SUGAR BEETS IN COLORADO IN 1897.

W. W. COOKE AND WM. P. HEADDEN.

During the past few years the interest in the growth of sugar beets has largely increased. The Colorado Experiment Station has for many years been encouraging their growth in Colorado, but the work of 1897 was conducted on a larger scale than any previous year. The United States Department of Agriculture at Washington gave the Station five hundred pounds of beet seed for conducting the trials, and the Station also received two hundred pounds from A. Keilholz, Quedlinburg, Germany, through his United States agent, F. G. Zimpel, New York City. The government seed was the Kleinwanzlebener variety, imported by the Oxnard Beet Sugar Co. and sent to us from Norfolk, Nebraska. The seed from A. Keilholz was the Imperial White variety.

With this large amount of seed on hand, it was determined to extend the experiments over all the agricultural sections of Colorado. Notices were inserted in the newspapers of the State, to the effect that the station would send the seed to those that applied for it, and who would promise to take good care of the crop and report results in the fall. Applications were received from and seed sent to six hun-

dred and eleven persons, representing forty-seven counties.

One pound of seed was sent to each person, accompanied with a copy of a bulletin giving full directions for the planting and care of the crop. How the directions were carried out will be noted in another place in this bulletin.

The seed was sent out in April and early May. About the middle of June a circular was sent to each one who had received seed, asking for information as to the planting of the crop. A copy of this circular is given later in this bulletin.

Of the six hundred circulars sent out, less than two hundred and fifty were ever returned, showing that not half of those who applied for the seed really desired to ascertain whether or not they could grow beets fit for sugar purposes.

When the time came in the fall for taking samples of the crop for analysis, it was deemed best that some at least of these samples should be taken by a representative of the Station so as to know better than it could be told on any blank, the exact circumstances under which the crop was grown and its condition at the time the samples were taken. With this object in view, the agriculturist of the Station visited about forty farms situated east of the range, secured samples of the beets, and made full notes of the conditions.

When the work of the season was planned it had been hoped that the new chemical laboratory of the college would be completed in season, so that most of the beets could be analyzed in Fort Collins. Owing to unavoidable delays, this building has not even yet been completed, and in the crowded condition of the old laboratory still in use, it was found impossible to make many more analyses than were required by the tests of beets grown on the college farm.

In this predicament, the Secretary of Agriculture at Washington came to the rescue, and through his kindness, nearly all the samples taken of beets grown outside of Fort Collins, were analyzed at Washington.

It was soon found that to get samples enough to fairly represent the different parts of the state would require more time than any representative of the Station had to spare, and therefore the first of October a circular was sent out asking those who had grown sugar beets to take samples and forward them direct to Washington.

At the same time there was sent to them from Washington, blanks for describing the samples and shipping tags, so that the beets could be sent by mail free of postage.

Below are given copies of the two papers sent from Washington.

UNITED STATES DEPARTMENT OF AGRICULTURE.

WASHINGTON, D. C., *August 15, 1897.*

Directions for Taking Samples of Sugar Beets for Analysis.

Prepared by H. W. WILEY, Chief of Division of Chemistry.

When the beets appear to be mature (September 15 to November 15, according to latitude and time of planting) and before any second growth can take place, select an average row or rows, and gather every plant along a distance which should vary as follows, according to the width between the rows:

From rows	16	inches	apart,	length	75	feet.	
"	"	18	"	"	"	66	"
"	"	20	"	"	"	59	"
"	"	22	"	"	"	54 and four-fifths	feet.
"	"	24	"	"	"	50	"
"	"	28	"	"	"	42 and nine-tenths	"

The beets growing in the row, of the length above mentioned, are counted. The tops are removed, leaving about an inch of the stems, the beets carefully washed free from all dirt and wiped with a towel. Where the row is not long enough to meet the conditions, take enough from the adjacent row or rows to make up the required length. Rows of average excellence must be selected; avoid the best or poorest. Throw the beets promiscuously in a pile and divide the pile into two parts. This subdivision, of one-half each time, is continued until there are about ten beets in a pile. From these ten select two of medium size. Be careful not to select the largest or smallest.

From all the rest of the beets, save these two, the necks are removed with a sharp knife at the point indicated by the dotted line in the figure. The beets, including the two saved as a sample, are then weighed.

The number of beets harvested multiplied by 435.6 will give the total number per acre. The total weight of beets harvested multiplied by 435.6 will give the yield per acre.

Wrap the two sample beets carefully in soft paper, and write your name legibly thereon. The beets must be perfectly dry. Fill out blank describing beets, enclose in the envelope, and sew up in bag with beets. Sew the beets up in a cotton bag, attach the inclosed shipping tag thereto, and send by mail.

No beets will be analyzed which are not sampled as described above and properly identified.

Miscellaneous analyses of samples without accurate description are of no value.

Blanks are sent to each one for two sets of samples. From two to four weeks should elapse between the times of sending the two sets of samples.

If additional analyses are desired other blanks will be sent on application, but not more than four analyses can be made for any one person, except in special cases.

A model, showing how blanks should be filled out, is inclosed.

U. S. DEPARTMENT OF AGRICULTURE.

DESCRIPTION OF SAMPLE OF SUGAR BEETS.

Prepared by H. W. WILEY, Chief of Division of Chemistry.

Variety .....
Date planted .....
Date thinned .....
Date harvested .....
Character of soil .....
.....
.....
.....
Character of cultivation (dates, implements, etc.) .....
.....
.....
.....
.....
Length of row harvested (feet) .....
Width between rows (inches) .....
Number of beets harvested .....
Total weight of beets harvested, less necks and tops, (pounds) .....
.....
Weather for each month .....
.....
.....
.....
.....
State .....
Post-office .....
Date .....
Name .....

NOTE—Samples of beets will not be analyzed unless accompanied with this blank filled out as indicated in model B.

The first samples were taken September 13, when the crop showed no signs of ripening. Several samples were taken during the next week and quite a number on September 24 and 25. In every case the beets were found in full growth and far from ripe. Analyses of these samples showed them to be low in both sugar and purity.

Of thirty-three samples taken, only two were found that were above twelve per cent in sugar and also above eighty per cent in purity, this being the ordinary standard adopted by sugar factories for merchantable beets. Four other samples showed below eighty per cent purity, but enough above twelve per cent sugar to make them of value for factory use.

In the following table the results of these early samples are omitted as the crops evidently, were too green for harvesting. Many of these fields were again sampled later in the season and the results of the second set of samples are given in the table.

Several statements need to be made in regard to these tables. They are intended to represent ripe crops. Besides the samples just mentioned, quite a number of other analyses were omitted when it was know that the crops were not ripe when the samples were taken. All analyses of ripe crops are entered, even though the analyses show that the crops were unfit for factory use.

These tables represent the character of the beets that were received for analysis, at the time they were received. It does not necessarily follow that they represent a fair average of the field from which they were taken or that when received at the labratory they were in the same condition as when pulled in the field. A great many of the samples were not taken by employes of the Station and we have to trust to the judgment of the person sending the sample, that it correctly represents the field. The greatest single chance for error is in the drying out of the sample between the time it is pulled and the time of analysis. In some cases this would increase the analysis, while in others, through fermentation of the beets, the results would be lowered. The instructions say clearly to wrap the beets carefully in paper in order to keep from drying out, and where the instructions have been followed the results are closely correct. But some samples have been received in bad shape. Indeed the analyses of some fifteen or more samples have been omitted from the tables because the samples themselve showed that they had dried out to such an extent that their

analyses did not represent the beets as they stood in the field.

For the purpose of this bulletin, the State has been divided into five sections.

1. The valley of the South Platte and its tributaries.
2. The Divide, south of Denver where crops are raised without irrigation.
3. The valley of the Arkansas.
4. The valley of the Grand.
5. The San Luis Valley.

Under each section the samples are given in the order of time that the beets were dug, since it is found that this factor has been more powerful than any other in determining the quality of the beets.

All the seed used was Kleinwanzlebener except the samples double starred which are Vilmorin and those starred which are Imperial White.

PLATTE VALLEY.

No	Name.	Address.	Date when sample was dug.	Average weight of the beets analyzed.	Sugar.	Purity.	Weight of crop per acre.
				Ounces.	Per cent.	Per cent.	Tons.
1	C M C Woolman.....	Sterling	Sept 18	11	14.5		16
2	" "	Sterling	" 18	9	12.5	76.3	16
3	F C Marks.....	Sterling	" 18	13	13.2	86.0	9
4	T B Robinson.....	Fort Morgan	" 29	20	13.3	82.8	*9
5	S M Scott.....	Fort Morgan	" 29	13	16.1	81.3	8
6	J A Davis.....	Berthoud	Oct 2	21	13.9	81.6	29
7	C A Caykendall.....	Loveland	" 3	22	14.4	78.7	30
8	L A Dwight.....	Boulder	" 4	24	13	77	29
9	Arthur Ling.....	Greeley	" 5	40	13.4	87	40
10	J W Bacon ** Upland	Longmont	" 15	63	14.6	81.4	21
11	" " **	"	" 15	15	15.4		21
12	" " ** Lowland	"	" 15	26	12.5	76.2	22
13	" " **	"	" 15	19	14	82.1	22
14	D M Lambert.....	Bellevue	" 20	14	15.5	76.4	
15	Fred Greve.....	Crook	" 15	18	16.5		15
16	Chas Johnson.....	Atwood	" 20	14	15.2	82.4	11
17	R S True.....	Highl'nd Lake	" 20	27	16.2	85.9	
18	W S Simpson.....	Fort Morgan	" 28	19	16.1		20
19	W W Remington.....	"	" 16	29	13.7	80.4	25
20	J A Davis.....	Berthoud	" 28	28	16.7	84.5	35
21	F M Wright.....	"	" 30	20	14.1	77.5	10
22	C Cornelius.....	Lafayette	Nov 1	28	14.3	77.7	30
23	C Reed.....	Orchard	" 1	13	16.1	82.8	47
24	S M Scott.....	Fort Morgan	" 1	15	15.6	80.4	12
25	H C Hatch.....	Sterling	" 1	43	12.7	75.6	23
26	L A Dwight.....	Boulder	" 4	16	18	84.3	31
27	J J Thomas *	Lafayette	" 23	29	20	86.4	36
28	" " *	"	" 7	73	14.4	80	
29	W M Post	Fort Collins	" 9	25	13.3	74.4	18
30	T R Baldwin.....	Bijou Basin	Oct 15	20	12.7	73.1	
31	Alfred Johnson.....	Atwood	Nov 12	19	15.3	83.3	
32	J A Davis.....	Berthoud	" 7		15.5	86	
33	E K Smith.....	Fort Lupton	" 8	19	14.5	80	
34	Fritz Neimeyer.....	Evans	" 6	74	14.2	81.2	
35	" "	"	" 6	53	12.6	78.3	
36	" "	"	" 6	41	11.5	81.8	

No.	Date of planting.	Pounds of seed per acre.	Stand.	Date of first cultivation.	Date of thinning.	Date of first irrigation.	Remarks.
1	May 22		Thick	June 15	July 3	July 1	Black heavy loam.
2		Same as	No. 1				
3	June 10		Good		July 10		First crop on new breaking bottom land.
4	May 5		Thick	May 25	June 29	May 14	Rich garden soil manured '97
5	May 15		Uneven		July 15	June 25	Sandy loam.
6	April 20	10	Thick	June 2	June 6	June 24	Sandy, with clay subsoil; broke ground May 28.
7	May 27	4	"				Rich bottom, irrigated 3 times.
8	May 7		"		June 15		Clay soil, manured in 1897.
9	May 10	4	"	July 15	July 10	Sept 5	Black bottom land, irrigated only once.
10	May 20	3	Good				Heavy loam,
11	"	Same as	No. 10				
12	"	3	Good				On bank of river, considerable alkali.
13		Same as	No. 12				
14	May 23	4	Thin	June 25			Light mountain soil.
15	May 10		Thin				Sandy loam; subirrigation.
16	May 24	16	Thick		June 26	June 12	First crop on new land; plowed three inches deep.
17	June 1		very poor			July 2	Land irrigated before plowing
18	May 15	20	Thick	May 1	June 1	June 15	Medium heavy soil; irrigated three days before planting.
19	May 22	10	Medium		Never	Late	Irrigated by flooding, no after cultivation.
20	April 20	Same as	No. 6				Still growing October 28; manured 1896.
21	April 27	6	Poor		June 10		Rich clay soil; seed irrigated up; manured 1896.
22	May 1	15	Fair		June 10	June 15	Sandy with clay subsoil; manured 1897.
23	May 10	20	Thick				Sandy soil; seed irrigated up, Broken 1896.
24		Same as	No. 5				
25	May 15	8	Thick	June 10	Never		Alkali ground; seed irrigated up; manured 1897.
26		Same as	No. 8				
27	May 8		Thick				Manured 1897.
28		Same as	No. 27				
29	May 5	15	Medium	June 15	June 28	June 21	Mountain soil; manured 1897.
30	June 1	4	Medium			Never	Very sandy loam.
31	May 24	11	Fair	June 13	July 1		New land; seed irrigated up.
32		Same as	No. 6				
33	April 20		Thin	May 20	Aug 15	Never	Watered by seepage from reservoir; sandy loam.
34	May 26			June 20			Sandy loam; manured 1897.
35		Same as	No. 34				
36		Same as	No. 34				

DIVIDE, SOUTH OF DENVER, WITHOUT IRRIGATION.

No.	Name.	Address.	Date when sample was dug.	Average weight of the beets analyzed.	Sugar.	Puritty.	Weight of crop per acre.
				Ounces.	Per cent.	Per cent.	Tons.
37	C H Clark	Eastonville	Sept 12	6	14.7		
38	F Holkowiez	Elizabeth	Oct 1	14	13.1	71.5	22
39	Alex Brazelton	Elbert	" 2	18	13.4	77.9	9
40	Geo H Stein	Fondis			13.6	80.3	
41	J D Steves	Parker	" 5	12	12.8	69.5	
42	W B Quein	Hilltop	" 9	22	15.7	85.5	17
43	Alice H Kent	Kiowa		26	11.6	87.7	
44	" "	"		28	16.9	83.9	
45	S H Rasmussen *	"	" 11	19	13.3	76.0	9
46	" " *	"	" 11	10	15.0		9
47	H C Hansen *	"	" 12	8	17.0		10
48	" " *	"	" 12	12	17.1		10
49	Mrs John Underhill *	Fondis	" 15	9	18.7		
50	D C Dormer *	Castle Rock	" 15	18	18.7	78.4	
51	Chas Shedd	Otis	" 20	11	13.8	78.4	
52	Wm Duffy	Fondis	" 21	26	15.3	76.2	
53	G H Ellicott	Ellicott	" 30	38	14.2	80.1	
54	Miss H S Jones	Elizabeth		12	16.7	75.7	
55	D C Dormer *	Castle Rock	Nov 14	27	18.6	81.2	

ARKANSAS VALLEY.

56	Sidney Flinn	Caddoa	Oct 3	18	14.7		
57	" "	"	" 3	20	19.4		
58	M D Parmenter	Lamar	" 6		15.0	78.5	
59	C G Anderson	Eldred	" 7	14	12.4	75.6	
60	J W Jameson *	Howard	" 10	11	13.8	80.1	12
61	B F Wyckoff	Rocky Ford	" 15	35	13.5	79.3	
62	C G Anderson	Eldred	" 23	19	16.0	84.8	13
63	B F Wyckoff	Rocky Ford	" 28	24	12.7	78.7	40
64	W F Crowley	" "	Nov 5	34	14.4	84.3	31
65	C K McHarg	Pueblo	" 13	16	20.2	85.9	24
66	M D Parmenter	Lamar	" 15	19	17.1	83.9	40
67	" "	"	" 15	26	12.4	77.8	
68	" "	"	" 15	34	12	72.8	
69	B F Rockafellow	Canon City	" 15	34	17.0		27

No.	Date of planting.	Pounds of seed per acre.	Stand.	Date of first cultivation.	Date of thinning.	Date of first irrigation.	Remarks.
37	May 20	20	Thick			Never	Black sandy soil.
38	May 17	20	Thick	June 20	June 20	"	Second crop from sod; daily rains Sept 16 to Oct 1
39	May 1	12	"	July 15	July 15	"	Sandy bottom land; manured 1897.
40	April 28	6	"	May 20	June 25	"	Sandy loam; 2d year from sod.
41						"	
42	May 2	8	Thin	May 26	May 26	"	Black sandy loam; second crop from sod.
43	Apr 29	2	Thin	May 27	June 1	"	Black sandy loam; manured 1897.
44		Same as	No. 43				
45	May 15	6	Thick	June 25	June 25	"	Firm sandy loam.
46		Same as	No. 45			"	
47	May 15	5	Thin	June 20	June 29	"	Black sandy loam.
48		Same as	No. 47			"	
49	June 1	8	Thick	June 18		"	Black sandy loam.
50	May 20	4				"	High prairie soil with a little adobe.
51	May 20	12	Thin	July 5	July 18	"	Sand with clay: manured 1897.
52		2		Never		"	Sandy loam; broken in 1896.
53	May 15	8				"	Light sandy loam.
54	June 1		Thick		July 10	"	Sandy loam; manured 1896.
55		Same as	No. 50			"	
56	May 25		Fair	June 3		June 26	New ground, rather heavy; seed irrigated up.
57		Same as	No. 56				From a dryer part of the field.
58	June 1		Thin	June 10	June 28	June 14	Sandy soil; mauured 1897.
59	Mch 25	10		April 13	April 15	April 20	Black sandy loam.
60	June 3	10	Poor	June 18	July 4	June 15	Light sandy soil.
61	April 30	20	Good	May 20	May 20	May 10	Clay soil, with some grit.
62		Same as	No. 59				
63		Same as	No. 61				
64	May 19		Good.	June 10	Never	June 28	Inclined to clay soil with some alkali.
65	May 10	9	Medium	June 15	June 26	June 15	Sandy soil, second year from breaking.
66		Same as	No. 58				No late irrigation.
67		Same as	No. 58				Medium late irrigation.
68		Same as	No. 58				Irrigated late in the season.
69	May 8	24	Thick	June 7	June 7	June 2	Adobe soil; manured 1897 seed irrigated up.

No.	Name.	Address.	Date when sample was dug.	Average weight of the beets analyzed.	Sugar.	Purity.	Weight of crop per acre.
				Ounces.	Per cent.	Per cent.	Tons.
70	Ira D Hale.....	Rocky Ford	Nov 20	35	13.4	77.3	17
71	" "	"	" 20	16	17.3		
72	J R Traxler.....	Lamar	" 1	10	16.5	75.5	25
73	" "	"	"	12	15.9		25
74	" "	"	" 10	15	14.7	85.4	
75	" "	"	" 10	16	14.4	81.	

GRAND VALLEY.

76	Levi Ward.....	Debeque	Sept 15	39	11.9	78.1	20
77	D G Edgerton *	Carbondale	" 18	10	14.4	82.5	18
78	H L Edgerton *	"	" 18	9	15.4		14
79	G S Osburn.....	Satank	Oct 1	11	14.1	78.0	
80	W C Smith	Cardiff	" 1	6	17.3	86.0	
81	Thos King	Glenw'd Spr'gs	" 1	19	13.3	83.0	
82	Mrs M H Lafever	Eagalite	" 1	22	17.0	88.1	
83	C R Thompson	Glenw'd Spr'gs	" 2	9	13.8	77.0	
84	C B Sewell.....	Carbondale	" 3	20	12.2	81.0	
85	C B Sewell.....	"	" 3	13	18.5		
86	J L Thomas	"	" 11	13	16.1	85.9	14
87	D G Edgerton.... ...	"	" 12	21	12.5	83.0	16
88	C H Harris	Catherin	" 12	13	17.4	85.0	
89	E Stanffacher.....	"	" 12	16	15.6	81.2	
90	Wm Gardner	Satank	" 12	10	19.0	86.9	
91	E E Westhafer.....	"		28	18.9	84.9	
92	C M Rulison.....	Parachute	" 12	11	15.2	79.9	42
93	Levi Ward.....	Debeque	" 12	18	17.6	86.0	15
94	Geo Siever.....	Glenw'd Spr'gs	" 15	18	15.0	80.1	
95	C D Fuller.....	"	" 15	17	14.9	83.0	
96	J L Brown	"	" 15	12	16.8	85.4	
97	B M White	"		10	15.2		
98	W V Hall	Peachblow	" 15	14	14.5	81.7	15
99	Cyrus King	Antlers	" 30	20	14.6	83.0	
100	J E Thomas	"	Nov 15		14.0	74.0	

SAN LUIS VALLEY.

101	C M Thomas.....	Monte Vista	Oct 1	11	13.4	77.5	14
102	M B Colt.....	Alamosa	Sept 28	17	11.5	80.5	23
103	Mrs H C Hefner.....	Mosca		12	15.9	86.9	

No.	Date of planting.	Pounds of seed per acre.	Stand.	Date of first cultivation.	Date of thinning.	Date of first irrigation.	Remarks.
70	May 10		Thick	June 5	June 1	May 25	Sandy loam.
71		Same as	No. 70				
72	May 25		Good	June 20	June 25	May 28	Hard soil.
73	May 1		Thick	May 25	June 10	May 28	Sandy loam,
74		Same as	No. 73				
75		Same as	No. 72				
76	May 15		Thick	June 10	June 10	June 10	Sandy loam, manured 1897; seed irrigated up.
77	May 15	8	Poor	June 24	June 24	May 25	Black sandy loam; manured 1897; broke ground June 1.
78	May 1	16	Thick	May 30	June 15	June 1	Clay loam, heavily manured 1896 and 1897.
79	May 10			June 6			Red sandy loam.
80	May 5	70	Medium	June 10	June 15	May 25	Sandy loam.
81	May 20			June 15			Sandy loam.
82	May 3	4	Thick	June 15	June 19	June 15	Sandy soil. manured 1897; daily rains Sept. 15-30.
83	May 16				June 7		Sandy loam.
84	May 16	32	Thick	June 10	July 7	June 1	Sandy loam, heavily manured 1897.
85		Same as	No. 84				
86	May 2				June 15	July 1	Sandy loam; heavily manured 1897.
87		Same as	No. 77				
88	May 1		Thick	May 25	June 20		Yellow sandy loam; seed irrigated up.
89	May 26		Good		July 10	July 10	Gypsum soil.
90	May 20				June 25		Red sandy loam.
91	May 28		Thick	June 22	July 10	June 20	Very sandy soil.
92	June 6			June 20	Never	June 21	Heavy sandy bottom land.
93		Same as	No. 76				
94	May 14				June 27		
95	May 1	13	Thick		May 25		Red sandy loam.
96							
97							
98	May 20	20	Good				Sandy loam; seed irrigated up
99	May 15	5	Thin	June 28	July 2	June 6	injured by hail.
100	June 20						Alluvial soil, seed irrigated up; manured 1897. Sandy loam.
101	May 12				June 15	Sub	Rich sandy loam; heavy rains before digging.
102							Alkali soil.
103	May 25		Thick	June 14	July 15		Sandy loam; seed irrigated up.

No.	Name.	Address.	Date when sample was dug.	Average weight of the beets analyzed.	Sugar.	Purity.	Weight of crop per acre.
				Ounces.	Per cent.	Per cent.	Tons.
104	David Albright.....	Poncha Spr'gs	Oct 4	29	13.6	79.5	16
105	W A Lockett.....	Saguache	" 7	10	16.5		11
106	S L Pierce.....	Montevista	" 10	7	17.3		14
107	Chas Milne.....	La Jara	" 12	38	13.4	78.7	33
108	M B Colt.....	Alamosa	" 13	9	15.7	78.9	
109	N G Shaw.....	"	" 22	14	17.9	85.9	31
110	David Albright.....	Poncha Spr'gs	" 25	16	17.4		19
111	Chas Milne.....	La Jara	" 28	31	16.4	84.3	33
112	M B Colt	Alamosa	Nov 3	25	16.1	83.6	23
113	G J Stafford *	Montevista	" 11	15	12.4	76.5	10
114	Mrs H C Hefner.....	Mosca		13	16.3	84.6	
115	W G Bradshaw	Alamosa	Oct 25	39	14.2	74.2	9
116	" "	"	" 25	38	11.9	70.6	
117	Wm Cross	"		34	13.4	74.5	
118	C M Thomas	Montevista	" 26	33	15.0	81.9	
119	A K Deitrich	"	" 10	17	17.6	84.1	18

OTHER PARTS OF THE STATE.

120	Geo H Hammond....	Hotchkiss	Nov 15	23	15.5	76.7	20
121	J L Ellis **	Craig		10	19.0	81.2	
122	" " **	"		11	18.6		
123	Chas A Barnes **	Delta	" 10	16	18.6	84.3	
124	Chas R Peter.....	Holyoke	Oct 4	61	11.4	75.4	
125	" "	"	" 4	37	14.7	70.0	

No.	Date of planting.	Pounds of seed per acre.	Stand.	Date of first cultivation.	Date of thinning.	Date of first irrigation.	Remarks.
104	May 9	13	Good				Rather sandy; heavily manured; seed irrigated up.
105	May 15	10	Fair			June 16	Sandy loam.
106	May 20		Thick	June 25	June 10		Sandy loam; manured 1896
107	May 8		Thick	June 1	June 4		Sandy loam; manured 1897; seed irrigated up.
108							Adobe soil.
109	May 20	2	Uneven	July 2	July 2		Black sandy loam; seed irrigated up.
110		Same as	No. 104				
111		Same as	No. 107				
112		Same as	No. 108				
113	May 5	8	Thick	June 1	June 15		Sandy soil, manured last three years; seed irrigated up.
114		Same as	No. 103				
115	May 24	16	Thick	June 24	July 1	July 3	Dark yellow soil and gravel.
116		Same as	No. 115				
117	June 2	4	Uneven	July 1	July 1		Clay: manured last two years; seed irrigated up.
118		Same as	No. 101				
119	May 10	15	Thick	July 1	June 15		Sandy soil; fifth year continuously in beet.
120							Sandy loam.
121							
122							
123	May 25		Good	June 20	July 1	June 1	Sandy soil; new breaking.
124	May 1	6	Thin	June 1	June 20	Never	Sandy loam; manured 1897.
125		Same as	No. 124				

TIME OF RIPENING.

From the standpoint of the manufacturer, the date at which the beets become sufficiently ripe for use, is one of the most important parts of the problem. A beet sugar factory costs several hundred thousand dollars. At the most, it can work but about a third of the year and must be idle capital the rest of the time. In the climate of Colorado, it would not be safe to calculate on running later than the last of January. If the factory should start the first of October, it could have a run of a hundred and twenty days. Every day before the first of October that it could run would increase the amount of beets that could be handled and the profit on the whole investment. As the net profits of a well conducted factory are more than five hundred dollars per day, every additional day is of great importance.

The results given in the foregoing table throw much light on the date at which sugar beets in Colorado may be expected to ripen.

In the valley of the South Platte, north and northeast of Denver, the samples taken in September showed conclusively that the beets were not yet ripe. But a great change takes place in the last days of September and in the first week of October. The average of the samples taken between September 25 and October 10 is 14.1 per cent sugar and 80.7 per cent purity. This is an excellent grade of beets for factory use. Had a factory been in operation in the valley of the Platte during the season of 1897, it could have started up about September 25 with beets running over thirteen per cent in sugar and about eighty per cent in purity. It is not meant by this that all the beets raised in the valley had reached that average at that date, but that on the three to four thousand acres of beets that would be grown for a factory, there would have been enough beets ready by September 25 to have kept the factory running until other beets ripened.

This is a very important matter and cannot be too carefully considered. To get the crop ripened is the principal aim of the beet grower since it is in the last stages of growth that the beet forms most of its sugar, and it is only when the beet becomes ripe that the juices become pure enough for profitable manufacture.

Several factors come in to influence the ripening of the sugar beet. The most important is this that *the beets shall keep growing all the time from the sprouting of the seed until harvest.* All of the directions given for the planting and cultivation of the crop have this object in view;

because if this is attained, both the quantity and quality of the crop are almost necessarily correct.

If the beets receive no set back, they make a large growth, ripen early, and at the end of the growing season, get rid of much of the impurities in the juice, and store up in the root a large amount of pure sugar. If, however, for any reason the growth of the beet is checked, even for a few days, the ripening is delayed for a much longer period; if the check is severe the beets will never ripen, but start a second growth that will keep on growing until killed by the frost.

Provided the beet grower has given the proper care, the actual date of ripening will then depend on several conditions, some of which are beyond his control. If the ground is very rich it will tend to increase the size of the beets and retard the time of ripening. But an important fact is to be remembered in this connection. No matter how rich the ground is, if the beets are properly cared for, they will eventually ripen and be all the better, both in quantity and quality for the abundance of plant food that has been at their disposal. But the richer the ground is the easier it is to start a second growth and produce an enormous weight of crop of a poor quality.

An abundance of moisture in the soil retards the ripening of the beet, so that if the fall is unusually rainy the crop will be late in maturing. In Colorado it is true in general that the crop will not ripen until the vigor of the growth has been checked by frost.

The fall of 1897 in northeastern Colorado was exceptional, in that the frost held off two or three weeks later than usual and more than the average amount of rain fell. If, then, under these adverse natural conditions, a factory could have started September 25, it is fair to presume that under average conditions it could have begun operations several days earlier.

In this connection it is important to note the fact that on September 18, there were found at Sterling, two fields of beets that were fully ripe, weighing ten and sixteen tons of beets respectively per acre, and the beets of a good quality for factory use. This shows that with extra good care these beets had been brought thus early to merchantable condition in spite of the unfavorable weather. What these two men did, others similarly situated, could have done by equal care. Both of these crops were on medium to light soil. It is probable that no one on a heavy clay soil could have brought the beets to ripeness by this early date.

But one other factor remains to be noticed in regard to the ripening of the crop. All of the beets in northeastern Colorado were grown from seed imported from Germany. The experiments conducted at Lehi, Utah, make it probable that by using seed grown in the United States at five thousand feet altitude the ripening of the crop is hastened from a week to ten days.

In view of all the foregoing statements, we have a right to conclude that whenever a factory is actually built in northeastern Colorado, it will find beets ready for manufacture soon after the middle of September.

After what has been said of the ripening of beets in northeastern Colorado, there need be but little said concerning the other portions of the state. The same principles govern the ripening everywhere. On the Divide, south of Denver, where beets are grown without irrigation, the crops matured somewhat later than in the valley of the Platte, with irrigation. The content of sugar reached thirteen per cent by the first of October, but the purity was then too low for manufacturing purposes. By the middle of the month the beets were all right for the factory.

The Arkansas Valley is one hundred and fifty miles south of that of the Platte and as a natural result frosts hold off late and the beets are late in ripening. Had a factory started up October 15, it could probably have found beets enough to keep it running, but the bulk of the crop was hardly in marketable condition before the first of November. On the other hand, the winters here are so open and mild that there would be little trouble in a factory running all winter or until the crop was all handled.

The analyses from the valley of the Grand show that the crops were easily ready for the factory by the first of October and probably several days earlier. The bulk of the crop was ready at least a week or ten days earlier than that of the valley of the Platte. The climate of the valley of the Grand is a little warmer than that of the Platte and hence it would be supposed that the crop would ripen later rather than earlier. The cause of this result must be due either to better care, or to different seed, and is probably due to both these causes. The farmers in this valley have been experimenting in the raising of sugar beets for several years, and many of them have made a careful study of the subject. Hence their fields were better cared for, the quality of the crop was better, and it ripened earlier.

The remaining section of Colorado is the San Luis valley. The analyses from this section are so mixed that it is

difficult to judge when the crop in general was ripe. There were only two samples dug before October 15 that could be profitably manufactured. These two, however, show such a very high grade as to seem to indicate that the lateness in ripening of the other crops was due to lack of care or the presence of too much alkali in the soil.

INFLUENCE OF RIPENING.

The process that goes on in the ripening of the beet is both an increase of pure sugar and a decrease of the impurities. This raises both the per cent of sugar and the per cent of purity. By the purity of the beet is meant the relation of the sugar to the whole amount of material in the beet that is not water. Suppose 100 pounds of the juice of some beets contain 80 pounds of water and 20 pounds of solids; and of that 20 pounds of solids 16 pounds are sugar; then it is said that the beet has sixteen-twentieths or eighty per cent of purity.

The following table gives ten cases where samples were taken from the same field at different times in the fall.

EARLY AND LATE SAMPLES.

Name.	Place.	Date when sample was dug.	Average weight of the beets.	First sample.		Second sample.	
				Sugar.	Purity.	Sugar.	Purity.
			Grams.	Per cent.	Per cent.	Per cent.	Per cent.
S M Scott	Fort Morgan	Sept 24	430	11.5	71.7		
		Nov 1	425			15.6	80.4
T B Robinson	"	Sept 24	310	11.9	78.3		
		" 29	567			13.3	82.8
J A Davis	Berthoud	Oct 2	595	13.9	81.6		
		" 28	794			16.7	84.5
L A Dwight	Boulder	Oct 4	680	13.0	77.0		
		Nov 4	454			18.0	84.3
C G Anderson	Eldred	Oct 7	397	12.4	75.6		
		" 23	538			16.0	84.8
Levi Ward	Debeque	Sept 15	1389	11.9	78.1		
		Oct 12	510			17.6	86.0
Mrs H C Hefner	Mosca		340	15.9	86.9		
			368			16.3	84.6
David Albright	Poucha Spr'gs	Oct 4	824	13.6	79.5		
		" 25	454			17.4	
M B Colt	Alamosa	Oct 13	240	15.7	78.9		
		Nov 3	709			16.1	83.6
Chas Milne	La Jara	Oct 12	1361	13.4	78.7		
		" 28	879			16.4	84.3
		Averages.	617	13.3	78.6		
			570			16.3	83.9

It is not claimed that this is an exact scientific comparison between early and late samples, for in some cases the samples were taken from different parts of the field and in others they were quite different in size. The figures, however, serve to illustrate forcibly the general truth that in the late days of its growth, the beet accumulates sugar rapidly and becomes of much purer quality.

In the ripening of sugar beets, there is not only an increase of sugar and consequently a relative decrease of the impurities, but there is also an absolute decrease of impurities. This is shown in the next to the last column of the following table, which is based on the results of about two hundred analyses of the Colorado beet crop of 1897.

Beets ranging in per cent. of Sugar from	Water.	Total Solids.	Insoluble Fiber.	Sugar.	Soluble Impurities.	Per cent of Purity.
8 to 11	81.0	19.0	5.0	9.9	4.1	70.2
11 to 12	79.7	20.3	"	11.6	3.7	76.0
12 to 13	78.8	21.2	"	12.5	3.7	77.0
13 to 14	77.9	22.1	"	13.5	3.6	78.8
14 to 15	77.1	22.9	"	14.4	3.5	80.9
15 to 16	76.1	23.8	"	15.4	3.4	82.0
16 to 17	75.4	24.6	"	16.5	3.1	84.1
17 to 20	73.8	26.2	"	18.2	3.0	85.8

QUANTITY OF CROP.

There seems almost no limit to the amount of sugar beets that can be grown on an acre of ground in Colorado. The soil of the State is wonderfully rich and the large amount of sunshine stimulates the growth of the crop wonderfully. The yields given, represent in most cases, estimates based on the digging and weighing of rather small areas, and would need to be decreased considerably to represent whole fields. But even if shrunk one-half, which is far more than necessary, the yields are above those of any state that now has a beet sugar factory in operation. The writer visited a great many beet fields during the fall of 1897 and was everywhere struck with the rank growth and general healthy, vigorous look of the crop. It is a common belief that it is not difficult to raise a large crop, but that a large crop always means one poor in sugar and purity. Such does not seem to be the case in Colorado. Some of the largest yields have been accompanied by a high percentage of sugar and extra good purity.

It would be difficult to make an estimate of the average yield per acre of sugar beets in Colorado during 1897. The extreme would be from half a ton to nearly forty tons per acre. The beets on the College farm were a very poor stand owing to bad weather at the time of planting. The different fields varied from half a stand to hardly a quarter of a full stand. The rows were two feet apart and the entire crops, taking all the ground planted, were from eight to twelve tons to the acre.

The average of fifteen fields at Sterling and Fort Morgan is 17.4 tons of beets per acre gross weight, equivalent to about 15 tons of trimmed beets ready for the factory.

The weights of the crops on the Divide are of course much less than these figures. The valleys of the Arkansas and Grand have given about the same yields as that of the Platte, while the San Luis valley comes forward with some surprisingly large yields. Chas. Milne, at LaJara, reports about thirty tons to the acre, testing 16.4 per cent sugar and 84.3 per cent purity; while N. G. Shaw, at Alamosa, harvested over fifteen tons of beets from a measured half acre of ground and the beets tested 17.0 per cent sugar and 85.9 per cent purity. One of the heaviest yields reported is that of J. A. Davis, at Berthoud, who raised at the rate of 35 tons to the acre testing 16.7 per cent sugar and 84.5 per cent purity.

Probably the most profitable sugar beets raised in Colorado the past season were those grown by J. W. Bacon, seven miles east of Longmont. When his field was prepared for wheat, he left out about an acre and planted this later to sugar beets, giving the land but one more harrowing in addition to its preparation for wheat. Only three pounds of seed were used per acre, in drills thirty-two inches apart, sown with the ordinary wheat drill. The plants were not thinned, were irrigated but twice, when the water was turned on the wheat, and received only such cultivation as would be given an ordinary field of corn. The crop from the acre was twenty-one tons of beets, which tested 15.0 per cent sugar and 81.4 per cent purity.

QUALITY OF CROP.

The question of the quality of the crop has been referred to several times in speaking of its quantity. In making any estimate of the quality of the beets raised in Colorado in 1897, it is of course unfair to use any of the analyses made of crops that were known to be unripe. By the middle of October it is fair to presume that the sugar content had

about reached its full limit. There were fifty-one samples reported after that date ranging from 10.5 per cent sugar with 72.4 per cent purity, to 20.9 per cent sugar and 85.3 per cent purity, with an average of 15.5 per cent sugar, and 81.6 per cent purity. What has been done by these growers on their first attempt ought certainly to be equaled on a large scale for factory use when they are better aquainted with the best methods.

One point needs to be specially mentioned. The large crops average the highest in quality. The nine fields, of which we have analyses from the ripe crops, reporting over twenty tons of beets per acre with an average of twenty-seven tons, test 16.0 per cent sugar and 82.6 per cent purity. Such fields would return to the grower over a hundred dollars per acre and give to the factory nearly three hundred dollars worth of sugar per acre.

COMPARISON OF 1897 WITH PREVIOUS YEARS.

Sugar beets have been raised on the Station farm and in various parts of Colorado for the past nine years. The records of the analyses include many high and many low results. The records from outside the Station are not accompanied with the dates when the samples were dug, or any statement of the ripeness of the crop, so it is not possible to tell whether the low analyses are due to the poor quality of the crop or to the early date at which the samples were taken.

The different varieties of beets raised at the Station in 1897 agree in quality quite closely with the samples of previous years, when the samples were taken at the same date or stage of growth. Judged by this standard, the year 1897 was the same or a little poorer than previous years.

In all the states that have factories, and raise beets on a large scale, the universal report is that the year 1897 has been exceptionally poor; indeed about the worst known since the factories started. Since this report comes from Nebraska, Utah and New Mexico, east, west and south of Colorado, it is probable that in this state it was not any better than an average year.

METHODS USED BY BEET GROWERS.

There are certain principles of beet growing that have been learned by experience and by experiments in this country and in Europe, that are considered as essential to the production of the best beets. It is undoubtedly true that these principles are correct, and that the beet growers of

Colorado will eventually accept and practice them, and thereby increase the quantity of their crops and improve their quality. But the point to be considered here is this: most of the tests in 1897 were made by persons who had never grown beets before; they violated all of the proper methods and still produced large crops of good beets. What stronger proof could be obtained that the soil and climate of Colorado are especially adapted to the sugar beet?

One of these rules is that sugar beets should never be planted on new ground. Such soil it is claimed is so full of soluble salts as to make the beet too impure for factory use. Chas. Johnson, at Atwood, reports that his beets were planted on newly broken land and they tested 15.2 per cent sugar and 82.4 per cent purity. Sidney Flinn, at Caddoa, under similar conditions on rather clay ground, which in Colorado would ordinarily be very rich in soluble salts, produced beets that contained 19.4 per cent sugar. Though the purity was not determined, it could scarcely have been less than 83 per cent.

The only other two persons who reported beets on new ground, had samples taken in September before the beets were ripe, but even in these two cases the beets tested better than the average of their neighbor's beets on old ground.

There were six cases reported where the beets were raised on ground that had been broken a year before and had raised one crop before the beets. These give uniformly fine beets and average 17.3 per cent sugar and 82.6 per cent purity.

All rules for sugar beet culture say to subsoil if possible, but if not, to plow very deep, and better if plowed in the fall. No subsoiling was done by any of the farmers; about a third of them plowed in the fall and but few plowed more than eight inches deep. It is probable that subsoiling in Colorado under irrigation is labor lost. Deep plowing is an advantage with the clay soils, but in the alluvial soils of the river bottoms which will be the land most used for beet culture, the roots go deep into the soil, whether the plow is run deep or shallow.

Another point was noticed in all the fields visited. The beets grew with the entire root under ground. This makes a little more labor in digging, but it lessens the amount of the top of the beet that has to be cut off with the leaves and increases the amount of sugar in the upper part of the root. It is probable that this fact goes far toward explaining the higher average quality of Colorado beets over those of the neighboring states. Just why the beets should grow so in Colorado is not yet evident, unless it is due to the furrow

irrigation which deposits the water below the soil rather than on its surface and tempts the beet to go deep for it. The writer noticed particularly at Grand Island, Nebraska, the past season, that nearly one-third of the weight of the beet was above ground, making a loss in the amount that was trimmed off and a poor quality in the upper inch that was left on the beet.

All writers on sugar beet culture are agreed that beets should not be planted on ground that has recently been manured with stable manure, because its tendency is to make a large beet that is late in ripening and is low in sugar and purity. Sixteen persons report that they manured their beet ground before planting it. The crops were large as was to be expected, and it was also true that unless the samples were dug late in the season the quality is low. The stable manure seems to have made them late in ripening, but on the ripe crops, the quality is good with three exceptions. As these three are almost the only ripe crops that are poor it seems a fair conclusion that the result is due, in part at least, to the stable manure. Taking the results as a whole they indicate much more gain than loss from the addition of stable manure.

One of the special advantages claimed for Colorado in the matter of beet raising is, that under irrigation, water can be kept away from the crop during the latter part of the season, allowing it to ripen and reach the full amount of sugar and purity. This is undoubtedly correct, but one queer sample shows that even this rule may have exceptions. Mrs. M. H. Lafever of Eagalite, sent a sample that was dug the first of October, after two weeks in which it had rained every day. Yet the beets tested 17 per cent sugar and 88.1 per cent purity.

The effect of alkali on sugar beets is still an open question, as is also the result of growing beets on seepage ground. As throwing some light on the latter question, two examples may be quoted. At Greeley, A. L. Camp Jr., planted beets on some strongly alkali seepage ground and they tested 6.8 per cent sugar and 46 per cent purity. Mr. Camp makes the statement that these beets were the first things he had found that were able to grow in the presence of so much alkali. E. K. Smith at Fort Lupton, grew beets on land kept moist by the seepage from a reservoir and his beets tested 14.5 per cent sugar and 80 per cent purity. Both raised large crops without irrigation, but in the first case the beets showed a large amount of second growth indicating that there had been a time when they had suffered from

lack of water, while the other beets were some of the finest seen during the season. They were finely shaped, thoroughly ripe, with nothing on the crown but the first growth of leaves. In other words the seepage from the reservoir had been constant through the season and just enough to give the beets all the water they wanted all the time.

STAND.

The number of beets to the acre determines in large measure the weight of the crop and its character. In general it can be stated that the more crowded the beets, the smaller they will be, but richer in sugar and of a higher purity; the farther apart, the larger and poorer they will be.

There should be some medium ground that will produce the largest amount of sugar beets per acre. This is approximately when there is one beet for each square foot of ground. If the rows are two feet apart, this would leave six inches between the plants. With eighteen inch rows, the distance between the beets would be increased to nine inches.

The hardest part of beet raising is to get a full stand all over the field. More than half of those who raised beets in 1897 report the stand as thin or poor. Two pounds of beet seed contain enough seed to make a full stand on an acre of ground, but to get this stand in practice it is necessary to sow a much larger amount. The idea is to sow a good deal more than is needed and then thin out the plants to the required distance. It is customary in the vicinity of factories to sow fifteen to twenty pounds of seed to the acre. The records show that different beet raisers in Colorado sowed varying amounts from two pounds to two hundred and seventy-five pounds to the acre. The average was nine pounds per acre, but more than half of the persons used less than eight pounds per acre or less than half the proper amount.

The poor growth of the seed is due to lack of moisture in the ground, too deep planting, and poorly prepared ground. East of the range, in Colorado, the first, due to the dry winters, will always be the greatest objection. It is possible to overcome this in two ways; by irrigating the field before the seed is planted, or by irrigating after the seed has been sown. The first is better if it can be done, but it is very likely that the second will come to be used as the regular method in growing beets for factory use.

Quite a number of persons tried this method in 1897. Fifteen persons report the resulting stand as follows: one,

poor; two, fair; one, uneven; two, good; one, thick in places; eight, thick. In other words eight out fifteen obtained a thick stand by irrigating up the beets.

This is about twice as large a proportion as those who obtained a thick stand by depending on rain or the original moisture in the ground.

Of two persons who irrigated ten days after the seed was planted, both report poor stands. Of two persons who irrigated before the seed was planted one reports a good stand and the other poor.

No relation can be traced between the stand and the analysis of the crop, for there is no record to show whether the beets analyzed grew by themselves or were taken from thick places in the field.

RECAPITULATION.

The results of the season of 1897 may be summarized in a few words.

Good sugar beets can be raised anywhere in Colorado that is adapted to any kind of farming. Large crops of good beets can be raised in any portions of these districts that are supplied with water for irrigation. The season opens early enough and the winters are mild enough so that a factory could have a run of at least one huudred and twenty days.

The average quality of the ripe crops of Colorado in 1897 was 15.5 per cent sugar and 81.6 per cent purity. The average quantity of beets per acre was not far from sixteen tons.

FACTORY CONDITIONS IN COLORADO.

Those who contemplate putting their money into a beet sugar factory will desire to receive answers to several questions in addition to those already presented.

It has been shown that Colorado has the soil and climate for the production of high grade beets. A natural question follows as to whether the people of the State are enough interested in the matter to raise the beets if a factory was built. The answer to this must be in the affirmative. This has been tested on several occasions and there would be no trouble in getting the necessary acreage pledged at several places in either the Platte, Arkansas, Grand or San Luis valleys.

A home market exists in Colorado for all the sugar that would be produced by three large factories, thus saving freight on the finished article. Each of the above mentioned regions is near to enormous deposits of coal, affording an abundance of cheap fuel. The deposits of limestone are

adjacent to the farming districts and much of the lime itself is almost chemically pure. Pure water for factory use can be easily obtained.

Indeed it can be said in all truthfulness that no place where a factory is now in operation presents advantages equal to those posessed by any one of half a dozen localities in Colorado.

INFLUENCE OF DRYING ON BEETS.

In the raising of sugar beets for a factory, it is customary to dig beets during the early part of the season, as fast only as the factory can use them. At the end of the season, in countries where there is danger of the ground freezing, all of the crop is harvested and either brought to the factory and stored in bins or piles or else the surplus of beets are piled up in the field where grown and covered with a thin layer of dirt to prevent their freezing.

It becomes a question of great importance to both beet grower and beet manufacturer as to what changes if any will occur in the beet during the weeks that elapse between digging and slicing.

Some investigations along this line were made at the station in 1897. Samples of beets were weighed and placed where the conditions would be much the same as those in the field, other samples remained in the cellar of the laboratory, others in the laboratory itself, while still others were buried in dirt.

The two ideas were to find out how fast beets dry out under these conditions and whether there is any loss of sugar when the beet dries. The first is important to the grower, because if he sells his beets by the ton, all the drying out reduces his tonnage. The second is equally important to the manufacturer, because having bought the beets and paid for the sugar in them at the time of delivery, he wants to know whether the sugar will keep until he is ready for its extraction.

A few of the results obtained will be given here in anticipation of the fuller figures to be published in a technical bulletin on the chemistry of the growth and handling of sugar beets.

On October 29th, a lot of beets were taken from a field on the College farm and divided into three equal lots; one was taken to the laboratory at once and kept in a cool, dark place; the second lot was left lying on the ground in the field exposed to the sun as would happen in ordinary practice. The next day this lot was gathered and analyzed,

together with the first lot. The third lot was piled up in the field, covered with a few inches of dirt and allowed to remain for five weeks before analysis.

The results are as follows.

	Per cent sugar.	Per cent purity.
Kept one day in a cool place,..	14.0	82
Left one day in the open field,.	14.9	79
Covered five weeks with dirt,..	14.7	84

The results show that the beets dried considerably during the one day exposed to the sun, but that in this case and also where covered with dirt, the loss was merely one of water, the sugar in the beet remaining without fermentation.

This was with ripe beets taken from a dry soil. No judgment can be drawn from this as to what would happen with unripe beets.

On October 6th, two lots of beets were taken; one from a field fairly ripe and the other still green and growing. Half the beets in each lot were analyzed at once; the other half were weighed, wrapped tightly in paper and put on the ground in the cellar of the laboratory. Both lots were weighed each day for sixteen days, to note the loss in weight and then each was analyzed.

In each case the beets lost one-twentieth of their weight in the first twenty-four hours or at the rate of a hundred pounds for each ton of beets. In five days each lot lost a little more than one-fifth of its weight. In sixteen days each lot lost thirty-eight pounds for every hundred pounds of original weight.

The more nearly ripe beets tested, when put in the cellar 9.8 per cent sugar; at the end of sixteen days they had dried out until they tested 15.9 per cent sugar. When the weights are taken into consideration it is found that of the 9.8 per cent of sugar in the original beets 9.55 per cent was still present, showing that the sugar had not fermented in the drying out and that the loss was merely one of water.

The green beets tested 9.3 per cent sugar when taken from the field and 12.6 per cent sugar after drying sixteen days. Making the same calculation, shows that of the original 9.3 per cent sugar, only 7.7 remained, indicating a fermentation and a loss of one-sixth of the sugar.

On January 3, 1898, some beets were dug that had been covered with straw for two months. They had started a slight second growth, but not enough to injure them for factory use. After analyzing enough of these beets to get their average composition, the remainder were brought to the laboratory and left for one day exposed to the air. They

lost just one-twentieth of their weight the same as in the fall. They were then covered with three thicknesses of sacking, but continued to dry out and in five days had lost nearly one-fifth of their weight. At the end of fifteen days they had lost just the same as the beets did in the fall in sixteen days. The beets tested originally 14.4 per cent sugar; fifteen days afterward they tested 21.6 per cent sugar. Calculations of weight show that of the original 14.4 per cent sugar, 13.4 per cent remained, or a loss by fermentation of about one-fourteenth of the sugar.

EFFECT OF FREEZING ON BEETS.

When the beet fields on the college farm were harvested, several small patches were left and allowed to freeze. After the tops had frozen and thawed several times the whole was covered with a thick layer of straw. Samples of these beets were analyzed at various times up to the middle of January 1898. From near the edge of the straw some beets were dug that had been partially frozen.

The first beet analyzed had been only slightly frozen. It was cut into thirds by weight and each third analyzed.

	Per cent. sugar.	Per cent. purity.
Upper third	12.9	78.7
Middle third	12.0	91.1
Bottom third	12.0	81.4

The second beet had been decidedly frozen.

	Per cent. sugar.	Per cent. purity.
Upper third, all froxen	10.9	73.2
Middle third, partly frozen	11.2	70.3
Bottom third, not frozen	14.3	88.3

Here the effect of the freezing seems to have been to drive the sugar into the lower part of the beet.

One of the patches of beets covered by straw tested the first of November when covered, 12.3 per cent. sugar and 77 per cent. purity. On January 3, the same patch tested 13 per cent. sugar and 86 per cent. purity. This was a patch of large beets and and to the eye they had increased in weight during their two months under the straw.

COLORADO SOILS.

The relation between the growth of the sugar beet and the character of the soil in which it grows has been studied very carefully in Europe. Almost nothing of this kind has been done in the United States. The results of the work in 1897 seem to indicate that it is not safe to apply the rules

formulated in Europe with beets dependent on rainfall, to our Colorado conditions, where the beets are grown with irrigation. This opens up a wide field for experiment and research. No one station in any one season can hope to compass the problem. The following soil analyses made by Mr. Chas. Ryan are presented as a contribution to the subject. They should be studied in connection with the analyses of the beets grown in the several sections.

Much more of this work will need to be done before any generalizations can be drawn.

PLATTE VALLEY.

	No. 3 Weld County	No. 53 Weld County	No. 32 Logan County	No. 36 Morgan County
Water		1.48	1.57	1.33
Soluble and insoluble silica	85.92	86.12	86.38	86.98
Potash	0.38	0.54	0.70	0.56
Soda	0.30	0.16	0.46	0.86
Lime	0.97	1.38	1.36	0.19
Magnesia	0.40	0.42	0.18	0.05
Iron Sesquioxide	3.01	2.43	1.76	0.99
Alumina	3.96	3.52	6.19	5.53
Phosphoric acid	0.31	0.11	0.03	0.04
Sulphuric acid	0.26	1.13	0.05	0.39
Carbonic acid	0.28			0.06
Volatile and organic matter *	4.42	2.52	2.02	2.67
Chlorine	0.05	0.05	0.05	0.05
Total	100.26	99.86	100.12	99.60
* Containing nitrogen	0.13	0.07	0.11	0.16

DIVIDE SOUTH OF DENVER.

	No. 14 Douglas County	No. 16 Elbert County
Water	1.42	1.34
Soluble and insoluble silica	82.12	87.04
Potash	0.37	0.46
Soda	0.51	0.93
Lime	0.24	0.12
Magnesia	0.28	0.42
Iron Sesquioxide	2.54	1.54
Alumina	8.34	3.83
Phosphoric acid	0.03	0.01
Sulphuric acid	0.20	1.19
Carbonic acid	0.02	0.48
Volatile and organic matter *	3.10	2.66
Chlorine	0.07	0.04
Total	99.24	100.06
* Containing nitrogen	0.13	0.12

ARKANSAS VALLEY.

	No. 38 Otero County	No. 27 Las Animas County	No. 42 Prowers County
Water	1.55	1.66	2.65
Soluble and insoluble silica	83.26	83.04	78.00
Potash	0.91	0.25	1.69
Soda	0.52	0.11	0.54
Lime	1.76	1.55	1.44
Magnesia	1.06	0.11	0.79
Iron sesquioxide	2.38	2.93	2.78
Alumina	4.45	4.70	5.94
Phosphoric acid	0.14	0.90	0.09
Sulphuric acid	0.50	0.45	0.60
Carbonic	1.15	1.01	5.79
Volatile and organic matter *	3.25	3.70	
Chlorine	0.09	0.04	0.03
Total	100.12	100.45	100.34
* Containing nitrogen	0.12	0.06	0.13

GRAND AND GUNNISON VALLEYS.

	No. 19 Garfield Co	No. 21. Gunnison Co
Water	2.82	2.30
Soluble and insoluble silica	77.88	72.51
Potash	1.38	0.75
Soda	0.63	0.86
Lime	0.71	2.05
Magnesia		0.58
Iron sesquioxide	2.07	2.86
Alumina	8.27	10.24
Phosphoric acid	0.14	0.01
Sulphuric acid	0.44	1.46
Carbonic acid	0.21	
Volatile and organic matter *	5.32	6.21
Chlorine	0.06	0.05
Total	99.93	99.98
* Containing nitrogen	0.16	0.13

SAN LUIS VALLEY.

	No. 5. Rio Grande County.	No 44. Rio Grande County.	No. 9. Conejos County.	No. 10. Costilla County.	No. 40. Saguache County.
Water		1.48	3.50	2.17	3.97
Soluble and insoluble silica	80.75	80.67	70.24	79.77	75.05
Potash	0.53	0.90	0.68	0.26	0.11
Soda	0.94	0.77	1.98	2.31	0.44
Lime	1.62	1.55	1.46	1.65	2.10
Magnesia	1.40	0.95	0.44	0.14	0.67
Iron sesquioxide	1.84	5.40	2.94	1.42	3.60
Alumina	7.90	5.09	5.07	8.03	5.33
Phosphoric acid	0.21	0.09	0.06	0.07	0.11
Sulphuric acid	0.22	0.67	0.02	0.39	1.10
Carbonic acid	0.70		0.38	0.01	
Volatile and organic matter *	3.63	3.00	13.10	4.57	7.41
Chlorine		0.09	0.03	0.06	0.09
Total	99.78	100.66	99.90	100.85	100.18
* Containing nitrogen	0.11	0.09	0.23	0.18	0.24

THE CAMPAIGN OF 1898.

It is evident that the more interest there can be aroused in Colorado in the culture of the sugar beet, the more likelihood there is of the erection of factories.

The Experiment Station has taken an active interest in the matter for several years and proposes to devote more time and energy than ever before to the campaign of 1898.

Seed will be distributed, free of charge, to those who desire to make tests of raising sugar beets. The seed will be sent out early in April, to those who desire it. Applications should be sent in at an early date. Enough seed will be sent to each applicant to plant fifteen rows, fifty feet long or their equivalent. This small area is selected because it is desired to know the best that Colorado can do, and that is most likely to be ascertained when the amount planted is small enough so that it can be put on the best land and given the best of care and attention.

Those who receive seed will be expected to keep full records concerning the crop.

About the middle of July the following circular will be sent out. It is suggested that those who receive seed make their records directly on this bulletin, of which they will have a copy, and from which they can copy these records on to the blank when it is received.

COLORADO AGRICULTURAL COLLEGE.

SUGAR BEET CIRCULAR NO. 1.

FACTS CONCERNING THE PLANTING OF THE CROP.

Date planted.....

Character of soil.....

.....

Much or little alkali in soil.....

Previous cropping and handling.....

.....

.....

When last manured.....

Date plowed.....

Plowed how deep.....

Other preparation given.....

Seed planted with what implement.....
Seed planted how deep.....
Width between rows.....
Was all the seed sent used?.....
How much land was planted?.....
Date beets began to show above ground.....
Date of each cultivation..... .....
How cultivated.....
Date of thinning.....
Distance between plants after thinning.....
Is the stand thick or thin?.....
Date of each irrigation.....
(Signed) Name.....
Postoffice .....

NOTE.—Fill out the blank the first of August and send by mail to

THE STATE AGRICULTURAL COLLEGE,
Fort Collins, Colorado.

The analyses of the beets will be made at Fort Collins. Instructions for taking and sending samples will be sent out next fall. No beets will be analyzed unless accompanied by the full history of the planting, cultivation and harvesting of the crop.

It is desired that two samples of the crops be taken, one early in October and the other about the first of November. No samples will be analyzed after the middle of November.

INSTRUCTIONS FOR THE GROWING OF SUGAR BEETS.

Select the best land on the farm. A rather heavy loam produces the best crops. Avoid light, sandy soils, poorly drained soils, heavy clay soils and alkali soils. Do not plant on newly broken ground unless it can be plowed very deep. Never plant beets on alfalfa sod. Beets do best after corn or potatoes. The freer the land is from weeds the easier and cheaper will the crop be raised. On land that has been manured just before plowing, it is difficult to get a good stand of beets, but if the choice has to lie between poor land and rich land recently manured, always take the rich land.

Plow at least eight inches deep; harrow thoroughly and smooth the ground before planting. Fall plowing is best, to be again plowed in the spring before planting. Whether fall plowed or not, the spring plowing should be done as short a time as possible before planting. If possible the seed should be planted the same day that the ground is plowed so as to have the benefit of all the moisture in the ground for germinating the seed. If a large acreage is to be planted, it should be handled in sections, plowing only what can be planted at once. On a large acreage it is advisable to plant the ground in three sections from five to seven days apart, so that the thinning will come at different times and economize labor.

Sugar beets can be planted from early in April until the last of May. In general they are planted about the same time as corn. They should always be sown under such conditions of warmth and moisture that the seed will germinate at once and the young plants show above ground within ten to fourteen days after planting.

Beet seed should be sown in drills from 16 to 24 inches apart; most beet seeders are made for 18 inch drills. The seed can be sown by hand, by the common garden drill, by a wheat drill closing up some of the holes, or regular beet drills can be used that are made for the purpose and sow four rows at a time. Sow the seed from half an inch to an inch and a half deep. Sow as near the surface as it is possible for the seed to get enough moisture to germinate. The earlier in the season the seed is sown, the less depth it should be planted. If the ground is very dry, sow near the surface and then irrigate up the seed by making a small furrow between every other row and running a small stream of water until the ground has wet sideways to both rows. Remember that getting a good stand is the hardest part of sugar beet raising.

Sow plenty of seed ; never less than fifteen pounds to the acre and from that to twenty pounds.

The thinning should be most carefully and promptly done, as on it depends in large measure the weight and quality of the crop. There is but one time to do this work, and that is while the plants are very young—just as soon as the third or fourth leaf becomes well defined and the root is nothing but a mere thread. If delayed the plant receives a set back from which it can scarcely recover. Just before thinning, work the ground between the rows with a hoe or

with a horse cultivator made to work the same number of rows at a time as were sown by the seeder. Next follow with a sharp hoe four to six inches wide, cutting across the row and dividing it into bunches six to nine inches apart. These bunches are thinned by hand to a single plant. The plants should be from six inches apart in a twenty-four inch drill up to nine inches apart in an eighteen inch drill.

After the thinning go through the field once more with the hoe and be sure that every weed is killed. The rest of the cultivation needed during the season is only such ordinary cultivation as would be given to a crop of corn.

Irrigate the beets only when they show the actual need of it. Delay the first irrigation as long as possible unless it is necessary when the seed is planted to produce germination, in which case the water should be turned on within two days after the seed is in the ground.

A slight wilting during the day does not necessarily mean need of water, but when they wilt and do not revive as soon as the sun sets or the weather is cloudy, they should be watered. After the first watering they will usually dry out quickly and need subsequent irrigations every ten to fourteen days. Few beets can be raised in Colorado without irrigation, the number of irrigations varying from two to five according to the ground and the season. Beets will seldom need irrigation after the middle of August and usually not after the last of July. Unless the ground is very compact it will be sufficient to run the water in every other row. At the next irrigation use the rows omitted the previous time. Cultivate after every irrigation. Never flood sugar beets if it can possibly be avoided. Be careful in cultivation and in furrowing not to throw any dirt on to the crown of the plant. Keep the irrigation water as much as possible away from actual contact with the plant.

Wait until the beets are ripe before harvesting; ripeness can be told by the wilting and dying of the outer leaves, by slicing a beet and noting that the cut surface remains white for a half hour or more, but best of all by a chemical test for the sugar it contains. At a factory this latter method is the one always employed.

On a small scale the beets can be dug out, plowed out or pulled. On the large scale they are always loosened by a beet puller made specially for the purpose. They are then lifted out by hand, thrown into piles and topped by hand with a corn knife or a heavy chopping knife.