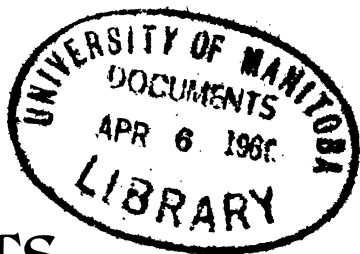


1) Colorado

THE STATE AGRICULTURAL COLLEGE.

2) THE AGRICULTURAL EXPERIMENT STATION.

3) BULLETIN NO. 36. 4)



SUGAR BEETS.

Approved by the Station Council,

ALSTON ELLIS, President.

FORT COLLINS, COLORADO.

MARCH, 1897.

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SUGAR BEETS.

AGRICULTURAL DEPARTMENT.

W. W. COOKE.

The present bulletin is written as an answer to the many letters that come to the Station asking for information about sugar beets. The fact that the number of these letters has largely increased during the past year shows that there is a renewed interest in the subject.

This Station has already sent out four publications on the subject of sugar beets, giving general instructions for their cultivation and detailing the results obtained in the experiments on their growth at the College Farm, on the sub-station at Rocky Ford, and at various places throughout the State. These publications have long been out of print and for this reason it is deemed advisable to repeat here some things that have been before published.

During the five years since the last bulletin on sugar beets was issued, the Station has continued its experiments at the College and many facts have accumulated concerning the adaptability of other parts of the State to sugar beet growing, so that we now have a pretty clear idea of the conditions of the problem for Colorado.

MARKET.

All manufacturers desire first of all to cultivate the home market in order to save transportation charges. He considers himself fortunate who can sell his entire product at the door of his factory. Such is the state of affairs that exists for the manufacturer of sugar in this State. Colorado pays out each year about \$500,000 for sugar. This statement is based on the assumption of half a million inhabi-

tants each consuming sixty pounds per year at a cost to the importer of five cents per pound. It would be a great help to the State if this money could be kept at home, as it would be if sugar was made here, since after the factory is once built nearly all expenses are for material and labor produced in the State. To produce the sugar consumed by the inhabitants of Colorado, would require five factories of large size employing two hundred men each, who with their families would represent about four thousand people. It would require the growing of sugar beets on fifteen thousand acres of land and add more than three hundred dollars to the income of each of two thousand farms.

PROFIT.

Are Colorado conditions such as to make the manufacture of beet sugar a profitable industry? The profit of the industry to the factory owner, depends ultimately on the price for which he can sell his product. This market price is at present so largely dependent on political legislation that the question at the head of this paragraph cannot be answered with any certainty.

What can be said is this; that sugar beets will grow as well in Colorado as any where in the world, both as regards their quantity per acre and richness in sugar. Moreover, land suitable for the growth of the beet exists in large bodies now under cultivation in several different parts of the State and this land is near to enormous deposits of coal and lime and but a few miles from the centers of population that will consume the finished product. It follows therefore that if prices are such as to make the business profitable anywhere, then it will pay in Colorado.

GROWTH.

The best possible climate for the growth of the sugar beet is that found in the section of Colorado east of the foothills of the Rocky Mountains and below 5,000 feet altitude. There are many valleys in western Colorado that have a similar climate, but the parks of the State are too cold for the sugar beet to be grown with profit.

The rainfall of Colorado is too small to grow the beet without irrigation, so that its growth will be restricted to the irrigated portions, especially to the valleys of the Arkansas, the Platte, and the Grand.

The soil best adapted to the growth of sugar beets is a rather firm sandy loam; such land as is used in northern Colorado for growing potatoes, and in the Arkansas Valley

is planted to corn. A factory to be profitable must have at its command the beets from at least two thousand acres. There are several places in the Platte Valley where five times that amount is now yearly cropped in potatoes and equally large bodies of land are devoted to corn in the Arkansas Valley.

PLOWING.

A common cause of failure among beginners in sugar beet culture is a lack of thorough preparation of the soil. The sugar beet grows with the entire root below ground, and as this root should be at least twelve inches long, it follows that only the deepest of plowing will make a suitable condition for its growth. The land should be plowed in the fall and subsoiled to a depth of fifteen to eighteen inches. This is especially necessary in an irrigated district, for under irrigation, where the ground is plowed eight inches deep year after year, there is a layer of soil just below the furrow that becomes very compact and so hard that the roots of the sugar beet cannot penetrate it.

If the plowing is done in the fall, nothing more will be needed in the spring but a thorough harrowing just before planting. The harrowing should be continued until the ground is very fine and smooth. If the plowing is done in the spring, it should be delayed until just before planting, so that the weeds that have started will be killed and the beets have a chance to grow before the next crop of weeds appear.

PLANTING.

The planting is done in drills and may be by hand or machine according to the size of the field. The best results are obtained by hand planting, but this is too expensive for a large field. An ordinary garden drill does very good work, but on the large scale some machine drawn by horses will be employed. There are special horse drills made for the planting of sugar beet seed and these are the implements mostly used in the vicinity of factories. For the one who wants to experiment or grow a few acres for stock feed, an ordinary wheat drill makes a very good substitute. In the 8-hoe drill leave open the first, fourth and seventh hole and stop up the rest. This makes the rows of beets twenty-four inches apart, which is none too far for irrigation. Suppose the first hole on the right-hand end of the drill is left open, and seeding is begun at the right-hand end of the field. Then the first time across, the right-hand wheel of the seeder is run close to the edge of

the field. In returning, the left-hand wheel follows the track it made in crossing. In starting across the second time, the right-hand wheel should go sixteen inches from the track it last made. In this way all the drills will be twenty-four inches apart.

The seed should be sown at the rate of about twenty pounds to the acre. This is far more seed than is needed if all grows, and a large part of it will be pulled up when the plants are thinned. But the most serious obstacle to a large crop is the lack of a full stand and the only way to get the ground well covered by plants is to start many more than are needed and thin out the surplus.

The seed should be covered about an inch and a half deep. If seeding happens to be done just after a hard rain, when the ground is thoroughly wet, half an inch deep is sufficient; but usually, in Colorado, the ground is rather dry at time of seeding and unless the seed is covered quite deep, there will not be sufficient moisture to insure germination. The getting a good stand is by far the hardest part of raising sugar beets.

There are a few favored spots in Colorado where irrigation water can be obtained very early in the spring. If then the plowing has not been done in the fall, it may be advisable to irrigate the ground thoroughly before plowing, and thus insure a good supply of moisture in the subsoil.

If, after the seed is sown, there comes on such a dry spell that the seed has to be "irrigated up," the chances of a profitable crop are slight. Even in such a case, there is some chance of success if a small furrow is made six inches from the seed drill and a small head of water allowed to run for quite a while until it has wet the seed by soaking sideways without running over the surface above the seed. This could only be done where the ground is well prepared and has a uniform slope.

Planting may be done any time from the last of March to the middle of June. If planting for a factory, it is advisable that both early and late planting be done, to extend the season for running the factory as long as possible. Where the beets are grown for stock food, the planting will be done at about the time of corn planting. Sugar beets sown the first of May will be ready for harvesting about the first of October.

CULTIVATING.

The first cultivation should take place as soon as possible, that is as soon as enough of the plants show so that the rows can be followed. Many forms of cultivators are on the

market for this particular purpose. Any of the tools used for cultivating onions will do good work on sugar beets. The ordinary one-horse cultivators are often sold with special attachments for working on beets. Whatever implement is used it should merely scratch the surface of the ground, leaving it level and killing the small weeds, without throwing dirt onto the young beets. This cultivation needs to be repeated about once a week until the beets are large enough to shade the ground and conquer the weeds. The ground should be cultivated after each irrigation to throw the dirt back into the irrigating furrow and make a dirt mulch on top that will preserve the moisture. The cultivator should also be run after each rain that the crust formed may be broken up. Ordinarily, it will require about five cultivations to keep the crop in good shape.

IRRIGATION.

The uses of irrigation before plowing and to germinate the seed have already been mentioned. It is advisable to delay the first regular irrigation as long as possible. When it is necessary, it is always given in furrows, care being taken to keep the water off the surface and not let it touch the crowns of the plants. All beet crops in Colorado will require one irrigation, and may need two or three. The cultivator should be run as soon as possible after each irrigation.

The most of the sugar is made by the beet during the last few weeks before it is ripe. To make the highest per cent. of the best sugar it is necessary that at this time the plant should almost cease growing and devote its energies to storing up in the root, as sugar, the nourishment that has already been taken from the ground and elaborated in the leaves. If water is applied at this time by rainfall or by irrigation, it induces the plant to keep on growing, making a large weight of crop, but one containing a low amount of sugar. Hence the last irrigation should be given about six weeks before the crop is matured. This will be from the first to the middle of August. In 1895, there was a heavy rain in September at the College Farm, which kept the beets in full growth until frost and gave a crop with much less than the usual amount of sugar. Such rains very seldom occur in Colorado and this fact coupled with the control that the farmer has over his water supply under irrigation makes the growth of a crop with the largest amount of sugar more reliable in this State than in those sections that depend on rainfall to grow the crop.

THINNING.

The thinning should be done when the plant has four leaves. The plants should be thinned so as to leave one plant in a place and the plants from eight to ten inches apart. If the crop is being raised for stock feed and the drills are two feet apart, a plant can be left every six inches. In general there is not much difference in the weight of the crop, at six, eight or ten inches apart, if the soil is rich and there are no missing plants; but the closer the roots are left the less likelihood there is of missing spots and the larger the crop on medium rich soil.

In beets for the manufacture of sugar it is not desired that they grow to a large size. They contain the largest amount of sugar when they weigh about two pounds apiece. They should average under this size rather than over. For stock feed there is less objection to the large beet. By thinning to twelve inches on rich ground it is easy to get beets that weigh five pounds and over, inferior for both sugar and stock food.

The thinning is usually done both by the hand and a hoe. With a narrow, sharp hoe the drill is struck cross-wise and the beets cut into hills. The final thinning of these hills to one plant, must be done by hand.

FERTILIZING.

The sugar beet takes from the ground a large amount of plant food. It follows therefore that the land must be liberally manured to keep it fertile. Most of the cultivated land in Colorado, contains at the present time, plenty of fertility to grow several crops without manuring; but at most this is only a temporary condition and sooner or later the farmers of this State will have to follow the customs of their eastern brethren and put as much plant food on the land as the crop carries away.

For the next few years most beet raisers, will obtain fertility for their crops, by growing alfalfa and plowing under the sod. In this case the beet should never follow the alfalfa immediately, but a crop of grain should be grown first. This will rot the alfalfa roots and work the soil into better shape for the sugar beets.

Unless in the case of alkali fields, which will be mentioned later, it is not considered advisable to grow beets more than two years in succession on the same ground. Where the supply of suitable land is not limited, better results will be obtained by raising but one crop, following the next year

with grain, or seeding back to alfalfa. Thus the rotation would be alfalfa three years, wheat one year, beets one year, oats one year with alfalfa seed, and alfalfa for the next three years.

When it becomes necessary to fertilize the ground with barnyard manure, the best crop to follow with is corn. The rotation would then be corn, beets, grain two years, manuring the second year after the grain, and then planting corn again the fifth year. If the stable manure is applied just before the beets, it produces a large crop, but the amount of sugar is small.

VARIETIES.

The varieties mostly used are the Kleinwanzleben and the Vilmorin. The beet sugar factories import this seed and sell it to their patrons at cost. An attempt is now being made in Utah to grow sugar beet seed on a commercial scale.

HARVESTING.

Harvesting for the factory is commenced as soon as the beets are ripe, which stage is known by the change in color of the leaves from green to yellow and at the same time the leaves droop to the ground and many of the outer leaves die and wither. Beets for stock food should be left in the ground as long as possible and gathered just before the ground freezes. In Colorado the harvest will extend from October 15th in the northern part to a month later in the southern and western portions.

Harvesting may be done by a beet puller made for the purpose, which looks much like a sulky plow, but in place of the plow are two strong iron prongs. When the machine is driven lengthwise of the row these prongs dig deep into the ground, one on each side of the beet and loosen it from its bed. It can then be lifted out by hand. A simpler method, and almost as good, is to plow a deep furrow by the side of the row of beets and as close to them as possible without cutting them. They may then be loosened by pushing sideways into the furrow and pulled by hand.

The most tedious and expensive part of the harvesting is the topping. Although machines have been invented for doing this, they have not been successful and the work is still done by hand. A strong heavy knife is used and with a single stroke the leaves are severed from the root. If for sugar, the "neck" of the beet is cut off with the leaves; that is, the part of the beet from which the leaves have grown.

For stock feed, where the beets are to be kept in a root-cellar for several months, this neck is left on the root, the

leaves alone being cut off. Under this condition the beet wilts less and keeps better.

After topping, the beets are thrown into piles, covered over with the leaves and allowed to remain until they are taken to the factory or the root-cellar. If to the root-cellar, the storing should be delayed as long as possible. The danger of heating in the cellar during the fall, is fully as great as that of freezing in the field.

STORING.

The sugar factory will begin running as soon as the earliest beets are ripe. From then until freezing weather sets in, it will work on beets drawn directly from the field. But all factories desire to lengthen the working season as much as possible, to lessen the size of the factory required to work up a given quantity of beets, or with a given sized factory to increase its working capacity. Some precautions have to be taken to preserve the beets from freezing that are to be used the latter part of the season. Long, broad and shallow pits are dug close to the factory into which the beets are thrown, as brought from the field, and then covered with straw and a layer of dirt more or less thick according to the degree of cold to be withstood. It is customary for the factory to supply these pits close to its works, rather than for the farmer to pit the beets in his own field, because it is much more convenient to get at the beets during freezing weather when they are close at hand.

The stock feeder can use the system on his own land near his feeding barn, or he may build a regular root-cellar like those that are found all over Colorado for storing potatoes. The latter way in the course of years is by far the more satisfactory.

COST.

No statement of cost can be given that will not be subject to many changes in different localities. Leaving out of account rent or interest on the value of the land and also any charge for water-tax etc., the items of raising an acre of beets will be approximately as follows:

Plowing and harrowing, man and team	10	hours
Seeding, man and team	2	"
Cultivating, man and horse	20	"
Hoeing, man	135	"
Thinning, man	65	"
Irrigating, man	10	"
Plowing, man and team	4	"
Pulling, man	20	"
Topping, man	80	"

Hauling will always be an item of cost, but varies from eight hours for man and team, to thirty hours according to distance to be hauled and facilities for hauling.

The time and expense for planting and cultivating the crop, will be about the same whether the yield is large or small. The expense of harvesting has been figured on the basis of twelve tons to the acre and will rise or fall according as the crop is greater or less.

Under the varying prices of labor, the ease with which the land can be worked, and the size of the crop, the cost of raising and marketing an acre of sugar beets has varied at different places in the United States from \$30 to \$45, and the cost per ton of beets from \$2 to \$4.

Beets are usually paid for according to their richness, the prices varying from \$4 to \$5 per ton and the returns per acre will average not far from \$50. About eleven tons of sugar beets per acre at \$4.50 per ton is a fair average crop, with a possibility of more than twenty tons at \$5 per ton. As compared with \$10 for the crop from the same land put into alfalfa, or \$12 for the wheat, it would raise, this return seems rather large, but of course there is a much larger amount of labor required to produce this return.

FEEDING VALUE.

Sugar beets have a high value for stock feed. They belong to the class of concentrated feeds in spite of the large amount of water they contain and are to be compared as a feed with grain rather than hay.

It is probable that the dry matter of beets has about the same value, pound for pound as the dry digestible matter in grain. On that basis, a pound of grain would have as much feeding value as four and one-half or five pounds of beets.

Sugar beets have been fed to stock at the College with very good results except where fed to steers. When the feeding is done out doors in cold weather, they seem to be too watery for profitable feeding to steers. They are excellent feed for milch cows and will take the place of grain for fattening lambs during the first half of the feeding period. It is advisable not to feed them during the last six weeks before marketing, giving grain at that time so that the flesh and fat may harden for shipment. Stock sheep and breeding ewes do well on beets all winter. They can even form profitably a portion of the food of breeding sows.

FEEDING VALUE OF LEAVES AND TOPS.

For every one hundred pounds of beets harvested there will be from fifty to sixty pounds of tops. These tops have

a high feeding value. They are worth almost as much pound for pound as the beets themselves.

The tops are good feed for all classes of farm animals. They may be fed at once as soon as harvested or put in a silo and fed through the winter. The past two years, on the College Farm, there has been stock enough to eat them as fast as gathered. They have been fed to breeding sheep and to cows, being hauled from the field and fed in racks. Some beet growers wait until the crop is all harvested and then turn the stock into the field to eat up the tops and leaves. This saves some labor but is wasteful of fodder.

CHEMICAL DEPARTMENT.

WILLIAM P. HEADDEN.

The following pages contain the analytical results obtained in the laboratory of this Station up to the present time. The greater part of them have already appeared in Bulletins Nos. 7, 11, 14, and 21. The data concerning the condition of soil and cultivation, under which the beets were grown, are not given in satisfactory fullness in all cases, but in others it leaves little to be desired.

The record of analyses of all samples analyzed is interesting and profitable to the inexperienced beet grower, as showing the extent to which the sugar content of the beet is dependent upon the cultivation it receives as well as upon the character of the soil in which it is grown.

It is evident, from our records, that a great many persons have furnished the department samples but once, and that was the only attempt that they had made in sugar beet raising. A complete record of the work done in the laboratory would contain many samples of which this would be true and which would give a wholly erroneous impression of the facts as to the quality of beets grown in the various parts of the State under proper cultivation.

In 1888, the Station experimented with four varieties of beets: Excelsior, Lane's Imperial, Vilmorin, and Imperial Improved, with the following results:

Varieties.	Per cent. sugar.	Tons beets per acre.	Pounds sugar per acre.
Excelsior	9.47	29.04	5,517.60
Lane's Imperial	12.08	30.45	7,318.00
Vilmorin	11.39	25.09	5,695.48
Imperial Improved	8.83	24.15	4,250.40

The number of analyses seem to have been small, but the samples were representative of the four lots grown; and while the percentage of sugar varied considerably the results were considered satisfactory, indicating that beets of good quality can be grown in Colorado, and that the yield is large.

The study was continued the following year (1889) on a somewhat different line, i. e., to determine the effect of different soils upon the ash constituents and percentage of sugar in the beets; also to determine the feeding value of the tops and the relation of the weight of the tops to the sugar content of the beet. The second object of this experiment was defeated by an early frost which killed the tops.

A further object was to study the distribution of the sugar in transverse sections of the beets and the relation of the specific gravity of the juice to the sugar content.

In order to establish the first point, the relation of the ash and its constituents to the soil in which the beets grew, the ashes of two varieties of beets, one lot of each, grown upon rich and poor soil respectively, were subjected to analysis. Just what is meant by poor soil and rich soil is not definitely stated and so far as I can learn, the soils were not analyzed. In one paragraph the terms fertilized and unfertilized are used as explanatory of rich and poor, but the rest of the record seems to justify the inference that the term poor, is used in its ordinary signification, and rich to indicate a productive condition of the soil, but not a condition produced by the application of manure or other fertilizer immediately prior to the growing of this crop.

The following data show that the Silesian appropriated nearly one-fifth more mineral constituents and the Imperial over one-half more from the rich than from the poor soil. The Silesian, grown on poor soil, contained 1.08 per cent. but grown on rich soil, it showed 1.28 per cent. And the Imperial, grown under similar conditions, contained 0.80 per cent., and 1.234 per cent., respectively.

There is a difference both in the amount of ash contained in the beets and in its composition, according to the quality of the soil on which the beets are grown. The percentages of phosphoric acid and lime are higher in the case of beets grown on poor soils, but the percentage of potash is higher in those grown on rich soils.

The experiment was not conclusive in regard to the effect of the two soils upon the percentage of sugar. The

Silesian grown on poor soil contained 9.66 per cent. sugar; the same variety grown on rich soil contained 10.47 per cent., while the Imperial, grown on poor soil, contained 10.44 per cent., and grown on rich soil, contained only 9.07 per cent. The difference in either case is too small, especially as it is based on so small a number of analyses, to be conclusive.

The amount of sugar in successive transverse sections of these varieties was also made, the sections being taken one inch thick, beginning to number at the top. The result of this examination was that the first section contained less sugar than any other section, except in one instance, and always from two to over four per cent. less than the maximum in any one section which was found in the tip of the beet. The increased amount of sugar was, with one exception, quite marked in the second section of the beet; in the succeeding sections it was much less and quite regular. In the case of the Silesian grown on rich soil the difference in the quantity of sugar in the first and second sections amounted to 1.21 per cent.; in the second and third to 0.7 per cent.; in the third and fourth 0.29 per cent.; in the fourth and fifth 0.29 per cent.; in the fifth and sixth 0.04 per cent.; and in the sixth and seventh 0.25 per cent. The loss on dressing was between two and three per cent., and was about the same whether the beets were grown in rich or poor soil.

The feeding value of the beets, as influenced by the soil, was also studied. The study of the tops was prevented by an early frost, but the analyses of the roots, as given in Bulletin No. 11, are as follows:

	Water.	Crude ash.	Fat.	Crude protein.	Crude fiber.	Nitrogen free extract.
Silesian, poor soil.....	87.17	1.08	0.24	0.93	0.83	9.75
Silesian, rich soil.....	86.31	1.28	0.27	1.77	0.68	9.69
Imperial, poor soil.....	87.88	0.80	0.14	0.81	0.59	9.78
Imperial, rich soil.....	89.80	1.23	0.18	1.44	0.44	6.91
Vilmorin.....	88.69	1.13	0.18	1.16	0.62	8.22
*Average analysis of sugar beets.....	86.50	0.90	0.10	1.80	0.90	9.80

*As given by Jenkins and Winton, Exp. Sta. Bul. 11.

The same is true of the results recorded in this series of analyses as of the sugar determinations, i. e., they have a general value as they show the beets to have been about

equal to the average sugar beet, so far as their feeding value was concerned, but the results are not positive enough nor based on a sufficiently extended series of experiments to show conclusively that the value of the roots for feeding purposes was materially affected by the nature of the different soils. It may be stated in this connection, that it is known that the beet is very sensitive to the influence of fertilizers and the cultivation it receives, particularly in regard to the purity of the juice or ratio of the sugar to the total solids.

Large beets are frequently received, being sent under the mistaken idea that the larger the beet the higher the percentage of sugar, which is not the case. The following table, reproduced from Bulletin No. 14, illustrates this, though the weight of the largest beet is much less than that of many samples sent us for analysis. The samples were selected with reference to their size as shown by the following table:

	Size.	Weight.	Loss on dressing.	Per cent. sugar.
Bulteau Desprez	Large.	1,245	170	12.83
“ “	Medium.	285	20	14.16
“ “	Small.	43	3	15.97
Kleinwanzleben	Large.	1,015	135	14.12
“ “	Medium.	240	20	14.18
“ “	Small.	42	2	17.11
Dippe's Vilmarin	Large.	860	70	14.37
“ “	Medium.	280	35	14.81
“ “	Small.	42	2	16.66
Bulteau Desprez, No. 2	Large.	980	110	14.26
“ “ “	Medium.	375	30	15.68
“ “ “	Small.	89	5	16.69
Simon Le Grande	Large.	1,150	150	12.17
“ “	Medium.	150	10	12.88
“ “	Small.	43	3	13.52
Florimond	Large.	1,310	170	12.99
“	Medium.	175	10	15.54
“	Small.	30	3	17.05

The size of the beet can be controlled by letting it stand closer in the row and its quality further improved by careful attention to cultivation and fertilizing.

Samples of the following varieties were sent to the Department of Agriculture, at Washington, for analysis and Dr. Wiley reports the results to Prof. Crandall, October 2, 1890, as follows:

	Per cent sugar.
Kleinwanzleben	10.11
Simon Le Grande.....	11.15
Florimond	15.39
Bulteau Desprez No. 1.....	15.20
Bulteau Desprez No. 2.....	14.75
Vilmorin	12.92

Samples were also sent to Grand Island, Neb., and their chemist reports, under date of Nov. 12, 1890, the following:

	Per cent. sugar.
Excelsior sugar.....	7.40
Improved Imperial.....	8.20
Bulteau Desprez.....	14.40
Dippe's Vilmorin.....	14.70
Kleinwanzleben	13.50
Florimond	13.20
Simon Le Grande.....	13.50

Taking the average of the analyses of the varieties made in this laboratory, we have:

	Per cent. sugar.
Bulteau Desprez No. 2.....	15.03
Bulteau Desprez No. 1.....	15.88
Kleinwanzleben	15.64
Dippe's Vilmorin.....	15.75
Florimond	16.30

The preceding samples were grown in a highly cultivated soil under the supervision of the Horticultural Department. The total solids do not seem to have been determined. Analyses were made of the following samples from various parts of the State, and also others which, being unaccompanied by any history, are omitted:

Name.	Where and by whom grown.	Per cent. Sugar.
Colorado Imperial.....	A. R. Black, Lamar, Colo.	8.02
California Sugar.....	" " "	13.03
Colored Vilmorin Desprez.....	" " "	11.26
Imported Florimond.....	" " "	8.45
Kleinwanzleben.....	" " "	11.04
Vilmorin.	Stimson, Neb.	10.38
Simon LeGrande's White Imperial.....	San Luis Valley Stat'n, Monte Vista, Colo.	15.59
Bulbeau Desprez.....	" " "	11.82
Vilmorin.....	" " "	14.14
Vilmorin Desprez.....	" " "	12.25
Kleinwanzleben.....	" " "	13.35
Red Top.....	Arkansas Valley Stat'n, Rocky Ford, Colo.	11.84
Simon LeGrande.....	" " "	13.28
Dippe's Vilmorin.....	" " "	14.09
Florimond Desprez.....	" " "	14.72
Bulbeau Desprez.....	" " "	12.89
Kleinwanzleben.....	" " "	13.66
Improved Imperial.....	College Garden, Fort Collins, Colo.	8.70
Imperial.....	" " "	9.75
Excelsior.....	" " "	6.95
Kleinwanzleben.....	" " "	12.57
Bulbeau Desprez.....	" " "	13.37
Florimond Desprez.....	" " "	12.90
Dippe's Vilmorin.....	" " "	14.20
Bulbeau Desprez.....	" " "	14.18
Simon LeGrande.....	" " "	11.38
Kleinwanzleben.....	" " "	11.11
Bulbeau Desprez.....	" " "	10.97
Florimond.....	" " "	9.82
Dippe's Vilmorin.....	" " "	12.74
Bulbeau Desprez.....	" " "	11.12
Simon LeGrande.....	" " "	9.26
Imperial.....	Chas. Green, Del Norte, Colo.	14.08
Imperial.....	A. S. Halsted, Del Norte, Colo.	14.76
Lane's Imperial.....	Chas. Schielman, La Junta, Colo.	11.30
Lane's Imperial.....		15.68
Imperial.....		15.00
Vilmorin.....	Denver, Colo.	18.00
Bulbeau Desprez.....	" "	15.00

Name.	Where and by whom grown.	Per cent. Sugar.
Vilmorin.....	Denver, Colo.	16.00
Vilmorin.....	" "	16.00
Bulteau, No. 2.....	" "	16.00
Vilmorin, No. 8.....	" "	15.00
Improved Imperial.....	College Farm, Fort Collins, Colo.	8.80
French Variety.....	" " "	10.20
Vilmorin No. 1.....	Arkansas Valley Station, Rocky Ford.	6.00
Vilmorin, No. 2.....	" " "	9.20
Vilmorin, No. 3.....	" " "	10.75
Vilmorin, No. 4.....	" " "	8.50
Lane's Improved Imperial.....	College Farm, Fort Collins, Colo.	8.95
Vilmorin Improved.....	" " "	9.68
Dippe's Vilmorin.....	Arkansas Valley Station, Rocky Ford.	15.17
Dippe's Vilmorin.....	" " "	15.35
Dippe's Vilmorin.....	" " "	15.37
Dippe's Vilmorin.....	" " "	11.48
Vilmorin Improved.....	College Farm, Fort Collins, Colo.	8.00
Vilmorin Improved.....	" " "	11.15
Vilmorin Improved.....	" " "	13.69
Lane's Imperial.....	" " "	8.95
Improved Imperial.....	" " "	8.83
*Name not given.....	" " "	10.21
Name not given.....	Divide Experiment Sta. Monument, Colo.	9.35
Kleinwanzleben.....	" " "	7.95
Kleinwanzleben.....	" " "	9.67
Dippe's Vilmorin.....	Arkansas Valley Station, Rocky Ford.	15.17
Dippe's Vilmorin.....	" " "	15.35
Dippe's Vilmorin.....	" " "	15.35
Dippe's Vilmorin.....	" " "	11.48

*This set of farm samples is accompanied by a note to the effect that they did not have water enough, but there is no further explanation.

The Department of Horticulture sent to the laboratory four samples, grown at different distances in the rows, to test the effect upon the percentage of sugar in the beets. The results are as follows:

Variety.	Inches apart in row.	Per cent. sugar.
Vilmorin Improved.....	3	13.60
Vilmorin Improved.....	3	13.50
Vilmorin Improved.....	6	9.00
Vilmorin Improved.....	6	11.00

The result is clearly in favor of a thick stand. Neither the distance between the rows nor the weights of the beets are given.

Seed beets, to the number of 110 of the Vilmorin varieties, were analyzed; the results may be summarized as follows: The percentage of sugar ranged from 7 to 17, and it is noted that the beets were in bad condition. Seven of the 110 beets contained less than 10 per cent. of sugar and sixteen of them contained upwards of 14 per cent.

The following samples are accompanied by a statement of the number of irrigations with which they were grown. The rainfall at Fort Collins, from May to October, inclusive, was 8.8 inches; at Rocky Ford, 8.26 inches, and at the San Luis Valley station, 4.58 inches.

Name.	Where grown.	Times irrigated	Per cent. sugar.	Coefficient of purity.
Vilmorin, No. 1.....	Arkansas Valley Station.	..	6.00	.....
Vilmorin, No. 2.....	" " "	1	9.00	.....
Vilmorin, No. 3.....	" " "	..	10.75	.....
Vilmorin, No. 4.....	" " "	..	8.50	.....
Vilmorin,	College Farm.	.	14.75	81
Vilmorin.....	"	..	15.25	82
Vilmorin Improved.....	"	..	13.69	.....
Vilmorin Improved.....	"	..	11.15	.....
Kleinwanzleben.....	Divide Station.	..	13.00	.....
Kleinwanzleben.....	"	..	13.70	.....
Vilmorin Improved.....	San Luis Valley.	..	13.50	.....
Vilmorin.....	Arkansas Valley Station.	..	21.00	.....
No name given.....	" " "	..	14.00	.....
Dippe's Vilmorin.....	" " "	1	15.17	.....
Dippe's Vilmorin.....	" " "	2	15.35	.....
Dippe's Vilmorin.....	" " "	3	15.37	.....
Dippe's Vilmorin.....	" " "	4	11.48	.....

Name.	Where grown.	Times irrigated.	Per cent. sugar.	Coefficient of purity.
Vilmorin Improved.....	San Luis Valley Station.	3	13.50	.....
Vilmorin No. 4.....	College Farm.	3	14.00	.....
Vilmorin No. 5.....	"	3	14.00	.....
Vilmorin.....	"	..	16.50	.....
Kleinwanzleben.....	Bellvue, Colo.	seepage	8.00	.....
Vilmorin Improved.....	"	seepage	9.00	.....
Kleinwanzleben.....	Arkansas Valley Station.	5	12.30	92.8
Vilmorin Brabant.....	" " "	5	8.80	80.0
Lane's Imperial.....	" " "	5	8.00	80.0
Dippe's Improved.....	" " "	5	8.00	72.0
Dippe's Improved rich sugar.....	" " "	5	7.70	55.0
Vilmorin.....	" " "	5	12.70	90.0
Vilmorin.....	" " "	5	13.43	67.0
Kleinwanzleben.....	" " "	5	8.80	63.0
Kleinwanzleben.....	" " "	1	10.00	55.5
Dippe's Improved rich sugar.....	" " "	1	10.00	71.4
Vilmorin Brabant Imperial.....	" " "	1	10.10	71.4
Vilmorin.....	" " "	1	11.50	71.8
Vilmorin No. 7.....	" " "	1	10.50	55.2
Lane's Imperial.....	" " "	1	10.70	56.3
Dippe's Improved White Imperial.....	" " "	1	5.70	38.0
Vilmorin.....	College Farm.	2	12.70	84.6
Red Skinned.....	"	2	15.00	88.2
Silesian.....	"	2	13.30	88.6
Lane's Improved.....	"	2	11.70	83.5
Heise Improved.....	"	2	16.50	91.6
Vilmorin White.....	"	2	15.30	90.0
Vilmorin Improved.....	"	2	13.50	84.3
Dippe's Kleinwanzleben.....	Fort Collins.	2	11.10	70.0
Vilmorin.....	"	2	10.30	70.0
Monteau Desprez.....	"	2	11.70	73.1
Vilmorin rich sugar.....	"	2	11.17	65.7
Kleinwanzleben.....	La Junta.	8	10.80	72.0
Vilmorin Improved.....	La Porte.	seepage	11.00	57.5
Kleinwanzleben.....	"	seepage	12.50	83.3
Vilmorin.....	Timnath.	2	10.50	87.5
Kleinwanzleben.....	Brighton.	2	15.54	91.4
Vilmorin.....	Loveland.	4	11.00	73.3
Kleinwanzleben.....	"	4	12.75	79.7

Name.	Where grown.	Times irrigated.	Per cent. sugar.	Coefficient of purity.
Vilmorin Imperial.....	San Luis Valley.	..	13.55	85.3
Vilmorin Imperial.. ..	" " "	..	14.08	87.1
Vilmorin.....	College Farm.	..	15.40	79.9
Vilmorin.....	"	..	14.78	79.7
Vilmorin.....	"	..	16.63	80.0
Silesian.....	"	..	14.42	83.9
Red Skinned.....	"	..	15.16	81.4
Vilmorin Imperial.....	"	..	16.13	84.5
Lane's Imperial.....	"	..	16.50	86.9
Vilmorin White.....	"	..	18.59	89.0
Neise Imperial.....	"	..	19.37	90.6
Vilmorin Imperial.....	"	..	16.52	86.1
Vilmorin.....	"	..	18.90	81.3

The last thirteen analyses were made at the Department of Agriculture, Washington, D. C.

The record is not complete enough to justify more than the general statement that an excess of water is as detrimental to the yield of sugar as a lack of water. The record, so far as it goes, shows that those beets which received two and three irrigations contain the highest average percentage of sugar, while those which received one and five, stand quite close to each other, and are much lower than those which received two and three irrigations. There are some pronounced exceptions to this, particularly in some instances in which the plants received five irrigations. Out of eight samples, furnished by the Arkansas Valley Station, each plat having received five irrigations, five of them showed less than 9 per cent. of sugar, and none of them reached 12 per cent. of sugar; whereas, the samples from this Station grown with fewer irrigations, show from 12 to 21 per cent. With one irrigation only, the percentage of sugar varies between 6 and 11 per cent., with one exception, which reaches 15.17 per cent.

The average percentage of sugar in beets grown on the College Farm, and analyzed in this laboratory, is 12.8 per cent.; but in 1893, we had heavy rains during the latter part of September and in October, immediately prior to harvesting the beets. The average percentage of sugar, as determined in seventeen samples, was 10.24 per cent., with a coefficient of purity ranging from 44.36 to 76.30. In one only did the coefficient of purity reach 81.13.

The alkalized portions of our land are wet and the beets grown on the College Farm in such soils have contained but little sugar. The Vilmorin made the best showing with 10.60 per cent. sugar. Whether this is due to the alkali or the water, matters not so far as the value of the beets is concerned.

The only attempt to raise sugar beets in the more elevated portions of the State, which has come to my knowledge, was made in the counties of Garfield, Eagle, and Pitkin, during the past season. The individual beets were mostly large, and no history of the soil in which they grew, or the cultivation which they received, was furnished with the samples. But it was the first experience which any of the growers had had in this line and they had apparently chosen the richest soil in which to make their experiment. Still 53 per cent. of the samples contained from 10 to 15 per cent. of sugar. The results of the experiment show that these counties can produce beets suitable for the manufacture of sugar, perhaps not to the same extent or at so fair a profit as our lower-lying districts, but still with great advantage to themselves.

