best of preparation and cultivation of the soil are far more important than size of plat. It will be better to take a plat of a few square rods and put plenty of work on it than to plant an eighth or a quarter of an acre and slight it during the hurry of this season. A very small plat should be taken if the subsoil is to be spaded. The plat should be of such proportion as to give not less than six rows.

THE SOIL.

Old ground that is in a good state of cultivation should be selected. The deeper it has been previously plowed, the better. Only that which is naturally open and porous, and which has been kept clear of weeds, will be available in this trial. Soil to which no barn-yard manure has been added for a year or more will be preferable.

PREPARATION OF THE SOIL.

The soil must be loosened to a depth of 16 or 18 inches, *without bringing much of the subsoil to the surface*. This is best done by running a common plow about an inch deeper than the ground has been previously stirred, and following in each furrow with a subsoil plow, putting it down to the required depth. If a subsoil plow is not available, the experimental plat may be prepared by spading the bottom of each furrow to the required depth before turning the next. It may be prepared wholly by spading if necessary. After the soil has dried somewhat, it must be

thoroughly harrowed, to reduce it to a fine, mellow condition. It is best to roll the ground finally.

THE PLANTING.

The planting should be done as soon as the ground is ready, so that the weeds will not start in advance of the beets. Plant in straight drills, 18 inches apart. Drop three or four seeds together at intervals of *five to nine inches* in the drills, the distance being less with rich than with poor soil. Cover one inch deep, pressing the earth down firmly on the seed. The crop should be planted early—as early as garden beets.

CULTIVATION.

The weeds must be kept down and the surface soil kept open and porous. If the weeds are not allowed to get a start, the cultivation can be done without much hand work. After the beets are well started, showing about four leaves, they must be thinned to one plant at a place, leaving the most thrifty plant, and taking care not to disturb it in pulling out the others. As soon as the leaves shade the ground, cultivation is to be discontinued. Care should be taken not to injure the leaves in cultivation. Beets that tend to rise out of the ground must be covered by drawing the soil up around them. This should be done during the cultivation of the beets as directed above.

Directions for taking and forwarding samples will be sent in the fall.

It was believed that the beets sent in to us in the fall would fairly represent the crop to be expected throughout the State in such a season, by the best of treatment. The general character of the climate at each section of the State could be known, likewise the kind of soil, its past history and its present treatment, and the variety of beet grown. We could thus obtain data not to be had otherwise.

In addition to these experimental plats grown for us by the farmers of the State, the department grew larger plats on thoroughly subsoiled ground, after the same method given in the instructions printed above.

It was not thought that the results of one season would be at all conclusive, but the plan involved the continuation of the trial through several years, in order to eliminate the effects of variable seasons.

In the general distribution we used the following imported seed: German Sugar Beet, raised by Heinrich Hette, Bulteau Desprez, and Vilmorin Improved. A portion of the seed of these varieties was received from the Department of Agriculture, at Washington, and some from the Oxnard Beet Sugar Company, of Grand Island, Neb. We also used some seed of Vilmorin Improved grown at Medicine Lodge, Kas., from imported seed. In our own plats we used all these kinds, and in addition the following, of which we imported small quantities of seed: Dippe's Improved White Imperial, Dippe's Klein Wanzlebener, White French (very rich), Dippe's Improved White, Klein Wanzlebener (from Vilmorin), White Sugar Beet, red top, White Sugar Beet, gray top, White Sugar Beet, green top, (Im-

proved Brabant,) Dippe's Improved Vilmorin, Florimond Desprez Richest, Simon Le Grand's White Improved.

Since the sugar develops in beets during the later stages of growth, instructions for taking and shipping samples were not sent out until the close of the season. On October 20, the letter and questions printed below were sent to each grower of beets:

Dear Sir: Your name is upon our list as one to whom we furnished sugar-beet seed last spring. During the summer we sent cards of inquiry to all who are growing beets for us, asking for information concerning the germination of the seed, and general condition of the crop. As replies were not received from much more than one-third of the persons addressed, it seems best to repeat the inquiries to a certain extent, and at the same time to collect some additional information. Will you kindly fill out the inclosed blank and put it in with your sample of beets, or, in case you have no beets, return by mail. We are desirous of having a report from every one, whether the seed was planted or not, and whether there is any crop or not.

Below will be found directions for taking and sending samples. After the analyses are completed, they will be collected and published in a bulletin, in which due credit will be given to the persons growing the beets, and reports will be made to them.

DIRECTIONS FOR TAKING AND SENDING SAMPLE.

From the middle rows of the plat select six beets weighing not more than two pounds each, and preferably about 1½ pounds. Should most of the beets be very much larger than two pounds, send an average sample. Take them from various places, so as to represent the whole plat. Reject any which are not regular in outline and sound at the crown. Cut off the leaves, wash the roots, and wipe or drain them dry, but do not expose to the sun much. Wrap each beet carefully in paper which has been lightly greased with melted lard. Wrap the whole in strong paper and tie securely, or put in a light box of suitable size. Attach the enclosed tag to the package, and send by express at our expense. If neighboring farmers will pack together and send by freight, it will save expense. *Be sure to fill out the blank for name of sender, or we can do nothing with the beets.*

REPORT UPON CULTURE OF SUGAR BEETS.

NAME OF GROWER
POST OFFICE
COUNTY
Did you subsoil the plat? If so, how deep? If not, how deep was the ground plowed?
Described kind of soil, briefly, including subsoil, and state whether soil has been manured, and if so, when
State in a general way the distribution of rainfall during the season, and whether the weather, as a whole, seemed to be favorable to the growth of the crop.
Variety of beet, if known
Date of planting Did the seed germinate well?
Distance between rows Distance between beets in row
Describe cultivation given
If any insects or diseases have attacked the leaves or roots so as to attract attention, please describe them.

The samples of beets sent in were all analyzed on the day of their arrival at the laboratory. The beets were first weighed whole, the leaves having been removed; this gave the gross weight given in the table. The crowns

were then cut off as far down as the beets had projected above the surface of the soil, and the remainder gave the net weight. The entire sample was then reduced to a fine pulp and the juice extracted by means of a powerful screw press. After standing a few minutes, the specific gravity of the juice was taken and the sugar in it estimated by the saccharimeter. Reducing sugars were not determined, as they are known to be present in but small quantity in beets.

No attempt was made to determine the percentage of sugar in the beets, only that in the juice. Since the proportion of juice varies in beets, there is not a constant ratio between the percentages of sugar in the juice and in the beets. But an approximately correct comparison of beets may be made by the use of the proportion of sugar found in the juice. However, there is usually about 95 per cent. of juice in sugar beets. Therefore, the percentage of sugar in beets is about 95 per cent. as high as in the juice. The analysis then resolved itself into determining the specific gravity of the juice and polarizing it after clarifying it. The specific gravity affords a means of getting the approximate amount of total solids in the juice. Knowing the amount of solid matter, and the amount of cane sugar, we determine the coefficient of purity, a very important element, by calculating what percentage the sugar is of the total solid matter in the juice.

A few words in reference to our machine for pulping the beets may not be amiss. Taking a worn-out feed-mill as the basis, we removed superfluous parts, leaving a short shaft in its bearings and carrying a heavy fly-wheel. A crank handle was attached to the fly-wheel near the shaft. A wooden pulley, such as is used for belts, was attached to the middle of the shaft. This pulley was four inches wide and 18 inches in diameter. Ten lines of tacks were driven into the pulley, each line running diagonally across its width. The angle of the lines and the distance between them was such that the successive lines lapped past each other slightly. The tacks in the lines were set close together, and were slightly sharpened with a file on the front edge. They projected about the sixteenth of an inch. The pulley was inclosed in a suitable case of galvanized iron, the top of which could be removed, and the bottom of which had an opening through which the pulp dropped. An opening was also left through which the beets were fed. The beets during grinding rested on a board which was placed as close to the pulley as possible. The beets were held by hand against the revolving pulley, the board giving a safe rest, so that there was no danger of accident. The crank handle being near the shaft, a much higher rate of speed was given to the periphery of the pulley than would have been possible with a longer lever arm. The beets pulped easily, and the only drawback was the rapid rate of turning demanded. Some multiplying arrangement to secure the necessary motion would be a great advantage. When run by steam power the cutter worked to perfection, pulping rapidly and very fine.

Turned by hand, about five minutes was necessary for pulping an average-sized sample of six beets.

Table No. 1, given hereafter, contains the results of our work on beets grown elsewhere in the State, and Table No. 2, the results with beets of our own raising.

In Table 1, we have collected such facts as we could gather and bring into tabular form regarding the soil and treatment of the beets. The farmers named the kind of soil in which they grew the beets; and it is probable that the terms employed were not always used strictly in the same sense by the various persons named. We depend on the same authority, the grower, for all facts regarding the production of the beets. The form, condition, size and quality of the beets are facts determined after they reached our laboratory. Owing to delay in sending the beets, or to some other cause, some of the samples were wilted; this, as well as other abnormal conditions, is noted in the table by a reference to a foot-note. In deciding whether to call a beet good, fair, etc., it was compared with the ideal beet as hereafter outlined. In tabulating preparation of soil and cultivation, we have fallen somewhat short of the full description in many cases. Slight variations in hoeing and plowing, as well as the thoroughness with which these were done, do not appear in the tabular statement. When no reply was made on a question, a blank appears in the table. It has been found impracticable to distinguish between subsoiling and plowing, in the preparation of the soil, but when the soil was deeply stirred, it may be understood to have been subsoiled.

In the trials on our own ground we can be more explicit and certain in the conditions of growth, such as kind of soil, its preparation, date of planting, distance between beets, culture given them, and attacks of insects or diseases.

The soil is a clay loam; it was subsoiled to a depth of 16 or 18 inches two weeks before planting. This treatment was not so effective as it would have been under proper condition of soil. The excessive rains had kept the soil too wet, and it baked somewhat after subsoiling. The beets were planted April 30 and May 1, in drills 18 inches apart. The planting was done very close in the row. The seed of all varieties germinated well. As soon as large enough, they were thinned to six to eight inches in the row. This proved to be too close for our soil, the beets being small. Where soils have not been brought into a high state of fertility by manuring and tillage, it appears that the beets must be given a larger area of soil to draw nourishment from. The beets were well tilled by use of hoe and horse cultivator; when this was no longer possible because of the beets covering the ground, any weeds that sprung up were pulled out.

In the latter part of July a disease of the leaves was noticed, which Professor Kellerman identified as *Cercospora Beticola*. The disease appeared as small, brown dry spots on the leaves, especially the outer ones. These spots in-

creased in size, until on a large portion of the crop the older leaves were entirely killed. The young, inner leaves continued to grow, but doubtless considerably at the expense of sugar already formed in the root. It is highly probable that the low content of sugar which our beets show was partly due to this disease.

In taking the sample for analysis, a portion of the row was selected where the beets grew evenly in the row, and 20 consecutive beets taken. These beets were treated in every respect as were those received for analysis. As this has already been described, it need not be repeated.

TABLE No. 1—SHOWING ANALYSES OF

NAME OF GROWER.	County.	Post office.	Kind of soil.	Depth soil runs stirred, inches...	Date of planting.	Distance between rows, inches...	Distance in rows, inches...
J. H. Jamieson.....	Allen.....	Humboldt.....	Loam, clay subs...	12	May 1.....	12	5
Addison Sleeth.....	".....	".....	Red loam.....	5	Last of May..	7	8
P. J. Thwaites.....	".....	".....	{ Calcare's loam, } clay subsoil.	8	May 10.....	18	6
D. A. Van Nice.....	".....	".....	Sand, clay subsoil,	14	" 6.....	30	7
W. F. Waggoner.....	".....	".....	Loam, clay "	6	" 12.....	16	3
A. W. Dwinell.....	".....	".....	" " " "	7	" 12.....	16	9
F. Frederick.....	Greenwood..	Neal.....	Poor.....	8	" 25.....	14	12
W. J. Burtis.....	Wilson.....	Fredonia.....	Stiff clay.....	18	" 25.....	18	12
M. Bumgarner.....	Chautauqua..	Wauneta.....	Loam, clay subs...	10	" 1.....	16	5
R. E. Walker.....	Elk.....	Grenola.....	" " " "	8	" 1.....	24	7
H. Flottmann.....	Cowley.....	Burden.....	Loam.....	11	April 13.....	18	10
H. Flottmann.....	".....	".....	".....	11	" 25.....	18	10
L. G. Wilkins.....	".....	".....	Loam, clay subs.	24	May 3.....	24	4
P. R. Page.....	".....	".....	" " " "	16	".....	18	6
F. M. Savage.....	".....	".....	" " " "	14	" 5.....	18	6
Jacob Nixon.....	".....	Kellogg.....	Sandy loam.....	11	" 20.....	36	6
Jacob Nixon.....	".....	".....	" " " "	11	" 20.....	36	6
Jacob Nixon.....	".....	".....	" " " "	11	" 20.....	36	6
Wm. Rogers.....	Linn.....	La Cygne.....	Red loam.....	5	June 1.....	24	6
A. S. Hoel.....	".....	".....	Loam, clay subs.	5	April 20.....	24	12
J. L. Vance.....	".....	".....	Light loam.....	5	May 4.....	12	6
Frank Cherry.....	".....	".....	Sandy loam.....	5	April 30.....	18	6
R. W. Brown.....	".....	Wall Street	Loam, subs. limes.	10	May 13.....	42	6
W. H. Schooley.....	".....	Mound City..	Red loam.....	18	June 10.....	18	12
Aaron Green.....	".....	La Cygne.....	{ Loam, hard } pan subsoil, }	6	May 26.....	36	.....
A. Dressler.....	Johnson.....	Edgerton.....	Sandy loam.....	7	".....	18	8
H. Rhoads.....	".....	Gardner.....	Loam, clay subs.	8	May 13.....	12	5
M. L. Ward.....	Franklin.....	Ottawa.....	Clay subsoil.....	18	" 4.....	18	9
Mary A. Brown.....	Coffey.....	Waverly.....	Loam.....	16	".....	24	3
L. Newcombe.....	".....	".....	".....	".....	".....	".....	".....
Wm. Norton.....	Chase.....	Cottonwood Falls.	".....	5	".....	40	15
T. J. Browning.....	".....	".....	".....	12	May.....	18	16
W. A. Wood.....	".....	Elmdale.....	Loam, clay subs.	10	" 4.....	20	12
W. L. Wood.....	".....	Strong City.....	" " " "	12	" 15.....	36	8
Wm. V. Roby.....	McPherson..	McPherson.....	Dark clay.....	9	" 1.....	18	6
B. F. McGill.....	".....	".....	Black.....	10	April 25.....	48	18
M. W. Yowell.....	".....	".....	Loam, clay subs.	10	".....	18	.....
C. W. Yowell.....	".....	Conway.....	" " " "	10	May 10.....	18	8
A. F. Waugh.....	".....	McPherson.....	" " " "	7	" 7.....	12	6
Geo. F. Kellogg.....	Rico.....	Sterling.....	Alkali, heavy clay	14	April 24.....	.....	6
Geo. F. Kellogg.....	".....	".....	" " " "	14	" 24.....	.....	6
E. H. Klüber.....	Barton.....	Ellinwood.....	Heavy loam.....	24	" 20.....	18	9
J. B. Miller.....	".....	Great Bend.....	{ River bottom, } sandy subs. }	4	Last of May..	18	6
J. B. Miller.....	".....	".....	" " " "	6	" " " "	18	8
J. B. Miller.....	".....	".....	" " " "	6	" " " "	18	8
J. B. Miller.....	".....	".....	" " " "	6	" " " "	18	8
J. B. Miller.....	".....	".....	" " " "	6	" " " "	18	8
J. B. Miller.....	".....	".....	" " " "	6	" " " "	18	8
I. Pelsor.....	".....	".....	Loam.....	12	May 14.....	18	12
M. W. Cobun.....	".....	Hoisington.....	".....	8	" 8.....	36	12
J. W. Allen.....	Rush.....	La Crosse.....	".....	".....	".....	".....	".....
J. E. Milliken.....	Ford.....	Wright.....	Calcareous loam.	16	June 10.....	16	12
A. P. Bundy.....	Jefferson.....	Oskaloosa.....	Loam, clay subs.	16	April.....	.....	10
C. A. Buck.....	".....	".....	Loam.....	14	May 12.....	30	6
G. H. McPherson..	".....	".....	".....	8	".....	36	6
M. M. Maxwell.....	".....	Valley Falls..	Loam, clay subs.	6	" 7.....	24	4
Edward Pape.....	Shawnee.....	Topeka.....	Sandy loam.....	8	" 27.....	18	6
Edward Pape.....	".....	".....	" " " "	8	" 27.....	18	6
W. A. Neiswanger..	Shawnee.....	Topeka.....	Loam, fertilized..	12	May 20.....	36	8
J. B. Zinn.....	".....	".....	Sandy loam.....	18	" 20.....	20	6
J. F. Kennett.....	".....	Silver Lake.....	" " " "	19	June 1.....	18	6
A. L. Entsminger..	".....	".....	" " " "	6	" 20.....	14	.....
R. Fowler.....	".....	".....	" " " "	12	May 15.....	24	10
L. H. Neiswender..	".....	".....	" " " "	16	" 15.....	18	10
Chas. Banks.....	".....	".....	Heavy loam.....	18	" 10.....	.....	6
J. H. Dearborn.....	".....	".....	Sandy loam.....	8	" 1.....	18	6
J. H. Dearborn.....	".....	".....	" " " "	15	April 30.....	18	6
Johnson & Williams,	".....	".....	" " " "	8	May 25.....	24	6
J. F. Willard.....	Wabaunsee..	Wabaunsee.....	Heavy loam.....	16	" 5.....	18	7

SUGAR BEETS SENT TO THE STATION.

Cultivation.	Variety of beet.	Form of beet.	AVERAGE WEIGHT, IN POUNDS.		Specific gravity of juice	Total solids in juice	Cane sugar in juice	Purity
			Gross ..	Net ..				
Weeded	German	Fair	2.11	1.58	1.054	13.3	9.07	68
	" .....	(*). .....	.50	.31	1.089	21.3	17.60	83
Hoed	"	Stocky *	1.78	1.25	1.048	11.9	8.21	69
Hoed and plowed	French .....	(*). .....	.77	.57	1.094	22.4	18.78	84
Hoed	German	Stumpy	1.32	.99	1.069	16.8	12.24	73
Hoed and plowed	French .....	(*). .....	.48	.37	1.089	21.3	16.97	79
Twice plowed	Bulleau Desprez .....	.....	1.40	1.08	1.059	14.5	.....	.....
Hoed	"	Fair	2.09	1.99	1.038	18.1	9.60	73
	"	Very good	1.59	1.24	1.043	10.7	6.44	60
Plowed, hoed well	French	Fair	1.41	1.13	1.058	14.2	10.33	72
Hoed	German .....	.....	2.09	1.56	1.050	12.3	8.68	71
	Vilmorin	"	2.64	1.76	1.048	11.9	7.76	65
	" .....	.....	.98	.68	1.061	14.9	10.63	71
	Bulleau Desprez	Fair	1.00	.79	1.049	12.1	7.51	62
Hoed a little	Vilmorin	Very poor	1.45	1.03	1.054	13.3	9.50	71
Hoed (*)	Vilmorin, Kansas grown	Stumpy .....	.70	.61	1.052	12.8	9.60	75
	Bulleau Desprez .....	.....	.49	.36	1.048	11.9	9.10	76
Hoed and plowed	Vilmorin	Fair .....	.55	.41	1.051	12.6	9.68	77
	"	Poor *	1.51	1.18	1.072	17.5	12.74	73
	Bulleau Desprez	"	2.00	1.29	1.054	13.3	8.68	65
Plowed	"	Fair	1.40	.94	1.051	12.6	8.02	64
Hoed	"	Fair *	1.80	1.48	1.080	14.7	10.01	68
	"	Poor * .....	.38	.77	1.085	20.4	16.06	79
	German	Good .....	.67	.55	1.068	16.5	12.76	77
Hoed once	Bulleau Desprez	Stumpy * .....	.79	.61	1.057	14.0	9.38	67
Well hoed	"	Poor	1.74	1.38	1.046	11.4	6.03	58
Hoed once	German	Stocky	1.73	1.35	1.060	14.7	11.15	76
Hoed and plowed	Bulleau Desprez	Poor	2.47	1.94	1.049	12.1	9.07	75
Hoed	Vilmorin	Fair	1.56	1.11	1.053	13.1	9.63	73
Plowed	Bulleau Desprez .....	.....	1.76	1.27	1.049	12.1	8.49	70
Hoed and plowed .....	" .....	.....	1.03	.81	1.057	14.0	11.18	80
Hoed	Bulleau Desprez	Fair	1.42	1.03	1.070	17.0	13.09	77
Plowed	"	Poor	1.98	1.54	1.058	14.2	9.70	68
Hoed and plowed	"	Good	1.74	1.41	1.066	16.1	11.42	71
Hoed	"	"	1.78	1.35	1.055	13.5	9.97	74
Hoed and plowed .....	" .....	.....	2.66	1.49	1.040	10.0	4.95	50
Hoed	"	Fair †	2.46	1.49	1.057	14.0	9.70	69
	"	Bad	2.33	1.30	1.040	10.0	5.37	54
	"	Good .....	.57	.43	1.064	15.7	10.75	88
Hoed and irrigated	"	Good * .....	.74	.68	1.065	15.9	10.17	64
Hoed .....	" .....	" .....	.88	.66	1.061	15.1	8.84	68
	Vilmorin, Kansas grown	Stumpy	1.63	1.07	1.054	13.3	9.03	68
{ Hoed but little, } { too wet. }	Bulleau Desprez	" forked,	2.02	1.76	1.078	18.8	15.63	83
"	"	Fair	1.22	1.05	1.075	18.1	14.98	83
"	Vilmorin, Kansas grown	Stumpy	2.11	1.78	1.078	18.8	16.42	87
" .....	" .....	.....	1.47	1.23	1.080	19.3	16.65	86
"	Bulleau Desprez	Forked	2.42	2.18	1.070	17.0	13.62	80
"	"	Fair	1.52	1.32	1.078	18.8	16.03	85
Weeds pulled	"	Poor	2.07	.70	1.065	15.9	11.59	73
Plowed .....	" .....	.....	2.75	1.16	1.054	13.3	8.91	67
	" .....	.....	1.11	.95	1.075	18.1	15.64	86
Hoed	Bulleau Desprez	Good	1.61	1.29	1.064	15.6	11.01	71
Poor	"	Very poor	1.42	1.06	1.057	14.0	10.41	74
Hoed	Vilmorin	Fair	1.71	1.21	1.057	14.0	9.76	70
Hoed and plowed	Bulleau Desprez	Forked	2.65	2.26	1.056	13.8	10.53	76
	"	Good	1.39	1.10	1.054	13.3	10.42	78
Hoed .....	" .....	" .....	.31	.27	1.060	14.7	10.79	74
	" .....	" .....	.94	.77	1.051	12.6	9.51	75
	Bulleau Desprez	Poor	1.80	1.38	1.063	15.4	11.48	74
	"	Stumpy	2.20	1.61	1.048	11.9	7.38	62
	"	Poor	1.74	1.19	1.054	13.3	10.05	76
	"	Good .....	.54	.43	1.050	12.4	8.43	68
	"	Good †	1.64	1.46	1.045	11.2	7.57	63
	"	Good	2.38	1.70	1.045	11.2	6.86	62
	Vilmorin Improved	Stocky †	2.05	1.48	1.056	14.8	9.71	70
	Bulleau Desprez	Good .....	.96	.70	1.054	13.3	10.49	76
	"	"	1.15	.85	1.049	12.1	9.15	76
Hoed and plowed	Vilmorin Improved	"	1.79	1.25	1.053	13.1	9.39	72
Hoed	White French .....	" .....	.83	.52	1.058	14.2	10.57	79

* Wilted. † Sunburned.

TABLE No. 1 — Continued — SHOWING ANALYSES

NAME OF GROWER.	County.	Post office.	Kind of soil.	Depth soil was sampled, inches.	Date of planting.	Distance between rows, inches.	Distance in rows, inches.
J. F. Willard.....	Wabaunsee..	Wabaunsee.....	Heavy loam.....	7	May 5.....	18	7
J. F. Willard.....	"	"	"	7	" 5.....	18	7
J. F. Willard.....	"	"	"	16	" 5.....	18	7
J. F. Willard.....	"	"	"	7	" 5.....	18	7
J. F. Willard.....	"	"	"	16	" 5.....	18	7
G. L. Christensen..	Riley.....	Clarkson.....	Sandy loam.....	15	" 10.....	18	12
J. T. Smith.....	"	Manhattan.....	"	8	" 10.....	36	8
John Jones.....	"	"	{ Stiff loam, clay subsoil, }		" 5.....	18	
A. W. Paige.....	"	"	Loam.....	9	" 12.....	18	8
H. W. Hungerford..	"	"	"	"	"	"	"
A. Heuquenet.....	Dickinson..	Stockdale.....	Loam.....	8	May 15.....	12	
A. Heuquenet.....	"	Hope.....	Loam, clay subs..	6	" 10.....	18	16
C. Heuquenet.....	"	"	"	6	" 10.....	18	16
F. S. Wilson.....	"	New Chillicothe..	Sandy loam.....	10	" 20.....	32	18
Chas. Young.....	"	"	Loam.....	8	April 26.....	24	12
Geo. A. Reed.....	Saline.....	Assaria.....	"	11	May 13.....	36	9
Thomas Tinkler.....	"	Gypsum.....	Loam, clay subs..	14	" 25.....	24	20
Sanford Smith.....	Ellsworth..	Ellsworth.....	Sandy loam.....	12	" 5.....	36	8
W. S. Leach.....	"	"	"	14	" 1.....	18	10
E. E. Moor.....	"	"	Loam.....	16	April 25.....	12	7
Geo. E. Alden.....	"	"	"	5	May 6.....	18	18
Chas. Trego.....	"	Kanapolis.....	Sandy loam.....	10	" 1.....	24	
C. L. Meyers.....	"	Ellsworth.....	"	8	" 9.....	22	20
E. W. Wellington..	"	"	"	18	April 26.....	18	6
E. W. Wellington..	"	"	"	18	" 21.....	18	6
E. W. Wellington..	"	"	"	18	" 22.....	18	6
E. W. Wellington..	"	"	"	18	" 24.....	18	6
E. W. Wellington..	"	"	"	18	" 25.....	18	6
Governor Glick....	Atchison...	Atchison.....	Loam, clay subs..	6	"	36	8
Isaac Vickery.....	"	"	"	8	May 20.....	24	26
John E. Springer..	Brown.....	Morrill.....	Loam.....	7	" 12.....	36	6
Joseph Kirk.....	"	"	Calcareous loam..	6	" 15.....	40	10
John Witschy.....	"	Fairview.....	Loam.....	10	June 1.....	18	9
W. D. Beal.....	"	Hamlin.....	Sandy loam.....	7	May 8.....	32	
A. Carothers.....	"	Hiawatha.....	"	18	" 25.....	40	
S. Detwiler.....	"	"	Clayey.....	4	" 20.....	36	
A. L. Rodkey.....	Marshall...	Blue Rapids.....	Loam, clay subs..	10	" 21.....	18	6
C. Rodkey.....	"	Irving.....	Sandy loam.....	18	" 6.....	24	6
H. N. Danheim.....	"	"	Loam, clay subs..	12	" 25.....	14	9
J. C. Rodkey.....	"	"	Sandy loam.....	6	"	24	
Wm. Burr.....	"	"	"	16	May 25.....	16	6
J. S. Heath.....	Pottawato'ie.	Fostoria.....	Loam.....	6	"	36	
Wm. Drake.....	Washington.	Clifton.....	"	18	"	18	1r.
Wm. Sager.....	"	"	Calcareous loam..	12	"	16	6
Henry Shuler.....	"	"	Sandy loam.....	10	May 12.....	18	8
John Woodruff....	"	"	Loam, clay subs..	8	" 20.....	20	8
Ed Short.....	"	"	Sandy loam.....	12	" 15.....	30	12
J. C. Ware.....	Republic....	Scandia.....	"	16	"	18	8
Geo. Nyland.....	"	"	Loam, clay subs..	18	May 20.....	12	6
A. J. Wilcox.....	Cloud.....	Clyde.....	Sandy loam.....	7	" 16.....	20	
David Ross.....	Jewell.....	Ezbon.....	Loam.....	8	June 1.....	12	12
John Denham.....	"	Mankato.....	"	10	May 1.....	30	6
William Totton....	"	"	"	6	" 15.....	24	
J. W. McRoberts, jr.	Jewell.....	Mankato.....	Loam.....	20	May 20.....	24	12
E. H. Kern.....	"	"	"	8	June 1.....	36	8
E. D. Hendricks....	Mitchell...	Cawker City.....	Loam, clay subs..	8	May 15.....	18	8
L. N. Walling.....	"	"	"	6	" 15.....	36	8
T. J. West.....	"	"	Loam.....	8	April 26.....	18	6
D. D. Swantley....	"	"	Sandy loam.....	18	May 15.....	18	3
D. P. Walling.....	"	"	Loam, clay subs..	5	April 29.....	20	
H. Burgdorf.....	"	"	"	12	"		10
Amos Shaeffer....	"	"	Loam, clay subs..	10	April 14.....	36	10
C. S. Farnham.....	"	"	Sandy loam.....	7	June 1.....	16	
Benj. Brown.....	Osborne...	Natoma.....	"	"	"	"	"
Benj. Brown.....	"	"	"	"	"	"	"
J. W. Hahn.....	"	Bloomington.....	Loam, clay subs..	8	May 5.....	24	16
P. W. Kenyon.....	"	Corinth.....	Loam.....	14	" 20.....	15	6
N. W. Gibbs.....	Phillips...	Marvin.....	Sandy loam.....	13	" 28.....	18	8
W. A. Pratt.....	"	"	Loam, clay subs..	16	"	20	8
W. O. Whipple....	Norton.....	Lenora.....	Sandy loam.....	12	April 15.....	24	6
Henry Claar.....	Decatur.....	Hawkeye.....	Loam.....	12	May 12.....	18	8

OF SUGAR BEETS SENT TO THE STATION.

Cultivation.	Variety of beet.	Form of beet.	AVERAGE WEIGHT, IN POUNDS.		Specific gravity of juice.	Total solids in juice.	Cane sugar in juice.	Purity.
			Gross.	Net.				
Hoed.	White French	Fair	.66	.58	1.067	16.3	12.84	79
"	Dippe's Klein Wauzelebener	"	.69	.62	1.067	16.3	13.90	85
"	"	"	.58	.32	1.069	16.8	14.19	84
"	Bulteau Desprez.	Good	.73	.65	1.064	15.6	12.70	81
"	"	"	.75	.64	1.063	15.4	12.21	79
"	"	Good †	1.10	.84	1.058	14.2	10.20	72
Hoed and plowed.	"	Good	1.75	1.43	1.067	16.3	13.10	80
Hoed.	Bulteau Desprez.	Forked tops.	2.17	1.47	1.049	12.1	8.14	67
"	"	Good	1.77	1.33	1.051	12.6	8.58	68
"	"	Stumpy*	1.35	1.00	1.062	15.2	10.50	70
Hoed and plowed.	"	Fair*	2.88	2.09	1.055	13.6	9.72	71
"	"	Good	3.98	2.92	1.050	12.4	9.27	75
"	Bulteau Desprez.	Fair.	5.10	2.29	1.151	12.6	8.51	68
"	"	Stumpy	1.92	1.39	1.054	13.3	9.38	75
"	"	"	.97	.70	1.051	12.6	9.49	75
"	Bulteau Desprez.	Poor	1.82	1.36	1.056	13.8	9.19	67
"	"	"	1.60	1.05	1.065	15.9	11.00	70
"	"	Fair	2.91	2.03	1.049	12.1	8.46	70
"	"	"	2.85	1.74		6.27		
Hoed.	Bulteau Desprez	Good	4.16	2.80	1.047	11.6	7.28	63
"	"	"	.96	.77	1.064	15.6	10.22	66
"	Vilmorin, Kansas grown	"	2.28	1.71	1.050	12.3	8.79	71
Hoed and plowed.	Bulteau Desprez.	"	2.71	2.10	1.051	12.6	9.49	75
Hoed.	Vilmorin, Kansas grown	Stumpy	2.64	1.92	1.056	13.8	9.65	70
"	Bulteau Desprez.	Good	1.76	1.45	1.063	15.4	12.20	78
"	"	"	2.16	1.69	1.050	12.3	8.26	67
"	"	"	1.95	1.50	1.058	14.2	10.32	72
"	"	"	1.56	1.21	1.067	16.3	13.20	81
"	"	Stumpy	1.87	1.76	1.065	15.9	11.97	75
"	"	"	3.37	2.43	1.062	15.2	10.67	70
Hoed and plowed.	Bulteau Desprez	Fair	1.89	1.42	1.060	14.7	10.76	73
"	"	Stocky	1.67	1.22	1.052	12.9	9.49	74
Hoed.	"	Good	1.31	1.12	1.060	14.7	11.48	78
"	Vilmorin, Kansas grown	Stocky	2.45	1.83	1.054	13.3	9.29	70
Hoed and plowed.	Bulteau Desprez.	Good	1.51	1.19	1.058	14.2	7.99	56
"	"	Fair	2.04	1.52	1.046	11.4	8.13	71
"	"	"	1.82	1.45	1.054	13.3	10.00	75
Hoed.	"	Good	2.29	1.75	1.057	14.0	10.12	72
Hoed and plowed.	"	"	2.39	2.02	1.055	13.5	10.00	74
Hoed.	"	Fair*	1.48	1.10	1.055	13.5	9.92	73
"	"	Fair.	1.14	.86	1.052	12.8	8.38	65
Hoed and plowed.	Vilmorin, Kansas grown	Stumpy	1.95	1.39	1.053	13.1	8.95	68
"	"	Good	2.75	2.08	1.059	14.1	11.68	83
Hoed.	Bulteau Desprez.	"	2.19	1.64	1.055	13.5	10.46	77
"	"	"	1.46	1.10	1.054	13.3	10.27	77
"	"	Stumpy	2.07	1.45	1.048	11.9	7.62	64
"	"	Fair	2.51	1.93	1.059	14.5	10.96	76
Plowed.	"	Good	1.32	1.03	1.041	10.2	6.28	62
Hoed.	"	"			1.050	12.4	9.35	75
"	Bulteau Desprez.	Fine	1.64	1.38	1.053	13.1	10.29	79
Hoed and plowed.	"	Poor*	3.08	2.16	1.069	16.8	10.51	63
"	"	Good	2.73	1.67	1.065	15.8	11.06	70
Plowed.	"	Good*	1.51	1.34	1.079	19.0	15.97	84
Hoed.	"	Poor	2.53	1.94	1.055	13.5	8.89	66
"	Bulteau Desprez	"	1.83	1.63	1.061	14.9	10.61	71
"	"	Good	2.28	1.69	1.043	10.7	6.27	59
Plowed.	Bulteau Desprez	Fair.	2.45	1.80	1.054	13.3	9.26	70
Hoed	"	Good	1.65	1.31	1.048	11.1	7.35	62
Hoed and plowed.	"	Poor	2.27	1.73	1.055	13.5	9.48	70
Weeded.	"	Fair.	1.94	1.54	1.061	14.9	11.83	80
Hoed	"	Stumpy	2.13	1.51	1.040	10.0	5.79	58
Hoed and plowed.	"	Bad			1.053	14.2	11.44	80
"	Klein Wauzelebener	"	2.70	1.87	1.048	11.9	7.78	65
"	Bulteau Desprez.	Good	1.73	1.43	1.055	13.6	11.19	82
"	"	"	1.65	1.37	1.061	14.9	11.80	79
Hoed and plowed.	Bulteau Desprez	Stumpy	1.85	1.48	1.062	15.2	10.85	71
Hoed	Vilmorin, Kansas grown	Good	1.71	1.25	1.054	13.3	8.68	65
"	Bulteau Desprez.	"	2.82	2.28	1.058	14.2	13.33	80
Hoed and plowed.	"	"	2.80	2.20	1.056	13.8	9.62	70
Hoed	"	(*)	1.51	1.14	1.087	20.8	15.89	76
"	"	Stumpy	4.03	3.07	1.058	14.2	8.35	59

* Wilted. † Sunburned.

TABLE No. 1 — Concluded — SHOWING ANALYSES.

NAME OF GROWER.	County.	Post office.	Kind of soil.	Depth soil runs straw, inches...	Date of planting.	Distance in rows, by lines.....	
						Distance between rows, inches.....	.....
Don Caster	Decatur.....	Oberlin .....	.....	.....	.....	.....	.....
William Black.....	Thomas.....	Colby	Sandy loam	12	June 1.....	16	8
G. W. Gilmore.....	"	"	"	18	" 10.....	18	6
W. H. Archer	"	Otterbourne.....	Loam	15	May 15.....	24	10
W. T. Craig .....	" .....	" .....	" .....	.....	.....	.....	.....
H. W. Marshall.....	" .....	" .....	" .....	.....	.....	.....	.....
Paul Haller	Rawlins.....	Atwood.....	{ Loam, hard- pan subsoil, }	13	May 6.....	16	8
Paul Haller	"	"	"	13	" 6.....	.....	12
Paul Haller .....	" .....	" .....	" .....	" .....	" .....	.....	.....

TABLE No. 2 — SHOWING ANALYSES OF SUGAR BEETS GROWN BY THE STATION.

No. of plot.....	VARIETY.	Form of beet.	WEIGHT, IN POUNDS.		Specific gravity of juice.....	Total solids in juice.....	Cane sugar in juice.....	Purity.....	Date of analysis.
			Gross.....	Net.....					
1 {	Bulbeau Desprez .....	.....	.....	.....	1.040	10.0	5.51	55	.....
	"	Good .....	.95	.71	1.045	11.2	7.81	69	Nov. 14
2 {	White Vilmorin.....	Fair.....	.89	.61	1.053	13.1	9.95	76	Oct. 24
	"	Fair.....	.98	.66	1.054	13.3	9.32	70	Nov. 14
3 {	German, Heinrich Hette.....	.....	.59	.43	1.058	14.2	11.01	77	Oct. 24
	"	Fair.....	.81	.60	1.050	12.4	7.82	64	Nov. 14
4 {	Dippe's Imp'r'd White Imperial,	.....	.61	.31	1.045	11.2	8.12	73	Oct. 24
	"	Fair.....	.70	.50	1.053	13.1	8.98	69	Nov. 14
5 {	Dippe's White Improved.....	.....	.81	.54	1.053	13.1	10.48	80	Oct. 24
	"	Fair.....	.54	.39	1.058	14.2	10.38	73	Nov. 14
6 {	Dippe's Klein Wanzlebener .....	.....	.74	.49	1.052	12.8	8.84	78	Oct. 24
	"	Fair.....	.72	.57	1.066	16.1	12.30	77	Nov. 14
7 {	White French.....	.....	.81	.49	1.045	11.2	7.82	70	Oct. 24
	"	Poor.....	.86	.56	1.044	10.9	6.69	61	Nov. 14
8 {	Klein Wanzleb'r, f'm Vilmorin .....	.....	1.13	.74	1.043	10.7	7.12	66	Oct. 24
	"	Poor, hollow top..	1.02	.71	1.052	12.8	8.20	64	Nov. 14
9 {	White, red top.....	.....	1.81	.89	1.037	9.2	5.53	60	Oct. 24
	"	Good.....	1.24	.88	1.040	10.0	5.37	54	Nov. 14
10 {	White, gray top .....	.....	1.10	.46	1.040	10.0	5.73	57	Oct. 24
	"	Poor	1.01	.56	1.041	10.2	5.70	57	Nov. 14
11 {	White, green top, Imp. Brabant.....	.....	1.54	.71	1.047	11.6	5.29	46	Oct. 24
	"	Fair.....	1.30	.77	1.040	10.0	4.35	44	Nov. 14
12 {	White Improved Vilmorin.....	.....	1.22	.65	1.051	12.6	8.89	76	Oct. 24
	"	Fair.....	1.07	.75	1.057	14.0	10.01	71	Nov. 14
13 {	Dippe's Vilmorin.....	.....	.73	.40	1.049	12.2	8.80	72	Oct. 24
	"	Fair.....	.65	.43	1.060	14.7	9.98	67	Nov. 14
14 {	Florimond Desprez richest .....	.....	.74	.47	1.041	10.2	6.47	63	Oct. 24
	"	Stumpy.....	.94	.67	1.044	10.9	6.28	58	Nov. 14
15 {	Simon Le Grande, White Imp. ....	.....	.78	.42	1.051	12.6	9.18	73	Oct. 24
	"	Poor	1.01	.71	1.054	13.3	8.45	64	Nov. 14
16 {	Desprez .....	.....	.78	.48	1.040	10.0	5.64	56	Oct. 22
	"	Good.....	.91	.70	1.050	12.4	8.05	65	Nov. 14
17 {	White Vilmorin, Kas. gr'n seed.....	.....	1.12	.81	1.046	11.4	9.75	85	Oct. 22
	"	Good.....	.65	.44	1.048	11.9	8.30	70	Nov. 14
18 {	White Vilmorin, Dept. Agr. ....	.....	1.08	.62	1.047	11.6	7.02	61	Oct. 22
	"	Good.....	.64	.49	1.062	15.2	10.85	71	Nov. 14

OF SUGAR BEETS SENT TO THE STATION.

Cultivation.	Variety of beet.	Form of beet.	AVERAGE WEIGHT, IN POUNDS.		Specific gravity of juice.....	Total solids in juice.....	Cane sugar in juice.....	Purity.....
			Gross.....	Net ..				
Hoed.	Bulleau Desprez.....	Good.....	2.03	1.70	1.062	15.3	10.22	67
	"	Fair*	2.82	2.16	1.064	15.6	10.29	66
"	Vilmorin, Kansas grown...	Good.....	1.65	1.36	1.068	16.5	12.63	75
Hoed and plowed...	Bulleau Desprez.....	"	1.73	1.43	1.068	16.5	13.12	80
	"	Fair.....	1.69	1.45	1.068	16.5	11.67	71
Plowed.	Bulleau Desprez	"	2.20	1.39	1.053	13.1	9.32	71
	Vilmorin, Kansas grown...	Good.....	.63	.58	1.092	21.9	18.36	84
"	"	"	.61	.56	1.098	23.3	18.41	79
"	Bulleau Desprez.....	Fine*.	1.30	1.09	1.093	22.2	17.37	79

* Wilted.

The analyses given in Table 1 are arranged by counties, and the counties are named in approximately geographical order. Four belts were taken across the State from east to west, and the counties named first are in the southernmost belt. The counties in each belt are named from east to west.

Although nearly all the growers of beets worked under the same instructions, it will be observed that there was a diversity of treatment. Owing to the unsatisfactory season, no attempt will be made to analyze the tables, to learn whether these different conditions seemed to influence the result; but no one set of conditions has produced uniform results. Where the beets were wilted before analysis, the sugar content of the juice was high, because the beets had dried out. The relation of net to gross weight is variable, as was to have been expected. In some cases, a very large proportion of the beet was cut away in removing the top that was exposed to the sun.

The past season was very unfavorable for our trial. In the greater part of the State, the spring and early summer were excessively wet. Farmers who found it very difficult to care for their regular crops because of the frequent and heavy rains were almost sure to neglect a small experimental plot; moreover, the labor and watchfulness necessary to keep the beets in proper condition were much greater than will ordinarily be the case. The wet and cold interfered with the germination of the seed in some instances; some were washed out or drowned out by floods; in some instances the seed was not planted because of the crowd of work. No replies have been received from many who accepted seed with the understanding that an experimental plot was to be grown. The one or the other of the above causes may account for the lack of responses to our requests for beets, and reports upon their growth. As our correspondents were specially requested to fill out the report blanks, whether or not they had grown beets, the fact that but two-thirds of the 360 did so may, perhaps, indicate that our farmers take but little interest in the sugar-beet question. At all events, the trial

this year was eminently unsatisfactory. It cannot be considered conclusive in any sense or particular, and will be repeated again next year, when it is hoped more decisive results may be secured. The names of all who sent in beets at the close of the season will be found in Table No. 1.

There is much misapprehension among our people as to what constitutes a desirable size and form of sugar beet. European experience has pointed out the kind of beet that is most profitable for sugar making. There are several points that are always combined in the typical sugar beet. It is comparatively small, somewhat less than one and a half pounds, and sometimes falling to one pound. A large tonnage is secured by growing the beets close together, a great number being grown on an acre. This typical beet is of long, tapering form, and of regular outline. This has to do, not only with the richness of the juice, but with the cost of harvesting and cleaning. The part of the beet growing out of the soil is of inferior quality and is rejected in sugar making. A beet that naturally grows well in the ground is preferred. By heaping the soil up during culture, the ill effects due to growing out of the ground are reduced.

In connection with the general subject of sugar-beet culture, it seems desirable to say something in recommendation of them as feed for stock. The value of a succulent ingredient in the winter rations of stock is recognized by all progressive farmers. One of the chief advantages of good silage is that it provides a juicy, palatable feed, which stimulates the appetite and assists in maintaining a healthy tone to the system. Root crops of various kinds serve a similar purpose, in addition to their nutritive value. It is evident, however, that the greater the nutritive value of the roots fed, the more they are worth. Farmers are too ready to conclude that the crop which yields the greatest bulk is of the greatest value. On this account, mangel-wurzels are likely to be esteemed above sugar beets, and large beets above those of medium size. Elsewhere, in this bulletin, we have called attention to the necessity of limiting the size of sugar beets, by restricting them in space, in order to develop the highest percentage of sugar. The same considerations hold with equal force in the growth of beets for feed. It is only the dry matter of the beet which gives nutriment to the animal, and a high percentage of sugar is just as desirable in beets designed for feed as it is in those grown for sugar making. The difference in the feeding value of two samples of beets may easily be 100 per cent., on account of the difference in the percentage of sugar in the two. For this reason, also, good sugar beets are far superior to any other root crop in nutritive value. To obtain such beets should be the object of the intelligent farmer; not to see how large beets he can grow. The additional weight of overgrown roots is water, to a very great extent; their texture is coarse, and they are nearly flavorless.

To illustrate the difference in value of certain roots, and to compare

them with sugar beets, the following analyses are given. They are all analyses of fresh material, grown at this Station.

	Water.....	Dry matter.....	Ash.....	Fat.....	Crude protein.....	Crude fiber.....	Nitrogen—free extract.....
Garden beets (red).....	92.89	7.11	1.14	.04	1.95	.71	3.27
Turnips.....	92.71	7.29	.90	.06	2.04	.82	3.47
Kohl-rabi.....	91.25	8.75	1.29	.08	1.71	1.43	4.24
Ruta-bagas.....	89.99	10.01	.69	.10	2.04	1.09	6.10
Sugar beets (Klein Wanzlebener, 1890, 10.3 per cent. sugar).....	84.04	15.96	.77	.03	1.76	.95	12.45

An examination of the table will show the wide difference in value of the roots named, and the decided superiority of sugar beets of even only moderate richness in sugar. It cannot be too strongly impressed upon those contemplating a trial of sugar beets for feed, that only the best seed should be used. That ordinarily sold by dealers as sugar-beet seed is usually not worth much more than ordinary beet seed.

SUMMARY.

A number of varieties of sugar beets were grown by the department on the college grounds. To make the experiment more conclusive as to the whole State, 26 counties were visited, and from one-half to two dozen farmers secured to assist by raising a small plat of beets from our seed according to our directions. In addition to these selected localities, seed was sent to more than 100 farmers in 30 additional counties, the whole number of plats arranged for amounting to about 360. The seed used in all cases was of the best strains of sugar beets.

The extreme wet in the spring and early summer, and the drought later, combined to make the trial unsatisfactory and inconclusive. The fact that only 40 per cent. of those undertaking to grow beets sent in samples, is probably largely due to the vicissitudes of the season.

An examination of the tables will show that the juice was usually of quite moderate to low sugar content. In only a few instances were the beets rich, while a greater number were of fair quality. If the beets raised last year represent our average product, the outlook for the sugar-beet industry in our State is not bright. But the season was so abnormal that no conclusion, as to an ordinary season, can be drawn from the results of last year. The trial will be repeated, hoping to secure average conditions and results.