

EXPERIMENT STATION.
KANSAS STATE AGRICULTURAL COLLEGE,
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CHEMICAL DEPARTMENT.

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EXPERIMENTS WITH SORGHUM.

The work on sorghum has been continued through the season of 1890 on the lines followed in 1888 and 1889. In all this work there have been three prominent aims: (a) The attempt to find better varieties of sorghum for producing sugar; (b) to improve well-known and approved sorts; (c) to secure both early- and late-maturing kinds of good quality, especially the former, in order to lengthen the working season. The desirability of these has been discussed in previous reports of the department. The way these ends have been sought is also fully explained in our former publications. It will not be necessary to treat these matters here further than may be requisite to make clear the work of the present year.

Following the plan of previous years, small plats of many varieties were planted May 3d. These varieties included all those which had given any promise in the past, and some others which it was deemed inadvisable to reject without further trial.

At this place, the past summer has been a peculiarly unfavorable one for sorghum. The soil was warmed up in good season, and was in good condition as regards tilth, but was rather dry. Showers soon brought the sorghum up, and a good stand was secured. It made a good growth until the dry weather of June checked it. It made but little headway during the month of July. The latter part of June and the whole of July were quite warm, being several degrees above the normal temperature for this season. While the sorghum plant is less affected in growth by drought than are many other agricultural plants, this year's heat and drought quite materi-

ally stunted ours, and it is probable that the effect upon the sugar-content is more marked than upon the size of the stalks. But this, the decrease in size, by diminishing the tonnage very materially, diminishes the profits of the crop. The dry, hot weather of June and July was followed in August and September by cooler and wet weather. This started a second growth, apparently. The heads, which had put out at a much less height than usual, ripened in due course, but side shoots in many cases started, a third or half-way down the stalk. From two to four or more of these side branches or suckers grew on a stalk, and reached a greater height than the main stalk. To what the effect is attributable is not so certain, but these canes were plainly inferior. This may have been directly due to the weather—hot and dry when the plants should have been making vigorous growth, and cool and wet when they should have been maturing—or it may have been an indirect effect of these climatic conditions. The late growth, caused by the conditions favoring it, may have consumed sugar, to the impairing of the crop. Further, it is well known that immature canes are quite deficient in crystallizable sugar. The suckers were blooming when the main stalks had ripened seed. It may be that to this immaturity is due the poor quality shown by analysis. This, or the using up of the sugar by the new growth, would seem to be the cause, since it was frequently observed that the canes remained stationary or deteriorated.

In addition to all these disastrous conditions (which might ultimately have been overcome by the whole plant maturing) a frost a full month before the usual time killed, or in so far injured, our sorghum as to render work after that date of questionable value. But it was deemed advisable to continue the analysis to as late a date as possible. We had several new varieties which, in an ordinary season, might have matured, and it was very much desired to learn something about them this first year. While it was fully recognized that their true value could not be told by analyses made in the imperfect state in which they were left by the frost, it was still possible to separate the promising canes from those that were certainly poor. A further reason for continuing the analysis was to select seed from stalks of good quality. This work was seriously interrupted by the frost of September 13th. It was hoped that the relative quality might be told in the imperfect and abnormal condition. In the first days after the date of this frost it is probable that this was true. But the abnormal character of the juice soon became apparent, so much so that the work was abandoned, much as it was regretted.

In previous years killing frosts have been much later than in this year. In 1888 the first frost occurred on the morning of October 3d, but the tender varieties of sorghum only were materially injured by this frost. It was not until October 20th that all the canes were entirely killed. However, the injury from the frost of the 3d seemed to be cumulative; so that even before the final killing the juice became abnormal. On Oct. 6th, 1889, occurred a frost which killed sorghum on low ground, and tender varieties on

higher ground. On the 27th a freeze killed all sorghum. But standard kinds that were mature and situated on high ground remained in good condition until this date. An examination of the records at this place reveals the fact that the earliest frost in the previous thirty-two years occurred on September twenty-third. This was in 1868. The average date of the first killing frost is October eleventh.

It has been questioned whether the northern or central portions of Kansas will prove to be suitable for sorghum-sugar growing, because of the shortness of the season. The experience of the past season would seem to give a basis for this fear. As before stated, a frost, which killed many varieties of sorghum and prevented the maturing of all others, occurred on the morning of September 13th. But this must be understood to be so very exceptional that no account should be taken of it. It is true that when such frosts come, it would cause disaster that year, and this would tell against the general profits of the industry. The unusual character of this early frost may be seen from the following facts: Letters of inquiry sent to the several sugar factories in the State, elicited the fact that the frost was peculiar in its geographical distribution. We had a hard freeze September 13th, but no further freeze occurred until October 19th. At Topeka, fifty miles east, no damage whatever was done, and the crop remained green and sound until the latter date. At Ness City there was only slight damage, and this in low places. At Sterling the damage was much the same as here at Manhattan. Fort Scott, Medicine Lodge and Conway Springs reported no damage whatever. Like Topeka, they entirely escaped the cold wave. It seemed to come in from the northwest, and penetrated toward the south and east. But the whole eastern part of the State was exempt from its effects. The erratic character of these cold waves is well known, and previous years have given familiar illustrations of their course.

The northern and western sections of the State will generally be more subject to these visitations, and it may be that the normal season in these parts will be too short for profitable sugar making, while further south it will be remunerative. At best the season is short, and although there is but little absolute difference in the season, it is considerable relatively. If the period between the ripening of the canes and the time they are killed by frost be eight weeks in one district and six in another, it is perfectly obvious that the time for work is thirty-three per cent, longer in the one case than in the other. This is a matter of very great importance, as will be understood when it is remembered that the expensive machinery is rusting out when not in use, and that interest must be paid on the investment for the whole year.

Quite a number of new sorts tried last year were found to be mostly non-saccharine, so called, or quite low in sugar, and were not grown again this year. Some thirty kinds never before grown in this country were tried. This new seed was kindly furnished us by Dr. Collier, Director of New York Experiment Station. Some of this seed failed to germinate, and

most of the others were very late and failed to mature seed. These late sorts are quite large, and have very heavy foliage, seeming to recommend them as forage plants. But most of them have dry, woody stalks, and but little sugar in the juice. The fodder which they would furnish would not only be lacking in nutritiousness, but would not be very palatable. For purposes of comparing the several varieties grown this year with each other, as well as with the same sorts grown in previous years, the analytical results are published in tabular form.

As this bulletin may come into the hands of some who have not read our previous publications, it may be explained that the "reducing sugar" of the tables is what is often reported as glucose, and includes the uncrystallizable sugars. "Cane sugar" is the common sugar of commerce, whether obtained from tropical cane, sorghum, beets, or maples, and is often called sucrose in reports of analyses.

ANALYSES OF OLD VARIETIES OF SORGHUM.

No. of plant.....	Names of varieties.	Date of analysis.	No. of stalks.....	Average Height in feet.....	Av. Wt. of Dressed Canes in grams.....	Av. Wt. of Dressed Canes in pounds.....	Av. Wt. of Tops in grams.....	Av. Wt. of Tops in pounds.....	Per cent. of Juice extracted.....	Specific Gravity of Juice.....	Per cent. of Cane Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
83	Chinese from Dept. Agriculture....	Sept. 19	10	8.3	424	.93	97	.21	55.4	1.060	9.15	2.86
62	Cross between Orange and Amber..	Sept. 5	20	6.4	241	.53	61	.13	36.7	1.072	13.20	1.73
70	Cross between Orange and Amber..	Sept. 6	20	6.4	240	.53	62	.14	41.6	1.072	13.26	1.73
66	Cross between Orange and Amber..	Sept. 6	20	6.8	306	.67	52	.11	44.9	1.072	13.26	2.53
11	Cross between Orange and Amber..	Sept. 10	20	7.1	433	.95	38	.08	42.6	1.077	13.87	2.16
62	Cross between Orange and Amber..	Sept. 15	45	.....	.....	.....	.....	.....	.....	1.077	14.59	1.19
10	Early Amber, best.....	Sept. 22	10	6.8	294	.65	58	.13	49.2	1.071	12.18	1.76
10	Early Amber, best.....	Sept. 4	20	.....	273	.60	85	.19	43.8	1.076	14.38	1.26
10	Early Amber, best.....	Sept. 13	55	.....	.....	.....	.....	.....	.....	1.074	13.73	1.06
87	Early Amber, var. from	Sept. 19	10	6.9	455	1.00	94	.21	56.0	1.053	9.33	2.63
67	Early Tennessee	Sept. 2	10	6	175	.39	49	.11	41.3	1.032	7.81	1.76
90	Folger's Early.....	Sept. 6	20	7.9	244	.54	74	.17	37.0	1.075	14.13	1.63
3	Honey Drip	Sept. 23	10	7.5	593	1.30	10	.22	56.2	1.062	10.42	2.42
75	Honey Dew	Sept. 10	10	7	318	.69	.....	.....	37.1	1.072	12.40	1.55
79	Improved Orange.....	Sept. 19	10	7.5	338	.74	71	.16	50.6	1.067	10.31	3.68
07	Kansas Orange	Sept. 15	10	5.8	305	.67	74	.16	47.8	1.077	14.75	1.26
81	Kansas Orange	Sept. 18	10	6.5	441	.97	95	.21	50.9	1.068	12.56	1.87
07	Kansas Orange.....	Sept. 19	86	.....	.....	.....	.....	.....	.....	1.071	13.01	1.37
1	Kansas Orange.....	Sept. 23	10	7.2	435	.96	42	.09	56.0	1.064	10.78	3.09
2	Kansas Orange.....	Sept. 23	10	7.5	488	1.07	.....	.....	54.2	1.069	11.65	2.92
47	Var. with late Orange	Sept. 20	100	.....	.....	.....	.....	.....	.....	1.071	13.58	.....
47	Var. with late Orange	Sept. 20	.....	.....	.....	.....	.....	.....	.....	1.080	13.87	.....
9	Late Orange.....	Sept. 23	10	6.7	505	1.11	68	.15	51.8	1.066	11.03	3.03
117	Late Orange.....	Sept. 27	15	.....	.....	.....	.....	.....	.....	1.067	13.81	.....
119	Late Orange.....	Sept. 27	15	.....	.....	.....	.....	.....	.....	1.080	14.45	.....
64	Link's Hybrid	Sept. 22	10	8.2	381	.84	52	.11	53.1	1.056	9.32	1.74
68	Link's Hybrid	Sept. 22	10	8.2	380	.84	57	.13	52.3	1.058	9.81	1.71
6	Link's Hybrid	Sept. 23	10	9	590	1.30	31	.07	54.4	1.064	11.73	1.21
8	Link's Hybrid	Sept. 23	10	8.9	533	1.27	80	.18	56.4	1.056	9.67	1.55
.....	Link's Hybrid	Sept. 16	40	.....	.....	.....	.....	.....	.....	1.065	10.95	2.14
73	Medium Orange.....	Sept. 3	10	5.9	206	.45	63	.14	37.6	1.071	13.66	1.85
65	Medium Orange.....	Sept. 3	10	6.9	247	.54	58	.13	37.1	1.077	15.04	.81
17	Medium Orange.....	Sept. 6	20	5.9	206	.45	55	.12	55.3	1.083	16.77	49
65	Medium Orange.....	Sept. 17	.....	.....	.....	.....	.....	.....	.....	1.076	14.85	.42
74	Medium Orange.....	Sept. 22	10	6.7	299	.66	63	.14	46.4	1.069	12.37	74
13	Price's Early	Sept. 6	20	7.3	301	.66	62	.14	46.1	1.052	7.09	3.65
88	Swain's Early Golden	Sept. 6	20	6.2	197	.43	24	.05	35.7	1.076	.....	1.24
88	Swain's Early Golden	Sept. 22	10	6.5	262	.58	25	.06	46.8	1.073	13.26	1.23
88	Swain's Early Golden	Sept. 2	20	6.8	193	.42	22	.05	37.7	1.077	14.91	1.66
60	Sorghum from Cape Town.....	Sept. 18	10	7.9	431	.95	83	.18	52.8	1.063	9.46	2.54
23	S. C. Early Orange	Sept. 23	10	8	692	1.52	58	.12	57.8	1.064	11.16	2.54
34	White African	Sept. 4	20	.....	279	.61	.....	.....	42.3	1.070	12.16	1.87
71	White African	Sept. 10	10	7.2	328	.72	.....	.....	42.2	1.070	11.22	1.57
61	White African	Sept. 13	10	7.5	291	.64	26	.06	51.7	1.070	11.71	1.38
5	White Amber	Sept. 6	20	6.3	200	.44	25	.06	31.4	1.080	15.57	1.65
5	White Amber.....	Sept. 17	54	.....	.....	.....	.....	.....	.....	1.074	13.60	1.61
85	White Mammoth.....	Sept. 18	10	5.3	355	.78	.....	.....	51	1.066	12.11	1.81

ANALYSES OF VARIETIES OF SORGHUM OBTAINED FROM DR. PETER COLLIER, IN 1889.

No. of plant.....	Collier's No., 1889.....	NAMES OF VARIETIES.	Date of analysis.....	No. of stalks in sample.	Av. Height, in feet.....	Av. Weight of Dressed Cane, in grams.....	Av. Weight of Dressed Cane, in pounds.....	Av. Weight of Tops, in grams.....	Av. Weight of Tops, in pounds.....	Per cent. of Juice extracted.....	Specific Gravity of Juice.....	Per cent. of Cane Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
22	6	Sorghum vulgare, var. bicolor, bl'ck-seeded, Calcutta,	Sept. 4	10	7.5	211	.46	85	19	2.98	1.047	.....	1.36
22	6	Sorghum vulgare, var. bicolor, bl'ck-seeded, Calcutta,	Sept. 4	10	5.3	200	.44	86	.19	43.1	1.051	7.02	1.16
58	6	Sorghum vulgare, var. bicolor, bl'ck-seeded, Calcutta,	Sept. 19	10	7.2	357	.79	110	.24	54.4	1.056	7.29	3.65
23	10	Shanghai Sorghum, China.....	Sept. 22	10	9.2	499	1.10	58	.13	50.0	1.055	8.04	2.76
52	12	Tsung Ming Sorghum, China,	Sept. 22	10	7.8	337	.74	54	.12	51.5	1.061	8.69	2.98
56	12	Tsung Ming Sorghum, China,	Sept. 15	12	6.5	303	.67	79	.17	49.5	1.070	10.93	3.11
40	42	Chinese Sugar Cane, Ning-Po, China.....	Sept. 22	10	7.9	387	.85	60	.13	48.5	1.067	8.52	1.95
14	42	Chinese Sugar Cane, Ning-Po, China.....	Sept. 5	20	7.5	229	.51	48	11	43.7	1.054	8.42	2.79
50	43	Sorghum, bicolor, red-seeded, India.....	Sept. 4	10	6.0	238	.53	85	.19	46.0	1.056	7.55	3.09
20	45	Sorghum, bicolor, black-seeded, India.....	Sept. 15	10	7.2	307	.68	93	.20	51.5	1.061	7.91	3.14
43	51	White-seeded Sorghum, Foo-chow, China.....	Sept. 10	20	5.4	212	.47	95	.19	41.1	1.056	8.05	1.10
46	59	Chinese Sugar Cane, Shanghai, China.....	Sept. 5	20	7.6	292	.64	55	.12	41.9	1.063	10.35	2.62
46	59	Chinese Sugar Cane, Shanghai, China.....	Sept. 8	20	7.8	303	.67	53	.12	36.0	1.067	11.11	2.35
42	60	Sorghum, Orange hatif, Algiers.....	Sept. 22	10	6.7	367	.80	89	.20	51.4	1.069	10.57	3.79
39	64	Sorgho, sucre de Changelard,	Sept. 16	10	6.7	359	.79	102	.22	50.6	1.058	7.94	2.10
38	68	Sorghum, from Caracas, Venezuela.....	Sept. 8	20	6.0	178	.39	55	.12	35.3	1.067	10.25	2.25
27	113	Second Autumn Red Millet, North China.....	Sept. 2	10	6.0	182	.29	.....	.....	15.2	1.053	6.42	.....
16	116	Second Autumn Red Millet, North China.....	Sept. 8	20	6.7	241	.53	89	20	39.2	1.058	5.37	3.88
29	122	Large People's Red Millet, North China.....	Sept. 9	20	7.8	175	.39	.....	.....	22.9	1.056	6.64	5.26
146	125	Large People's Red Millet, g. n., North China.....	Sept. 9	20	7.0	270	.59	79	.17	42.7	1.065	9.86	2.76
30	125	Large People's Red Millet, g. n., North China.....	Sept. 19	10	8.5	403	.89	104	.23	51.9	1.062	8.96	2.86
147	126	Large People's Red Millet, large, North China.....	Sept. 10	10	7.5	261	.57	94	.21	29.2	1.032	1.69	1.61
17	128	Undendebule, Natal, Africa.....	Sept. 12	20	6.5	211	.46	91	.20	35.5	1.064	9.94	1.24
49	131	Ukubane (a), Natal, Africa.....	Sept. 13	10	7.6	363	.80	85	.19	48.3	1.063	10.11	1.81
143	132	Ukubane (a), Natal, Africa.....	Sept. 5	20	6.5	145	.32	73	16	26.0	1.058	8.08	1.28
48	135	Jyagentombi, Natal, Africa.....	Sept. 22	10	8.0	381	.84	72	.16	48.6	1.060	9.07	2.73
151	141	Dindemuka, Natal, Africa.....	Sept. 8	20	6.1	.....	.....	44	10	.....	1.073	12.40	2.16
31	142	Dindemuka (Nesbit), Natal, Africa.....	Sept. 16	10	7.1	319	.70	84	.18	48.6	1.059	4.96	2.30
35	142	Dindemuka, (Nesbit), Natal, Africa.....	Sept. 16	10	7.4	326	.72	79	.17	49.5	1.060	9.42	1.81
153	145	Uboyana, Natal, Africa.....	Sept. 18	10	6.4	321	.71	101	.22	50.6	1.053	7.62	2.50
57	152	Ufatane (Nesbit), Natal, Africa.....	Sept. 18	9	6.5	279	.61	87	19	52.7	1.057	7.83	3.27
51	155	Unkunjana, Natal, Africa.....	Sept. 16	10	7.8	413	.91	69	.15	52.1	1.064	10.83	1.96
156	159	White Imphee, Iowa.....	Sept. 13	10	7.5	239	.53	89	.18	38.1	1.071	11.33	7.8
153	165	Iowa Red Top, Illinois.....	Sept. 3	10	7.3	214	.47	48	.11	37.2	1.063	11.53	2.53
26	166	Black Sorgho, Cawnpoor, India.....	Sept. 5	20	5.8	193	.42	84	.18	41.8	1.058	8.73	2.10
26	166	Black sorgho, Cawnpoor, India.....	Sept. 8	20	6.0	178	.40	63	.14	35.3	1.067	10.25	2.23
159	167	Black sorgho (b), Cawnpoor, India.....	Sept. 19	10	7.5	398	.88	88	.19	53.2	1.061	8.18	3.50
159	167	Black Sorgho (c), Cawnpoor, India.....	Sept. 15	10	8.2	353	.78	74	.16	52.8	1.053	7.17	3.65
36	167	Black Sorgho (c), Cawnpoor, India.....	Sept. 22	10	7.2	390	.86	96	.21	53.2	1.060	8.28	3.05
161	168	Black sorgho (Nesbit), Cawnpoor, India.....	Sept. 12	10	7.4	283	.62	76	.17	41.1	1.069	12.29	1.67
160	168	Black Sorgho (Nesbit), Cawnpoor, India.....	Sept. 15	10	7.4	202	.44	77	.17	31.2	1.059	8.23	1.27
41	170	Red Sorgho (Nesbit), Cawnpoor, India.....	Sept. 9	20	7.9	182	.40	79	.17	32.0	1.059	8.01	1.00

ANALYSES OF VARIETIES OF SORGHUM — CONCLUDED.

No. of pubd.	Cultivar's No., 1889 ...	NAMES OF VARIETIES.	Date of analysis.....	No. of stalks in sample	40. Height, in feet.....	40. Weight of Dressed Cane, in grams.....	40. Weight of Dressed Cane, in pounds.....	40. Weight of Tops, in grams.....	40. Weight of Tops, in pounds.....	Per cent. of Juice extracted.....	Specific Gravity of Juice.....	Per cent. of Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
37	170	Red Sorgho (Nesbitt), Cawnpoor, India..	Sept. 12	15	5.3	186	.41	77	.17	38.3	1.068	10.99	1.20
162	175	Gray-Top, Tenn.....	Sept. 22	10	6.1	285	.66	64	.14	51.4	1.058	7.83	2.95
59	176	New Variety, Haswell, Iowa	Sept. 16	10	7.0	354	.78	92	.20	49.5	1.072	12.03	2.45
25	177	Chinese Imphee, Haswell, Iowa	Sept. 12	10	7.9	390	.86	78	.17	25.3	1.065	11.21	1.64
21	177	Chinese Imphee, California	Sept. 12	10	8.5	294	.64	54	.12	41.3	1.069	11.33	2.17
163	179	New Variety, Bradford, N. C.	Sept. 19	10	7.5	453	1.00	91	.20	55.6	1.074	4.45	5.75
55	183	H. P. W's. Seed.	Sept. 4	10	7.5	308	.68	51	.11	47.1	1.077	14.11	1.29
15	183	H. P. W's. Seed.	Sept. 16	10	8.0	409	.90	100	.22	52.3	1.051	6.55	2.79
54	183	H. P. W's. Seed.	Sept. 16	10	6.5	345	.76	52	.11	49.3	1.072	12.46	2.53

ATTEMPTS TO IMPROVE SORGHUM BY SEED SELECTION.

Good-sized plats were planted with seed obtained from our best stalks last year, and up to the dry weather of midsummer we had every reason to anticipate interesting results. A large number of stalks were analyzed, but while some of the results were quite favorable, a comparison of the table of analyses of single stalks with the table published last year will show that on the whole the results are lower this year. A few varieties show improvement, but the most of them do not. The lowering of the results is most marked in the later varieties, some of which, like African, became too poor to work with. As an indication of what might have been looked for, we call especial attention to the results obtained with Medium Orange, a cane which is nearly or quite identical with Early Amber, and hence matured before the frost. The best stalk obtained in 1888 gave in 1889 a crop from which a general sample had 14.05 per cent. of cane sugar, and a single stalk had 16.16 per cent. The seed from this stalk in 1890 yielded cane, an average sample of which, September 6th, contained 16.77 per cent. cane sugar, which was the highest result obtained in any analyses during the season. By September 17th, four days after the frost, the average had fallen to 14.85 per cent., and the best stalk obtainable had 15.37 per cent.

To illustrate further the inferior results of this year, we call attention to Kansas Orange and Link's Hybrid. In 1888 the highest percentages of cane sugar in these varieties were 16.44 and 14.47, respectively; in 1889, 16.79 and 16.94; in 1890, 15.24 and 14.47.

TABLE GIVING ANALYSIS OF SINGLE STALKS.

VARIETIES.	Date of Analysis.	Kind of Seed, 1889.	No. of stalks from which selections were made	Specific Gravity of Juice.	Per cent. of Cane Sugar in Juice.	Per cent. of Reducing Sugar
Amber and Orange crossed.	Sept. 15	Best	50	1.083	16.03	.87
Amber and Orange crossed.	Sept. 15	Best	50	1.083	15.87	1.10
Amber and Orange crossed.	Sept. 15	Best	50	1.081	15.06	.....
Amber and Orange crossed.	Sept. 24	Sterling	60	1.084	15.48	.77
Amber and Orange crossed.	Sept. 24	Sterling	60	1.083	15.17	.....
Amber and Orange crossed.	Sept. 24	Sterling	60	1.082	15.19	.....
Amber and Orange crossed.	Sept. 24	Sterling	60	1.082	15.06	.....
Early Amber.	Sept. 24	Best	60	1.084	16.01	.87
Early Amber.	Sept. 24	Best	60	1.083	16.03	.....
Early Amber.	Sept. 21	Best	60	1.080	15.38	.....
Early Amber.	Sept. 24	Best	60	1.080	12.91	.....
Early Amber.	Sept. 24	Best	60	1.080	15.56	.....
Kansas Orange.	Sept. 19	Best	89	1.080	15.24	.....
Kansas Orange.	Sept. 19	Best	89	1.081	14.90	.94
Link's Hybrid.	Sept. 16	Best	79	1.079	14.47	.....
Link's Hybrid.	Sept. 16	Best	79	1.075	13.87	1.03
Medium Orange.	Sept. 17	Best	.....	1.081	15.23	.36
Medium Orange.	Sept. 17	Best	.....	1.080	15.37	.....
Swain's Early Golden	Sept. 12	Best	60	1.082	15.72	1.30
Swain's Early Golden	Sept. 12	Best	60	1.082	15.43	.....
Undendebule	Sept. 23	Sterling	40	1.085	15.79	.84
Undendebule	Sept. 23	Sterling	40	1.084	15.34	.96
Undendebule	Sept. 23	Sterling	40	1.081	14.48	.....
Undendebule	Sept. 24	Sterling	45	1.079	14.45	1.32
Undendebule	Sept. 24	Sterling	45	1.079	14.15	.....
White Amber	Sept. 17	Best	54	1.079	15.17	1.19
White Amber	Sept. 17	Best	54	1.079	15.14	.....
White Amber	Sept. 17	Best	54	1.078	15.09	.....

We have collected into a table the principal results obtained by analysis of individual stalks during the last three years. While the results are not always consistent, as a whole it may be safely said that the plan of improving sorghum by seed selection is given considerable support. The column headed "General sample" contains average analyses of the varieties named. The single-stalk analyses are of individuals selected from the plat the analysis of which is recorded in the same line and the same year. The general samples for 1889 and 1890 were from crops grown from seed the products of the sample next to the left.

Examples: Kansas Orange, average composition 1888, cane sugar 12.62, red. sugar 2.90. From this a single stalk was selected, having cane sugar 15.51, red. sugar 1.69. In 1889 a general sample was taken from a plat grown from the general sample of 1888, and another grown from the single stalk. Results: 12.33 cane sugar, 2.89 red. sugar; and 13.88 cane sugar, 2.85 red. sugar, respectively. A single stalk was selected from the plat grown from average seed, which gave cane sugar 16.08, red. sugar .81. Two stalks were selected from the plat grown from the single head; composition of juice 16.79 and 15.28 of cane sugar, and 2.11 and 2.43 of red. sugar.

Toward the left side of the table many of the analyses will be found repeated in two or more lines, in order to show the ancestry of general samples and individual stalks further to the right.

TABLE SUMMARIZING RESULTS OF SEED SELECTION WITH SORGHUM.

VARIETIES.	1888.				1889.				1890.			
	General sample.		Single stalk.		General sample.		Single stalk.		General sample.		Single stalk.	
	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.	Per cent Cane Sugar.....	Per cent Re-ducting Sugar.
African	10.11	4.38	11.05	7.05	7.58	5.21	9.63	4.88	.....	.....	.....	.....
Early Amber .....	.....	.....	.....	.....	13.95	1.76	15.56	.68	14.37	1.26	16.01	.87
Honey Drip.....	8.41	2.91	10.41	2.70	11.73	2.31	15.21	1.14	10.42	2.42	.....	.....
Kansas Orange.....	12.62	2.90	.....	.....	12.33	2.89	16.08	.81	14.75	1.26	15.24	.94
Kansas Orange.....	12.62	2.90	15.51	1.69	13.87	2.85	16.79	2.11	11.65	2.92	.....	.....
Kansas Orange.....	12.62	2.90	15.51	1.69	13.87	2.85	15.28	2.43	10.73	3.09	.....	.....
Late Orange.....	15.04	1.69	15.37	2.01	13.98	2.59	16.48	2.05	11.03	3.03	.....	.....
Link's Hybrid.....	14.01	.83	14.27	.54	12.94	1.13	14.10	.75	11.77	1.21	.....	.....
Link's Hybrid.....	14.01	.83	.....	.....	15.32	1.01	16.94	.53	10.95	2.14	14.47	1.03
Medium Orange.....	12.32	1.07	16.25	.45	14.05	.51	16.16	.73	16.77	.49	.....	.....
Orange & Amber cross'd	12.70	1.57	14.18	1.70	14.83	1.54	17.47	1.33	14.59	1.19	16.03	.87
Orange & Amber cross'd	12.70	1.57	14.18	1.70	14.83	1.54	15.38	1.23	.....	.....	.....	.....
S. C. Early Orange.....	14.63	4.84	15.34	1.64	10.57	2.77	14.19	2.27	11.16	2.54	.....	.....
Swain's Early Golden.....	12.67	1.55	14.65	1.02	12.59	1.68	15.32	2.03	14.66	1.24	15.72	1.30
White African.....	9.25	2.46	9.77	6.46	12.72	1.98	15.50	.....	12.16	1.87	.....	.....
White African.....	10.43	1.65	12.51	1.22	12.42	1.55	15.56	1.18	13.60	1.61	15.17	1.19

The Department received, from the Secretary of Agriculture, a large number of selected seed-heads of sorghum, grown at Sterling, in this State. This seed has been selected because of the high sugar-content of the cane on which it grew, and each head was accompanied by the analytical data obtained. We selected a number of representative heads of the best quality, and planted some in entirely isolated plats, and others in our general series of plats. The unprecedented frost of September 13 destroyed all hopes of comparing these plats with sorghum grown from our own selected seed. We give in a table the results obtained. While many of them are favorable, they are much inferior to the stalks which produced the seed.

ANALYSES OF SORGHUM GROWN FROM SEED FURNISHED BY THE DEPARTMENT OF AGRICULTURE.

VARIETIES.	Date.	No. Stalks taken.....	Ave. Height, in feet.....	Ave. Weight of Dressed Canes, in grams.....	Ave. Weight of Dressed Canes, in pounds.....	Ave. Weight of Tops in grams.....	Ave. Weight of Tops in pounds.....	Per cent. of Juice Ex-tracted.....	Specific Gravity of Juice.....	Per cent. of Cane Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
Cross bet. Amber and Link's...	Sept. 10	10	7.9	.....	.....	94	.21	.....	1.059	9.07	2.86
Cross bet. Amber and Link's...	Sept. 10	10	7.2	245	.....	54	.53	.12	83.1	1.072	2.75
Cross bet. Amber and Orange...	Sept. 25	10	6.4	431	.....	95	.73	16	54.6	1.068	11.57
Cross bet. Amber and Orange...	Sept. 9	20	6.6	345	.....	76	.94	21	45.8	1.076	14.37
Cross bet. Amber and Orange...	Sept. 24	60	.....	.....	.....	.....	.....	.....	1.074	13.49	1.29
Cross bet. Amber and Orange...	Sept. 9	20	6.3	348	.....	77	.97	.21	47.4	1.077	15.39
Cross bet. Amber and Orange...	Sept. 9	20	7.0	341	.....	75	.98	.22	41.8	1.072	13.61
Cross bet. India and Orange....	Sept. 15	10	7.0	302	.....	66	.73	.16	49.4	1.069	11.49
Cross bet. India and Orange....	Sept. 26	10	7.0	355	.....	78	.62	.14	50.4	1.062	10.37
Cross bet. Link's and Liberian..	Sept. 25	10	7.0	348	.....	77	1.00	.22	56.5	.....	9.43
Cross bet. Link's and Orange..	Sept. 25	10	7.6	376	.....	83	.70	.15	80.0	.....	12.56
Link's Hybrid.....	Sept. 26	10	8.3	408	.....	90	.76	.17	54.2	1.054	8.98

ANALYSES OF SORGHUM GROWN FROM SEED — CONCLUDED.

VARIETIES.	Date.	No. Stalks taken.....	Av. Height, in feet.....	Av. Weight of Dressed Canes, in grams.....	Av. Weight of Dressed Canes, in pounds.....	Av. Weight of Tops, in pounds.....	Av. Weight of Tops, in grams.....	Per cent. of Juice Extracted.....	Specific Gravity of Juice.....	Per cent. of Cana Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
Link's Hybrid	Sept. 26	10	9.1	447	.98	71	.16	53.0	1.056	9.32	1.66
Late Orange	Sept. 26	10	7.3	477	1.05	52	.11	54.6	1.067	11.81	2.60
Rio Blanco.....	Sept. 26	10	7.3	444	.98	46	.10	52.5	1.066	10.44	3.23
Sorghum Bicolor.....	Sept. 12	15	5.6	188	.41	72	.16	38.1	1.071	11.60	1.09
Sorghum Bicolor.....	Sept. 26	10	5.9	249	.55	79	.17	47.8	1.066	10.49	1.04
Ubeblana	Sept. 26	10	9.5	569	1.25	57	.13	56.4	1.064	9.91	3.03
Ufatane.....	Sept. 25	10	7.3	412	.91	116	.26	55.0	1.053	7.86	2.54
Undendebule.....	Sept. 15	10	8.1	439	.97	40	.09	49.4	1.074	13.60	1.29
Undendebule.....	Sept. 19	10	7.8	393	.86	73	.16	51.9	1.070	12.50	1.42
Undendebule.....	Sept. 23	40	.....	.....	.....	.....	.....	.....	1.075	13.47	1.19
Undendebule.....	Sept. 24	45	.....	.....	.....	.....	.....	.....	1.068	12.09	1.46

A TRIAL WITH FERTILIZERS.

An experiment was begun to see whether better sorghum may be produced by the use of fertilizers and good cultivation. To this end plats were staked off permanently, so that the same treatment may be given these plats for a series of years. The treated plats alternate with "nothing" plats. The following substances were selected for trial: Lime, superphosphate, nitrate of soda, sulphate of potash, plaster (gypsum), and a complete fertilizer, composed of superphosphate, sulphate of potash, nitrate of soda, and plaster. The lime was applied at the rate of 20 bushels per acre; the superphosphate at the rate of 600 pounds per acre; nitrate of soda, 400 pounds; sulphate of potash, 400 pounds; and plaster, 200 pounds. To the plat receiving the complete fertilizer the following amounts per acre were applied: Sodium nitrate, 200 pounds; potassium sulphate, 200 pounds; superphosphate, 300 pounds; plaster, 100 pounds. The fertilizer was sown broadcast along the rows soon after planting. All the plats, the "nothing" and the treated ones, were planted on May 3d with Kansas Orange seed of good strain. A good stand was secured, and the plants grew well until the dry, hot weather of the summer injured them. The comparison contemplated was the sugar-content of the fully-matured canes. Accordingly, the crop was left standing until it should ripen. The Kansas Orange cane, to which the plats were planted, is usually a clean, straight cane. But this year it was badly suckered, so that every stalk had as many as three heads. The suckers were not those so commonly seen in sorghum starting from near the base of the stalk. They put out nearly three feet below the central head. This tendency to branch has been observed in ordinary seasons in some sorts, but it was greatly exaggerated this year. At the time of the maturing of the central stalk the side branches were immature, and were caught by the early frost. Owing to the inferior canes on all the plats, the full work was not completed, as it became apparent that no comparison of value could be made with such sorghum as was produced this year. However, in accordance with our custom of publishing all work, whatever the outcome, the results of the analyses are here given. As a caution, the statement is

here repeated, that the canes with which late analyses had to do had deteriorated.

Each plat will be given the same treatment in succeeding years as in this, and it is hoped that the problem of the effect of fertilizers may be studied under more favorable circumstances, and hence with more satisfactory results.

ANALYSES OF SORGHUM GROWN ON FERTILIZED PLATS.

FERTILIZER APPLIED.	No. of Plat.....	Date of analysis.....	No. of Stalks in sample.....	Av. Weight of Clean Canes, in pounds.....	Per cent. of Juice extracted.....	Specific Gravity of Juice.....	Per cent. of Cane Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
Nothing.....	1	Oct. 1.....	37	.65	47.0	.....	11.62	2.87
Superphosphate, Potassium Sulphate, Sodium Nitrate, and Gypsum.....	2	Oct. 1.....	36	.68	47.6	.....	11.68	2.78
Nothing.....	3	Sept. 29.....	35	.77	50.4	1.068	11.17	3.07
Potassium Sulphate.....	4	Sept. 29.....	41	.63	48.1	1.065	10.29	3.29
Nothing.....	5	Sept. 29.....	47	.62	48.2	1.068	11.43	2.84
Sodium Nitrate (Chili saltpetre).....	6	Sept. 29.....	42	.70	49.0	1.072	12.13	2.91
Nothing.....	7	Sept. 29.....	44	.69	49.8	1.070	11.79	2.92
Superphosphate.....	8	Sept. 30.....	45	.68	48.7	1.068	11.46	2.92
Nothing.....	9	Sept. 30.....	41	.66	47.6	1.071	11.97	2.86
Gypsum (plaster).....	10	Sept. 30.....	36	.75	50.3	1.070	11.52	2.88
Nothing.....	11	Sept. 30.....	23	.72	50.6	1.070	11.57	2.92
Lime.....	12	Sept. 30.....	39	.51	45.9	1.073	12.08	2.55
Nothing.....	13	Sept. 30.....	42	.51	46.5	1.075	12.83	2.51
Salt.....	14	Sept. 30.....	42	.45	45.6	1.070	11.71	2.53
Nothing.....	15	Sept. 30.....	37	.61	47.3	.....	11.68	2.79

RESULTS WITH CROSSES.

Last year a large number of crosses were observed in some of the plats. But few of these gave any promise of superiority, and most of them were inferior to the parent variety. Seed was preserved from some of the best, and the crops obtained this year analyzed. They show no improvement. The results are given in a table. A comparison with the varieties from which they sprung will show the deterioration by crossing. It is evident that to produce cane of the highest value the seed should be pure and two varieties should not be planted in close proximity.

ANALYSES OF SORGHUM GROWN FROM CROSSES SELECTED IN 1889.

No. of Plat.....	VARIETY FROM WHICH CROSS WAS TAKEN.	Date.	No. of Stalks.....	Av. Height of Stalks, in feet.....	Av. Weight of Dressed Canes, in grams.....	Av. Weight of Dressed Canes, in pounds.....	Av. Weight of Tops, in grams.....	Av. Weight of Tops, in pounds.....	Per cent. of Juice extracted.....	Specific Gravity of Juice.....	Per cent. of Cane Sugar in Juice.....	Per cent. of Reducing Sugar in Juice.....
94	Cross from African.....	Sept. 9.....	10	6.9	.....	.....	106	.23	.....	1.054	7.47	2.96
98	Cross from African.....	Sept. 22.....	10	7.3	.....	.....	95	.21	.....	1.068	7.84	3.70
102	Cross from African.....	Sept. 22.....	10	7.3	477	1.05	116	.26	53.4	1.052	6.81	3.33
100	Cross from var. with Amber.....	Sept. 15.....	10	6.9	387	.85	85	.19	50.6	1.066	10.49	2.92
99	Cross from Link's.....	Sept. 15.....	10	7.4	401	.88	83	.18	53.1	1.052	7.92	2.21
96	Cross from Link's.....	Sept. 18.....	10	7.9	404	.89	65	.14	52.9	1.064	10.11	2.84
103	Cross from Link's.....	Sept. 19.....	10	8.7	496	1.09	88	.19	58.6	1.053	9.91	2.13
72	Cross from White African.....	Sept. 10.....	10	7.2	350	.77	84	.18	97.2	1.062	9.34	3.14
92	Cross from Chinese.....	Sept. 8.....	20	6.9	271	.60	48	.11	41.4	1.074	12.86	2.54

SMUT IN SORGHUM.

In our efforts to find earlier or better varieties of sorghum, seed has been planted which originated in various parts of the world.

An observation made this year suggests a word of caution in regard to the indiscriminate introduction of foreign varieties. Several varieties grown by the department for the first time in this country were found to be badly infected by a smut which, while not changing the appearance of the seed-top to a great extent, completely destroys the infected grains. They become considerably enlarged and in many cases burst, allowing the black spores to escape. This *grain smut* of sorghum has also been observed here upon sorghum grown by the Farm Department. In addition to this, we have observed a single example of a smut which in general appearance closely resembles the ordinary smut of corn, the grains being enormously enlarged and converted into a loose black powder. This occurred in a plat of African or Liberian sorghum. The seed from which this was derived was first planted here two years before, and had shown no signs of the disease in the two former years. Neither had an example of the disease been observed on any other variety at this station before. What was the origin in this case we are unable to say. Only one stalk was affected. The principal central head was blasted, having not over half a dozen seeds in it. The smut appeared in four lateral heads, which were entirely destroyed by the disease.

These smuts are at present not prevalent enough to cause much injury, but too great care cannot be taken to avoid increasing the disease by planting native or imported seed which is infected. It is not improbable that some fungicide which has been successful with wheat or oat smut may also entirely eradicate these diseases in cases where they have obtained foothold.

EXPERIMENTS WITH SUGAR BEETS.

During the past season several varieties of sugar beets were grown by the department. Four varieties of seed were obtained direct from the well-known seedsmen, Vilmorin Andrieux & Co., of Paris, France. The remainder of our seed was obtained from the Department of Agriculture. Most of our plats were on ground prepared in the ordinary way, and next to our sorghum plats. A small amount of this field was thoroughly subsoiled to the depth of two feet. This was done by spading, care being taken to keep the surface soil at the top. The soil in this field is upland, with a tolerably rich, loamy surface, and a stiff clay subsoil. Several varieties were also planted on light, sandy soil.

The soil was in fair condition when the seed was planted, by hand in drills about three feet apart. This width may not have been most suitable, but it was adopted for convenience; it will be planted about half this width another year. An excellent stand was obtained. After the plants had started well, they were thinned so as to stand six to nine inches apart. The beets grew very well, and most of them reached a size larger than is said to produce roots richest in sugar. Notwithstanding the apparent thriftiness of the plants, the sugar-content was not found to be as large as we had hoped for in view of the results reported from other parts of the State, and from Nebrasks. The season at this station was undoubtedly not conducive to the production of sugar in the beet. The best conditions require an abundance of moisture during the growing season, with comparative dryness in the fall for ripening and sugar-development. The last season reversed these conditions; the rainfall for the months in question being as follows: April, 1.74 inches; May, 1.81 inches; June, 1.85 inches; July, 2.89 inches; August, 5.7 inches; September, 3.24 inches. From April 1 to July 21, the rainfall was only 6.04 inches; from July 22 to September 30, it was 11.21 inches. The preceding months, January, February, and March, gave only 2.78 inches of rain and melted snow.

It is stated by the Department of Agriculture that a mean temperature of 70° Fahr. for the summer months of June, July and August is the most favorable for the production of good beets, this being warm enough to push the beets to maturity, while a higher temperature is unfavorable to the production of sugar. The mean temperature of the months named for last summer was 77.82°, and the average of these months for the last ten years is 75.62°. Last summer was the hottest since 1881, when the mean temperature of these three months was 80.97°. We must not, however, conclude too hastily that the last word has been said respecting the best temperature for the sugar beet. Hon. Gee. F. Kellogg, State Sugar Inspector, in his last report states that the average per cent. of sugar in the entire crop worked at Medicine Lodge was 15.25. This is a very favorable showing. No data are accessible respecting the summer temperature at that point, but it is doubtless higher than here.

It is quite possible that our soil is not adapted to beet culture. Another year we hope to try the various soils found in this vicinity, and in other parts of the State. The beets planted last year on light, sandy soil, showed no superiority over others, and were much smaller.

A few analyses were made of single beets. Some interesting observations were made, although the analyses made were not sufficiently numerous to justify any positive conclusions. Many beets were tested by tasting, without being analyzed. We were unable to trace much connection between size of root and per cent. of sugar, and strongly incline to the belief that, other things being equal, maturity is the point essential to richness of sugar.

This seems to be indicated by a brown epidermis, and many instances were noted in which the sweetness of the beet was proportional to the extent to which the epidermis had become brown. It may be that thick planting, so as to limit the weight of the beets to one and one-half pounds, will favor early ripening. As our beets were grown, the small ones were more often immature than the larger ones.

Plats 25 to 33, inclusive, each consisted of a single row twenty rods long, the plats being side by side. Plats 23, 24, 34 and 35 each contained two rows two rods long. These were the subsoiled plats. They were side by side, and adjoined the other plats. The plats marked F are those in another field, upon light, sandy soil.

The leaves of the samples were weighed, as it has been held by some that a large percentage is favorable to a large content of sugar in the root. We have been unable to confirm this. A comparison of the last two columns of the table will show that there is no uniform relation between weight of leaves and per cent. of sugar. It may be of some significance, however, that of the ten samples in which the weight of the leaves is less than 75 per cent. of the weight of the roots, six contained over ten per cent. of sugar; while in the thirteen cases in which the leaves were over 75 per cent., the sugar content reached ten per cent. in only one instance. It is possible that the beets having the larger proportion of leaves were less mature than the others, and that further development would have increased the weight of the roots. It may be, too, that the wet weather succeeding the drouth induced a renewed growth of foliage, to the exclusion of sugar-production. There was no special evidence of this, however.

ANALYSES OF SUGAR BEETS.

Plat.	VARIETIES.	Date of analysis.	Number of beets in sample	Average weight of roots, in grams.	Average weight of roots, in pounds.	Average weight of leaves, in pounds.	Per cent. of leaves, calculated on weight of roots.	Per cent. of cane sugar in roots.
25	White French Sugar Beet, rich.	Oct. 6..	7	1211	2.67	2.42	90.8	6.18
26	White Sugar Green-top, Brabant.	Oct. 7 ..	5	1138	2.50	1.53	61.1	6.40
27	Improv'd Vilmorin	Oct. 10..	5	992	2.18	1.32	60.1	8.48
28	Klein-Wanzleben	Oct. 11 ..	5	1149	2.53	2.09	82.6	6.54
29	Dippe's Klein-Wanzleben.	Oct. 13 ..	5	890	1.96	1.98	101.3	10.32
30	Simon Legrande's White Improved.	Oct. 11..	5	1007	2.22	1.63	73.5	10.39
31	Bulteau Desprez, richest	Oct. 14 ..	5	1080	2.38	1.98	85.2	8.55
32	Florimond Desprez, richest.	Oct. 15 ..	5	1132	2.49	1.99	80.0	7.46
33	Dippe's Vilmorin	Oct. 15 ..	5	921	2.03	1.50	73.9	9.46
23	White French Sugar Beet, rich	Oct. 20 ..	5	647	1.42	1.46	102.6	9.74
24	Improved Vilmorin	Oct. 21..	5	1032	2.27	2.15	94.6	8.29
34	Klein-Wanzleben (Vilmorin)	Oct. 21..	5	997	2.19	1.92	87.8	8.02
35	White Sugar Green-top, Brabant	Oct. 22 ..	5	1498	3.30	2.08	63.1	6.61
F	Bulteau Desprez, richest	Oct. 16 ..	8	258	.57	.63	111.4	9.28
F	White Sugar Green-top, Brabant	Oct. 16..	7	449	.99	1.13	114.6	5.45
F	Florimond Desprez, richest.	Oct. 16 ..	6	487	1.07	.97	90.4	5.73
	Beets grown by A. D. H. Kemper, Newton, Kansas.	Dec. 27..	3					*14.69

*These beets had dried out somewhat, which may have increased the apparent amount of sugar present.

ANALYSES OF INDIVIDUAL ROOTS OF SUGAR BEETS.

Plat.....	VARIETIES.	Date.	No. of Beets.....	Weight of Root, in grams.....	Weight of Root, in pounds.....	Weight of Leaves, in pounds.....	Per cent. of Leaves calculated on weight of root.....	Per cent. of Cane Sugar in root.....
30	Simon Le Grand's White Improved.....	Oct. 24...	1	2795	6.15	5.06	82.3	9.45
30	Simon Le Grand's White Improved	Oct. 24	1	1023	2.25	1.06	47.1	12.17
30	Simon Le Grand's White Improved	Oct. 25...	1	542	1.19	.73	60.9	10.36
30	Simon Le Grand's White Improved	Oct. 25...	1	1078	2.37	2.19	92.3	9.80
29	Dippe's Klein-Wanzleben.....	Oct. 28 . . .	1	1087	2.28	1.40	61.2	11.09
29	Dippe's Klein-Wanzleben.....	Oct. 28 . . .	1	1278	2.81	2.05	72.8	11.04
29	Dippe's Klein-Wanzleben.....	Oct. 29 . . .	1	1296	2.85	1.74	61.0	10.99
29	Dippe's Klein-Wanzleben.....	Oct. 29 . . .	1	719	1.58	.....	.....	10.12
29	Beets grown by Edward Pape, Topeka..	Nov. 29 . . .	1	797	1.73	.....	.....	13.82
	Beets grown by Edward Pape, Topeka..	Nov. 29... .	1	398	.88	.....	.....	* 15.15

*These beets had dried out somewhat, which may have increased the apparent amount of sugar present.

In analyzing general samples of beets from the different plats, great care was taken to obtain as nearly fair a sample as possible. To this end, beets of all sizes were included in the samples, as it is believed that the size has an important influence on the sugar-content. The beets selected were washed and weighed. The leaves were also weighed in most cases. The part of the root to which the leaves are attached was included in the sample. As this is not used in the manufacture of sugar, it would perhaps have been better not to have taken it in the samples. That part of the beet contains less sugar and more impurities than the remainder of the root. To avoid pulping the whole beet, each was divided into a certain number of approximately equal, longitudinal, radial sections. In this way one-eighth, usually, of each beet was taken to make up the sample for analysis. This was pulped by a small rotary grater. The pulp, loosely confined by strong muslin, was put into an iron cylinder and submitted to the pressure of a powerful screw press. The residue was saturated with hot water and pressed again. The treatment with hot water was repeated two or three times, when the exhaustion was complete. The dilute juice thus obtained was analyzed by the saccharimeter as usual, the results being calculated back to the weight of the sample taken. This shows the per cent. of the sugar in the *beets*. The juice extracted by one pressure will contain a larger per cent. of sugar than the whole beet. The results obtained by analyzing juice so obtained, while comparable to a certain extent between themselves, give figures higher than the true sugar-content of the beets. This should be borne in mind in comparing results obtained at different stations. We have extracted the sugar by means of hot water instead of by Scheibler's alcohol method, as it involves less error in sampling, was more convenient for us, does not require special apparatus, and has not been shown conclusively to be less reliable. Reducing sugars were present in such small amount that they were not estimated. In analyzing single beets the whole root was reduced to pulp and treated as above described.

SUMMARY.

SORGHUM.

1. The season of 1890 was very unfavorable to sorghum here, owing to deficient rainfall and intense heat during the early summer, followed by cool, wet weather, culminating in an unprecedented, killing frost, September 13. This frost was so exceptional as to date, and so erratic in distribution, its limit bearing no relation to isotherms or latitude, that it gives no ground for the conclusion that we are too far north for successful sugar manufacture from sorghum. Notwithstanding this, the tables show that the standard varieties maintained a good, though lower, standard of excellence.

2. The selection of seed with a view to improvement of varieties was almost wholly prevented by the early frost. A comparison of the results obtained for three years in selection of specially good canes lends encouragement to the hope that the standard of sugar-content may be permanently raised by this means.

3. A comprehensive experiment to test the effect of fertilizers on sorghum has shown no marked results this year, as was to be expected in view of the conditions of growth. The experiment will be continued from year to year, the same fertilizers being applied to the same plat throughout.

4. In view of the occurrence of two varieties of smut in our plats this year, caution in the introduction of new varieties is urged lest destructive contagious diseases be brought in at the same time.

5. Crossing of varieties deteriorates the crop.

SUGAR BEETS.

1. The sugar beets grown did not appear to be of as good quality as those reported to have been produced in other parts of Kansas and in Nebraska. This may have been due to the unusually unfavorable climatic conditions of last summer, or to unsuitability of soil.

2. Analysis of individual beets indicated that *maturity*, more than size, determined the sugar-content of the beet. A brown epidermis accompanied high per cent. of sugar. As far as our observations went, a high weight of leaves, as compared with the roots, was no evidence of high sugar-content, but rather the reverse.