UNIVERSITY OF MINNESOTA.

EXPERIMENT STATION

OF THE

COLLEGE OF AGRICULTURE,

ST. ANTHONY PARK, RAMSEY CO., MINN.

APRIL 1888.

BULLETIN No. 2.

SILOS AND ENSILAGE.
TESTS OF VARIETIES OF CORN FOR FEEDING VALUES.
EXAMINATION OF BEETS AND OTHER ROOTS FOR SUGAR AND FEEDING VALUE.

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INTRODUCTORY.

In carrying out the objects of the organization of an "Agricultural Experiment Station," we cordially invite the co-operation of all persons interested in its success. Suggestions as to lines of experimental work, problems to be solved, inquiries relating to agriculture, horticulture, stock, and the dairy, will be cheerfully received, and answered as far as possible; but no work will be undertaken unless of public value, and the results of which we are at liberty to use for the public good.

Specimens of grains and grasses; seeds of fruit and forest trees; vegetables, plants, and flowers that are true to name; varieties of beneficial and injurious insects; samples of mineral waters and ores, and whatever may illustrate any department of agriculture will be gladly received, and due acknowledgments made in annual reports. Directions for collecting, packing and shipping such specimens will be furnished on application, and all expenses paid.

Bulletins will be issued at least quarterly, giving the results of experimental work as fast as completed, together with such suggestions and information as may be thought valuable to the farmers of Minnesota. These bulletins and the annual reports will be sent, *free of charge*, to each newspaper in the State, and to such indivuduals as may request the same.

All correspondence and contributions intended for the station should be addressed to

EDWARD D. PORTER,
Director of Experiment Station.
St. Anthony Park, Ramsey County, Minnesota.

SILOS AND ENSILAGE.

SILOS.

The silos of the Station, two in number, were erected in 1884, and their construction fully described in the Report for 1886, but as the edition was limited and reached the hands of but few persons who will receive this Bulletin, it may be well to repeat in substance what was there said. These silos are located on the right and left side of the main threshing floor of the barn and are 16 feet by 16 feet square, and extend from the level of the feeding floors of the basement stables, to the third floor of the barn, a height of 21 feet. Doors open into them from the threshing floor for filling, and out of them on a level with the basement for facility of feeding. The walls to the level of the second floor of the barn, 11 feet, are of stone, 18 inches in thickness,—above that are double studded with 2x6 inch scantling, well "bridged." The floor of the silo was made with a bed of concrete, composed of one part of Louisville cement, and two parts of sand, with water enough to make the mixture the consistency of thick cream; then adding coarse gravel and small pebbles thoroughly incorporated until the mass was like stiff mortar, when it was spread evenly over the bottom of the pit, three inches thick and well rammed down, and finished off smoothly with a wooden float. A slope of one inch to the foot was given to the floor, towards the centre, where a well two feet in diameter and four feet deep, was sunk into the underlying gravel formation, for the purpose of giving thorough drainage to the silo. The sides of this well were cemented, but the bottom was left open and then filled up to the level of the floor with pebbles the size of a hen's egg. The walls of the silo were listed up and down with 2 x 4 scantling, 16 inches from centre to centre, and boarded up with matched flooring—thus leaving an air space of two inches around all the sides. Over this lining I placed two thicknesses of tarred building paper, and over this a covering of matched flooring nailed on vertically. This construction gives an air-tight, water-tight, and frost-proof silo, and most conveniently placed for filling, feeding, and the preservation of its contents.

I wish to call especial attention to one point in the construction of these silos. The sides do not extend to the bottom, but stop short one and one half inches all around. Before filling the silo, a strip of tarred paper is folded lengthwise and doubled, so that one half of it will lie against the wall and the other portion on the floor, and is held in place by a strip of board. This makes an air tight joint, when the pit is filled. When the ensilage is fed out, this strip of board and the lining of paper are removed, and there is a free circulation of air around all the sides of the silo between the wall and lining, which keeps the wood work dry and adds greatly to its durability. The air chamber provided by this method of construction has preserved the ensilage from freezing during the two past winters, although located on the north side of the barn, and exposed to a temperature of forty degrees below zero.

THE ENSILAGE CROP.

The plat of ground devoted to the growth of the crop designed for ensilage in 1887 contained three and two-thirds acres. The land was prairie land, with a light clay subsoil, mingled with gravel, giving thorough drainage. The ground has been under tillage continuously for twenty-five years, with only an occasional light dressing of manure until 1884, when the lot was in wheat, and seeded down to clover. In 1885, a heavy crop of clover was plowed under in June, and in 1886, was again used for the experimental plats of wheat. In the fall of that year, one-half of the field was covered with well-rotted barnyard manure at the rate of twenty tons to the acre, and plowed down. The remaining half was manured at the same rate during the winter, and the ground plowed in the spring of 1887. The whole field was put in fine tilth by repeated harrowing and rolling and the use of the "disc harrow" and was planted May 30th. The seed used was the "Burrell & Whitman Ensilage Corn," and was planted with a "Buckeye" grain drill, by "stopping off" all but two tubes, making the rows forty-five inches apart, and so regulated as to drop about four grains to the foot. The depth was regulated by a "drill roller" attachment so as to plant two inches deep. The field was well rolled after planting and the corn came up evenly by June 8th. The smoothing harrow was passed over the field from time to time until the corn was from five to six inches high, when a fine tooth

cultivator was used for the after tillage. The crop was hand-hoed once to remove the weeds from between the stalks. A marked difference was observed in the condition of the two portions of the field. The one manured and plowed in the fall, was almost free from weeds and grass; the corn came up one day earlier than on the plat manured and plowed in the spring, and maintained its more vigorous growth for the entire season,—and at harvest yielded two tons more to the acre.

In the latter part of July, the "chinch bugs" swept over the farm, destroying many of our experimental plats of grain and grasses, and covering the ensilage field so that the stalks were almost black with them for two or three feet from the ground, but the growth was so vigorous that but little injury seemed to be done.

There was a marked difference in the yield and quality of the crop this year from that of 1886. The corn was planted last year in drills twenty-five inches apart, and the stalks stood four to a foot,and the yield on the same quality of ground and with the same fertilizers and method of cultivation, was twenty-two tons pe-acre. This year the drills were forty-five inches apart, and three stalks to a foot, and the yield was thirty-five tons pr. acre, and a much larger proportion of the stalks bore well matured ears of corn, which were in the "milk". when harvested.

HARVESTING.

We commenced filling the silos, Sept. 13, and the work was continued from day to day until Sept. 26. The corn was too heavy to cut with any machinery available, as it stood on an average thirteen feet high, and had been blown down by a severe storm in August. It was cut by hand, placed in open gavels, on the ground, and laid from twenty-four to thirty-six hours, to wilt and dry out a portion of the moisture. It was hauled in and weighed on the road to the silo. It was found on careful trial that the loss of weight by drying was about one sixth in thirty-six hours. The yield of green corn was One hundred and twenty-seven and one half tons or nearly thirty five tons pr. acre.

FILLING THE SILO.

The corn was cut with a "Ross Ensilage Cutter," into half inch lengths, and delivered by an "Angle Carrier" to the silo, where it was leveled and firmly packed. The filling was done in

the afternoon of each day from September 13th to 26th, not only to permit the fermentation to become well established but to prolong the work so as to allow its inspection by the numerous visitors who were interested in the operation.

The East silo, or No. 1, was filled to the depth of 16 feet, with 142,600 lbs. of cut fodder which gave 35 pounds to the cubic foot. It was carefully leveled and covered with plank, placed side by side, and but one inch shorter than the width of the silo, so as to allow easy settling; this was covered with two thicknesses of tarred building paper, and over this a covering of inch boards, and the whole weighted with one hundred and thirty pounds to the square foot. On December 1st they mass had seetled four feet or one fourth. There was no further settling, and on March 30th a cubic foot of the ensilage, taken six feet from the surface weighed forty-three pounds—showing a loss of 10,504 pounds or seven per cent. in curing. Silo No. 2 was filled in the same manner as No. 1, with thirty-eight tons of the same kind of fodder coon, and the balance with ensilage corn from other experimental plats. This was packed and covered the same as No. 1, except it was *not weighted.* The amount of settling was only six inches less.

Both silos were opened early in December and their contents examined. The silage in No. 1 was perfectly preserved, not a cubic inch injured, and as bright under the covers and around the sides of the wall and in the corners as when put in. It was light brown in color, slightly acid—and with an agreeably vinous odor.

In silo No. 2 the contents were decayed about twelve inches from the top and nearly as much around the sides, and the silage had a strongly acid taste and smell. The sound fodder from the silo was readily eaten by all the stock, but not with the relish or results as that from No. 1.

Experiments are still in progress, showing the value of this food, in the production of milk, butter and flesh, which will be reported in a future Bulletin.

COST OF GROWING ENSILAGE.

As every hour of labor performed at this station has to be paid for at full market rates, and an account is kept of all weights and measurements, we are prepared to show the exact cost of growing this crop the past season. The average haul of manure and produce was one thousand feet.

COST OF GROWING ONE ACRE.

Hauling and spreading 20 loads of manure	$ 5.50
Plowing the ground	1.00
Harrowing and rolling	1.00
Planting with wheat drill	1.00
Seed ½ bushel	1.25
Cultivating four times	2.00
Hand hoeing and weeding	4.00
	$15.75
Equal per ton	.45

COST OF HARVESTING AND FILLING SILO.

Capacity of machine 50 tons per day of 10 hours.

Six men in field cutting and loading	@ $1.33	$7.98	
Two teams hauling	@ 2.00	4.00	
One driver	@ 1.33	1.33	
Two men feeding machine	@ 1.33	2.66	
Two men packing in silo	@ 1.33	2.66	
One man at the engine	@ 1.33	1.33	
Coal used, one-fifth ton	@ 8.00	1.60	
Cost of narvesting 50 tons		$21.56	
Cost of harvesting one ton			.43
Total cost per ton			.88

Comparative Tests

OF

VARIETIES OF CORN FOR ENSILAGE.

For the purpose of determining the best varieties of corn to plant in Minnesota for Ensilage, we have conducted a series of experiments the past season with the following varieties of Flint, Dent, and Sugar Corn. The ground was in the same general condition as that of the Ensilage field, and only one hundred feet north. It was prepared in the same manner, and all the varieties were cultivated, and harvested alike. The different plats were planted June 6, and 23, and harvested Sept. 25. The rows were three feet apart, and the stalks averaged two to a foot. All the varieties were seriously injured by the chinch bugs and the yield greatly below the average. The different plots were of the same size and when harvested were carefully weighed, and cut into half inch lengths, thoroughly mixed, and samples of each drawn, packed in large glass preserving jars hermetically sealed, packed in ice, and kept there until wanted for use. The analyses were made in the Laboratory of the University, as shown by the following letter and tables. I have computed both the yield and composition of the crops by the acre.

THE UNIVERSITY OF MINNESOTA.
MINNEAPOLIS, MINN.,
Dec. 31, 1887.

Professor E. D. PORTER, Dear Sir:

I hereby report the results of my analyses of corn ensilage, received from you.

The work of pulverizing the material, after the same had been partially dried, was mainly done by Mr. Avery, a student in this department. The determinations of phosphorus in the ash

were made by Mr. C. F. Sidener, Instructor in the Chemical Labratory. All the rest of the work of these analyses was done by myself. The "albuminoids" were determined by getting the nitrogen by the process of combustion with soda-lime and multiplying by 6.25. The fat was determined by extraction with "deodorized benzine." The figures in the column headed "starch sugar &c." were obtained by subtracting the sum of the figures for the determined constituents, from 100.

A few duplicate determinations of nitrogen and of fat were made, and showed a satisfactory agreeement.

Very Respectfully,

JAMES A. DODGE,
Professor of Chemistry.

TABLE NO. 1.

Analysis of Varieties of Corn for Ensilage.

In this table the different samples were thoroughly dried, and the proportions of water and dry substance determined. The water-free material was then analyzed giving the percentages of composition as below.

(1) SPECIES.	(2) No. of Plot	(3) Variety	(4) Green Fodder Per 100 Pounds.		ANALYSIS OF DRY SUBSTANCE.					
			Water.	Dry Sub.	(5) Crude Cellulose.	(6) Ash.	(7) Phosphoros in Ash.	(8) Albuminoids.	(9) Fat.	(10) Starch Gum and Sugar.
SUGAR CORN...	1	Narragansett.....	74	26	13.07	3.83	0.34	8.06	2.20	72.84
	2	Early Minnesota	76.2	23.8	15.33	3.96	0.36	9.00	2.36	69.35
	3	Black Mexican.....	71.9	28.1	16.31	4.05	0.35	9 25	2.52	67.87
	4	Crosby's Early, No. 1..	75.9	24.1	16.06	3.83	0.39	9.25	2.10	68.76
	5	Marblehead.....	69.3	30.7	18.63	5.93	0.42	8.94	2.55	63.95
	6	Old Colony Sugar....	79.3	20.7	18.41	4.55	0.34	9.00	2.35	65.69
	7	Moore's Concord.....	72.8	27.2	13.39	3.99	0.33	8.87	2.45	71.30
	8	Stowell's Evergreen..	80.8	19.2	19.19	3.95	0.25	7.94	1.14	67.78
	9	Mammoth Sugar.....	83.4	16.6	12.19	4.50	0.37	8.25	2.25	72.81
	10	Early Minnesota, No. 2	78.1	21.9	15.83	4.47	0.36	8.75	2.27	68.68
	11	Crosby's Early, No. 2	78.9	21.1	17.50	5.80	0.37	9.19	2.64	64.87
	12	Perry's Hybid.....	79.8	20.2	18.22	4.86	0.45	8.69	2.22	66.01
FLINT CORN...	13	King Philip.....	63.2	36.8	12.84	3.72	0.30	8.88	2.25	72.31
	14	Canada Flint.....	51.5	48.5	11.22	3.23	0.31	8.31	2.37	74.87
	15	Waushakum.....	71.5	28.5	15.69	3.97	0.33	8.75	2.27	69.32
	16	Longfellow.....	76.8	23.2	15.88	4.53	0.28	8.81	2.23	68.55

DENT CORN....	17	Minnesota White.....	73.9	26.1	19.10	3.38	0.26	7.63	1.85	68.04
	18	Minnesota Yellow....	62.9	37.1	28.06	2.93	0.21	7.69	1.69	59 63
	19	Dakota Dent.....	71.5	28.5	14.74	2.96	0.20	8.87	2.40	71.03
	20	Pride of the North...	73.1	26.9	18.25	3.72	0.29	7.44	1.64	68.95
	21	Leaming.....	78.2	21.8	19.99	3.76	0.31	7.87	1.64	66.74
	22	Smedley	78.1	21.9	19.20	3.28	0.28	8.06	1.65	67.81
	23	Sheep-tooth.....	86.6	13.4	27.39	3.55	0.34	7.81	1.18	60.07
	24	Southern EnsilageNo 1	83.4	16.6	22.63	3.65	0.32	7.25	0.83	65.64
	25*	Southern EnsilageNo 2	79.4	20.6	26.50	6.05	0.29	7.00	0.80	59.65
	26	Southern EnsilageNo 3	.....	.....	.....	.....	.....	.....	.....	.....
		Tops	79.2	20.8	20.51	5.03	0.34	9.06	1.62	63.78
		Middles.....	79.	21.	15.09	3.33	0.31	8.75	1.73	71.11
		Butts.....	82.6	17.4	33.17	5.70	0.14	5.50	0.28	55.35
		Averages.....	80.3	19.7	22.92	4.69	.26	23.31	1.21	63.41

* No. 25 was composed of stalks selected fro n the main field of ensilage corn described in previous pages; they were of fair average growth, but were destitute of ears; he yield per acre was 58 260 pounds. No. 26 was selected from the sam e field, and represents the composition and yield per acre of stalks standing six inches apart, in rows forty-five inches wide. Each stalk bore a well developed ear of corn in full milk. The average weight of the stalks was three and one-half poun is, giving a yield of 93,040 pounds per acre, which seems to be about the maximum yield obtainable for ensilage corn. Bundles of fair average specimens were taken, and cut into three equal lengths, representing the upper, middle and lower portions of the stalks, and from them samples were drawn for analysis, showing their feeding value.

TABLE NO. 2.

Analysis of Varieties of Corn for Ensilage.

In this table the numbers given represent the pounds of each substance found in one hundred pounds of the green fodder, as drawn from the field.

(1) SPECIES.	(2) No. of Plot	(3) VARIETY.	Percentage of Undried Samples from the Field. (4) Water.	(5) Crude Cellulose.	(6) Ash.	(7) Phosphorus in Ash.	(8) Albuminoids.	(9) Fat.	(10) Starch Sugar and Gum.
SUGAR CORN.....	1	Narragansett.....	74.	3.40	0.99	0.088	2.10	0.57	18.94
	2	Early Minnesota.....	76.2	3.65	0.94	0.086	2.11	0.56	16.51
	3	Black Mexican.....	71.9	4.58	1.14	0.098	2.60	0.71	19.07
	4	Crosby's Early No. 1.....	73.9	3.89	0.92	0.094	2.23	0.51	16.57
	5	Marblehead.....	69.3	5.72	1.82	0.129	2.74	0.78	19.63
	6	Old Colony Sugar.....	79.3	3.81	0.94	0.070	1.86	0.49	13.60
	7	Moore's Concord.....	72.8	3.64	1.09	0.090	2.41	0.67	19.39
	8	Stowell's Evergreen.....	80.8	3.68	0.76	0.048	1.52	0.12	13.11
	9	Mammoth Sugar.....	83.4	2.02	0.75	0.061	1.37	0.37	12.09
	10	Early Minnesota No. 2.....	78.1	3.47	0.98	0.079	1.92	0.50	15.04
	11	Crosby's Early No. 2.....	78.9	3.69	1.22	0.078	1.94	0.56	13.69
	12	Perry's Hybrid.....	79.8	3.68	0.98	0.091	1.76	0.45	13.33
FLINT CORN.....	13	King Philip.....	63.2	4.73	1.37	0.110	3.27	0.83	26.61
	14	Canada Flint.....	51.5	5.44	1.57	0.150	4.03	1.15	36.31
	15	Waushakum.....	71.5	4.47	1.13	0.094	2.49	0.65	19.76
	16	Longfellow.....	76.8	3.67	1.05	0.065	2.04	0.52	15.91

DENT CORN.....	17	Minnesota White.....	73.9	4.99	0.88	0.068	1.99	0.48	17.76
	18	Minnesota Yellow.....	62.9	10.41	1.09	0.078	2.85	0.63	22.12
	19	Dakota Dent.....	71.5	4.20	0.84	0.057	2.53	0.68	20.24
	20	Pride of the North.....	73.1	4.91	1.00	0.078	1.99	0.44	18.55
	21	Leaming	78.2	4.36	0.82	0.068	1.72	0.36	14.55
	22	Smedley.....	78.1	4.20	0.72	0.061	1.77	0.36	14.85
	23	Sheep-tooth.....	86.6	3.67	0.48	0.046	1.05	0.16	8.05
	24	Southern Ensilage No. 1.....	83.4	3.76	0.61	0.053	1.20	0.14	10.89
	25	Southern Ensilage No. 2.....	79.4	5.46	1.25	0.060	1.44	0.16	12.29
	26	Southern Ensilage No. 3.....	.....	.....	.....	.....	.....	.....	.....
		Tops.....	79.2	4.27	1.05	0.071	1.88	0.34	13.27
		Middles.....	79.	3.17	0.70	0.065	1.84	0.36	14.93
		Butts	82.6	5.77	0.99	0.024	0.96	0.05	9.63
		Averages	80.3	4.40	0.91	0.053	1.56	0.25	12.61

For the purpose of instituting a comparison between the different varieties of corn, I have computed from Prof. Dodge's tables and our own memoranda of dates, weights and measurements, the yield and composition of each one per acre, the amount of digestible material according to our best American authorities, the nutritive ratio of each, and the relative rank of each variety as food for domestic animals.

By omitting the water, crude fibre, ash and phosphorus from these table, and adding the percentages of albuminoids, fats, starch and sugar, the valuable feeding ingredients of the fodder, and multiplying the total yield per acre, by this number, we obtain a product which represents approximately the rank of that variety in feeding value. The last column in this table shows this result.

TABLE NO. 3.

Comparative Feeding Values of Varieties of Corn for Ensilage.

(1)	(2)	(3)	(4)	(5)	Amount of Digestible Matter in 100 Pounds.					(11)	(12)	(13)
SPECIES.	No. of Plot	VARIETY.	Condition at Time of Harvesting.	Yield Per Acre.	(6) Protein.	(7) Cellulose.	(8) Starch and Sugar.	(9) Fat.	(10) Totals.	Yield Per Acre of Digestible Matter.	Nutritive Ratio.	Comparative Value as Food for Animals.
SUGAR CORN.	1	Narragansett ...	Ripe Sept. 1.	12,150	1.53	2.45	14.69	.43	19.10	2,321	1:10.9	24
	2	Early Minnesota	Ripe Aug. 28	29,160	1.40	2.49	10.08	.37	14.34	4,182	1: 9.6	17
	3	Black Mexican..	Ripe Sept. 10	29,025	1.90	3.30	12.78	.53	18.51	5,373	1: 8.6	10
	4	Crosby's E'ly No1	Ripe Sept. 2.	26,460	1.42	2.66	9.17	.42	13.67	3,617	1. 9.8	20
	5	Marblehead	Ripe Sept. 1.	8,910	2.00	4.12	13.15	85.	19.85	1,769	1: 9.4	26

	6	OldColonySugar	Ripe Sept. 10	29,700	1.36	2.74	9.11	.37	13.58	4,033	1: 9.4	19
	7	Moore's Concord	Ripe Sept. 10	23,625	1.76	2.62	12.99	.50	17.87	4,222	1: 9.6	15
	8	Stowell'sEverg'n	In dough...	35,775	1.10	2.65	8.78	.09	12.62	4,515	1:10.6	14
	9	Mammoth Sugar	In milk.....	42,255	1.00	1.45	8.10	.28	10.83	4,576	1:10.2	13
	10*	Early Minn. No.2	In dough...	22,275	1.54	2.63	11.06	.42	15.65	3,486	1: 9.5	22
	11*	Crosby's E'lyNo2	In dough...	26,325	1.42	2.66	9.17	.42	13.67	3,599	1: 9.8	21
	12*	Perry's Hybrid..	Ripe Sept. 15	18,225	1.28	2.66	8.93	.33	13.20	2,406	1: 9.5	23
FLINT CORN.	13	King Philip.....	Ripe Aug. 15	18,900	2.39	3.41	17.82	.62	24.24	4,581	1: 9.5	12
	14	Canada Flint....	Ripe Sept. 1.	20,925	2.94	3.92	24.33	.86	32.05	6,706	1:10.3	1
	15	Waushakum....	Ripe Sept. 15	21,735	1.82	3.22	13.24	.49	18.77	4,080	1: 9.7	18
	16	Longfellow.....	Ripe Sept. 20	27,675	1.49	2.64	10.66	.39	15.18	4,201	1: 9.6	16
DENT CORN.	17	Minnesota White	Ripe Sept. 10	31,860	1.45	3.60	11.90	.36	17.31	5,515	1:11.2	9
	18	Minn. Yellow...	Ripe Sept. 10	24,300	2.08	7.50	14.82	.47	24.87	6,043	1:12	7
	19	Dakota Dent....	Ripe Sept. 10	32,940	1.85	3.02	13.56	.51	18.94	6,239	1: 9	5
	20	Pride of the N'th	Ripe Sept. 15	34,425	1.45	3.54	12.43	.33	17.75	6,110	1:11.6	6
		Leaming.....	In dough Sept. 24....	45,360	1.26	3.14	9.75	.27	14.42	6,541	1:10.7	3
	21											
	22	Smedley	Ripe Sept. 25	44,010	1.29	3.02	9.95	.27	14.53	6,395	1:11 4	4
		Sheep-tooth	Grain just formed September 24..	51,975	.88	2.70	7.29	.11	10.98	5,707	1:11.7	8
	23											
		Ensilage No. 1.	Grain just formed September 24..	49,815	1.05	3.93	8.23	.12	13.33	6,640	1:11.9	2
	24											
	25	Ensilage No. 2.	In milk Sept. 25	58,260	.77	2.64	5.39	.12	8.92	5,197	1:10.8	11
	26	Ensilage No. 3.	In milk Sept. 25	.....	....	....	.....	...	.....	.....	.....	....
		Tops		17,150	1.37	3.07	8.89	.25	13.58	2,329	1: 9.2	....
		Middles		44,590	1.34	2.28	10.00	.27	13.89	6,194	1: 9.7	....
		Butts.....		34,300	.70	4.15	6.45	.04	11.34	3,890	1:15	....
		Averages		†96,040	1.14	3.17	8.45	.19	12.95	†12,413	1:11.3	....

*These plots were planted June 23d, and all the varieties were harvested September 25th, 1887.
† Yield per acre. See note to Table I.

CONCLUSIONS.

From Table No. 3, we seem to be warranted in drawing the following conclusions so far as the experiments have been conducted:

(1) The different varities of Sugar Corn do not possess the high percentage of feeding value, generally attributed to them, even when taken in their most favorable condition, as shown in plats Nos. 8, 9, 10 and 11, and when the small yield per acre is taken into consideration, they stand the lowest in agricultural value, among the three varities.

(2) The very high percentage of Carbo-hydrates found in No. 14, in comparison with the other varieties of Flint Corn, would indicate the presence of some unusual conditions, rather than extra feeding value, and these facts can only be determined by a repetition of the experiments.

(3) Rejecting the Canada Flint as above, we find the first eight highest numbers, among the Dent varieties, and considering their early maturity, high nutritive value, and large yield of fodder they are the most valuable of all the varities for food for domestic animals.

(4) Comparing the different varieties of Dent Corn with each other, we find that although the southern Ensilage Corn, yields nearly double the quantity of fodder per acre to the Minnesota Dents, the Dakota Dent, Sibley's Pride of the North, Leaming and Smedley, nevertheless when we take into consideration the short season required for their growth, their high nutritive values, and the saving of labor in the handling of the crop, we must give the preference to these varieties of corn for feeding purposes in Minnesota and the Northwest. Their superiority is much more evident when the fodder is dried for feeding, than when used as ensilage, owing to the smaller growth of their stalks, and consequent easier mastication by animals.

(5) A comparison of the composition of Nos. 25, and 26, as given in Column 11, of table 3, shows the great importance of thin seeding, so as to secure full development of both stalk and ear, the difference of yield of digestible fodder in the one, being nearly two and one half times as much per acre as in the other.

Facts Concerning Silos and Ensilage.

SILOS.

(1) A silo is only a preserving can on a large scale, and the same conditions necessary for success prevail in both.

(2) A good silo may be built with very rough lumber and with ordinary labor, by a liberal use of tarred building paper, the "pioneer's friend."

(3) The location, form and construction of the silo, the arrangements for filling, covering, weighting and feeding must be governed by local circumstances, but it is always better to fill above the feeding floor, than below, as it is easier to elevate the ensilage, at the time of harvesting, when it can be done by automatic machinery, than to do so day by day by hand through a long winter, with the mercury below zero.

(4) Of whatever material the silo is built, the walls must be perpendicular, and the inner faces smooth, so that the ensilage may settle easily.

(5) The walls of the silo must be strong enough to withstand the lateral pressure of the enclosed mass.

(6) Water tight and air tight bottoms, and air proof walls are prime essentials in building a silo.

(7) It is advisable to divide the space intended for a silo into three compartments of equal size, so that they may be filled to the depth of four or five feet, alternately, and thus allow time for fermentation to set in, and the heat to raise to 125 to 140 degrees, before again filling. This temperature aids in the digestion of the food, kills the germs which promote fermentation, partially expels the air, and secures comparatively sweet ensilage.

ENSILAGE.

(8) While any plant or vegetable fit for cattle food when green or undried may be preserved in the silo for an indefinite period, Indian corn is the cheapest and best for ensilage in this country.

(9) Plant such varieties of corn for ensilage as will reach maturity in an ordinary season in your section. Plant in rows

wide enough to admit of easy cultivation, and just thick enough in the row to allow each stalk to form a well developed ear.

(10) The best time to cut corn for ensilage is when the grains are fully formed, and in the doughy or glazing state; the fodder then contains the largest amount of digestible matter.

(11) Corn partially dried before packing in the silo gives equally good fodder, and at a reduced cost.

(12) The best results are obtained by cutting the ensilage into half-inch lengths, especially for well-grown and nearly matured cornstalks.

(13) In filling the silo, care should be taken to spread it evenly as put in, to pack the corners and sides firmly, to cover the top with a layer of boards or plank, spread over this a double layer of tarred paper, and then a layer of rough boards, and on the whole a moderate weight of from 50 to 100 pounds to the square foot. The weighting material may be anything convenient, sand, gravel or dirt in barrels, stone, fire wood, farm implements, for storage and the like.

(14) Pits should not be opened until fermentation has ceased and the mass has cooled, which will be in from six to eight weeks from the time of filling.

(15) In feeding from the silo, it is better to feed day by day from the top in uniform layers, rather than from top to bottom, as by this method the surface is not exposed long enough to the air to sour.

VALUE OF ENSILAGE.

(16) Ensilage can be grown and preserved much cheaper than root crops, by the ordinary farmer, and will successfully take their place in feeding value.

(17) Corn ensilage is not a complete feeding ration, as it is deficient in protein, and this must be supplied by some bye-fodder, as bran, shorts or oil cake.

(18) The tests of the laboratory and the feeding stables do not agree as to the value of ensilage. The practical results of its use are so satisfactory as to surprise the chemist, and thus far he has failed to give them a satisfactory explanation.

(19) The best results of feeding ensilage are obtained by using it in combination with dry fodder, the best of which is clover hay.

(20) We *do* get more out of the silo than we put in it, for the reason that the chemical changes which take place in the process

of curing are identical with those that take place in the first stages of digestion, and consequently there is a saving of vital energy to the animal, and an economy of food consumption.

(21) Ensilage furnishes a succulent and easily digested food, greatly relished by all animals, during the long winters of our Northwest, when they would otherwise be confined to an almost uniform ration of dry provender.

CONCLUSION.

(22) The ease with which silos may be constructed, the certainty with which they will preserve feed from injury, the low cost of raising and storing the crop, and its value as a cattle food, render this the cheapest provender a stockman can raise.

Examination of Beets, for Sugar and for Stock.

For the purpose of testing the adaptation of our soil for the growth of Sugar Beets, for sugar, and their value for stock feeding, we imported last spring from Vilmorin, Andreaux & Co., the noted seedsmen of France, a collection of thirteen varieties of beet seed, having the best reputation, in that country, and Germany for the production of sugar. These varieties together with several others grown for table use and stock feeding were planted side by side on good garden soil, in rows fifteen inches apart, cultivated and harvested at the same time, and average samples drawn and sent to the Laboratory for analysis, with the results as shown in the following tables.

UNIVERSITY OF MINNESOTA,
Chemical Laboratory.
Jan. 23, 1888.

Prof. E. D. Porter.

Dear Sir:—I hereby report the results of my determinations of sugar in twenty samples of the juices of Sugar Beets, and other roots received from you for analysis, also the composition of some specimens of roots furnished for examination.

The determinations of sugar were made with the use of Laurent's Saccharimeter. The samples of juice were clarified with a solution of acetate of lead and with bone black, for the polarization test.

The specific gravities of the several samples were also determined with the use of a hydrometer giving on its scale the specific gravity directly. The readings so obtained were for convenience, converted into degrees Beaumé, with the use of a table given in Tucker's "Manual of Sugar Analysis." All were reduced to 60 degrees Fahrenheit.

The Albuminoids in tables 2, and 3, were determined by combustion with soda-lime, multiplying the amount of nitrogen found by 6.25, The starch, sugar and gum, were computed by substracting the sum of the other constituents from 100.

Respectfully yours,
JAMES A. DODGE,
Chemist.

TABLE I.

ANALYSIS OF SUGAR BEETS AND OTHER ROOTS FOR SUGAR.

No. of plat.	NAME.	Average weight of each root, ounces.	Yield per acre, pounds.	Per cent of sugar by Polariscope.	Specific gravity of juice.	Temperature of juice.	Degrees of Beaume at 60° Fah.
	Sugar Beets.						
1	White German, acclimated	12½	45,312	8.2	1.057	55°	7.7
2	Green Collet	12	43,500	7.3	1.052	56°	7.0
3	Yellow Sugar	17½	63,431	6.1	1.045	55°	6.1
4	White Green Collet	14	50,750	6.9	1.05	54°	6.7
5	White Sugar of Klein	16	58,000	7.4	1.049	56°	6.6
6	White Grey Collet	15	41,375	10.0	1.058	57°	7.8
7	White German Imported	13⅓	48,212	7.8	1.053	56°	7.2
8	Early White Rose	13⅓	55,432	8.1	1.057	55°	7.7
9	White Imperial	10⅔	38,412	9.9	1.064	56°	8.5
10	White Rose Collet	13	47,125	8.5	1.058	58°	7.3
11	White Electoral	11½	41,687	8.7	1.069	55°	8.0
12	Vilmorin's Improved White	10¼	37,156	10.2	1.065	56°	8.7
13	White Fleshed Black Sugar	14½	52,560	6.6	1.052	55°	7.0
	Table Beets.						
14	Egyptain Blood	13	47,125	5.1	1.037	55°	5.1
15	Eclipse's	14¼	52,562	5.2	1.037	55°	5.1
16	Dewings Blood	14½	52,562	1.9	1.024	54°	3.2
	Mangel Wurzels.						
18	Norbiton Giant	41½	60,258	5.5	1.044	57°	6.0
19	Golden Globe	82	119,064	4.1	1.036	55°	4.9
	Carrots.						
17	Long Orange	5⅓	46,090	3.8	1.035	55°	4.8
	Parsnips.						
20	Hollow Crowned	7	60,874	11.9	1.067	55°	8.9

TABLE II.

ANALYSIS OF ROOTS GROWN FOR STOCK FEEDING.

No. of Plat.	NAME OF VARIETY.	Analysis of the green root.		Analysis of the Dry Substance.				
		Per Cent. of Water.	Per Cent. of Dry Matter.	Pr C'nt. Crude Cellulose.	Per Cent. Ash.	Phos'phs in Ash.	Albumin oids.	Starch, Sugar &c.
7	White Green Collet	89.3	10.7	9.78	14.26	.56	17.25	58.71
14	Golden Globe	87.8	12.2	7.43	11.12	.45	16.63	64.82
15	Norbiton Giant	88.7	11.3	7.93	12.55	.36	16.62	62 90
16	Eclipse	89.7	10.3	8.74	10.48	.41	16.15	64.63
19	Carrot, Orange	87.3	12.7	8.65	9.34	.65	14.36	67.65
20	Parsnip	86.8	13.2	7.85	9.13	.64	15.92	67.10

TABLE III.

ANALYSIS OF ROOTS GROWN FOR STOCK FEEDING, CALCULATED IN PERCENTAGE OF THE ORIGINAL UNDRIED ROOTS.

No. of Plat.	NAME OF VARIETY.	Water.	Crude Cellulose.	Ash.	Phosphorus in Ash.	Albuminoids.	Starch, Sugar &c.
7	White Green Collet	89.30	1.05	1.35	.060	1.84	6.28
14	Golden Globe	87.80	.91	1.36	.055	2.02	6.91
15	Norbitan Giant	88.70	.89	1.42	.041	1.88	6.11
16	Eclipse	89.70	.90	1.08	.042	1.66	6.66
19	Carrot, Orange	87.30	1.10	1.19	.082	1.82	8.59
20	Parsnip	86.80	1.04	1.21	.084	2.10	8.85

From the above analyses of Prof. Dodge, and our own weights and measurements of the crops produced, rejecting the percentage of water and ash, and assuming the other ingredients to be digestible, as we are entitled to, by the best authorities, we obtain table No. 4, which shows the total amount of digestible food produced on an acre of each of these roots at this station. A comparison of this table with table No. 3, of corn grown for ensilage, will show their relative merits as feed for domestic animals, so far as our experiments have gone.

TABLE IV.

SHOWING THE AMOUNT OF DIGESTIBLE MATTER CONTAINED IN ONE ACRE OF THE FOLLOWING ROOTS:

No. of plat.	Name of Variety.	Average weight of each root in ounces.	Yield per acre in pounds.	Percentage of digestible matter.	Pounds of digestible matter on one acre.		
7	White Green Collet	12 oz	50,750	9.17	4,654	Average am't of digestible matter produced by six varieties of corn grown for ensilage.	6,328
14	Golden Globe	82 oz	119,064	10.84	12,906		
15	Norbiton Grant	41½ oz	60,258	9.88	5,955		
16	Eclipse	14¼ oz	52,562	9.22	4,846		
19	Carrot, Orange	5⅓ oz	46,090	11.51	5,305		
20	Parsnip	7 oz	60,874	11.99	7,299		