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LAMBS PRACTICAL RATIONS FOR—ALSO LAMBS VS. WETHERS, FOR FATTENING—VALUATION OF WHEAT SCREENINGS—FIELD EXPERIMENTS—VARIETIES OF WHEAT, OATS AND CORN—METHODS OF PLANTING OATS, WHEAT AND POTATOES—DEPTH TO SOW OATS AND WHEAT, AND TIME TO SOW—HEAVY VS. LIGHT OATS FOR SEED—METHODS OF PREPARING LAND FOR OATS.

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LAMBS—PRACTICAL RATIONS FOR;

ALSO

LAMBS VS. WETHERS, FOR FATTENING.

W. M. HAYS.

During the winter of 1891-2 an experiment was conducted in feeding sheep under the supervision of the present writer. As he was absent from the Station during the latter half of the feeding, the last part of the work was superintended by Mr. Andrew Boss, foreman of the farm, while the feeding was done by herdsman Wm. Gibbs. Eighty Shropshire grade half-blood lambs were purchased in December of Mr. E. M. Prouty, of Grand Forks, N. D., at 5 cents per pound. These were divided into eight groups of ten, each very uniform in weight, averaging about 735 pounds. Ten fair average Montana wethers were also purchased at the same time at $4.20 per 100 pounds; these averaged 107 pounds each. The object of the experiment was to compare several of our most practical grains, when fed with timothy hay, in fattening lambs; also to get at the comparative profit of feeding grade lambs and western wethers. The rations were so constructed that we might determine the value of the addition of a limited amount of oil cake to a grain ration of corn or of barley (see pens 2 and 4 in comparison with pens 1 and 3 in table VII.) These grains were compared with wheat screenings (see pen 8.) By securing screenings composed mainly of small wheat, pen 5; another lot of nearly pure wild buckwheat, pen 6, and another of nearly pure pigeon grass seed, pen 7, the value of these three most prominent ingredients of screenings were compared with the ordinary screenings composed of a mixture of these three ingredients together with minor amounts of other weed seeds, chaff, etc. The screenings fed (pen 8) were selected as an average of the screenings offered in the Minneapolis market. (See

analyses in table I.) The analyses of the other grains are also given in table I. The wethers (pen 9) were fed screenings and hay in the same manner as the lambs in pen 8 were fed these two foods.

The plan of the experiment was to give timothy hay ad-libitum in self feeding racks and allow the sheep access to the self-feeding grain boxes two hours in the morning and two hours in the evening during the first period. The second period they were to be allowed to run to the open self-feeding grain boxes or troughs all the time and all pens were to have the same limited amount of hay, that the effect of the grain rations might be compared in the different groups. This plan for the second period was slightly modified by allowing all the groups access to the hay the same limited time each day—two hours at midday. This makes the comparison of the grain rations a little more difficult, but was the more practical way to feed, and the comparison of ration with ration as to net profit is all the more practical.

The sheep were placed under the Station barn in a shed which was open on one entire side into a large alley, which in turn was open to the free entrance of outside air, thus making uniform conditions for all pens. The groups were separated by hurdle-like fences, each group having a pen about 10 by 16 feet, and were all very similarly situated and fed and watered and salted alike. The lambs were, withal, a very even, thrifty lot of sheep, as shown by their appearance and by their profitable gains.

The groups of lambs in pens 5, 6 and 7 were fed with a view to gaining a knowledge of how to estimate the value of any given sample of wheat screening by getting at the comparative value of the several most prominent ingredients. These pens were accordingly given respectively screenings composed almost entirely of small wheat, wild buckwheat seed and pigeon grass seed. As the results indicate these three main constituents of screenings to be of about equal value, and nearly equal to corn for feeding sheep, it is easy to estimate the value of any sample of screenings by determining the percentage of solid grains and of ground particles of grains contained. As straw and other coarse roughage on the farm is

very cheap not much value is attached to the chaff, pieces of straw and similar parts of the screenings. Where feeders must purchase straw and hay they can count these "light parts" of the screenings as of equal value to straw or coarse hay of rather poor quality. Where a sample contains mustard, pig weed seeds or other bitter weed seeds which are not relished by the animals, something must be subtracted from the estimated value. The presence of weed seeds which might gain an entrance to the farm is a great objection to the use of many samples of screenings, as some uneaten seeds will be scattered in the manure. Where it can be done all screenings fed to cattle, hogs or horses should first be run through a roller mill, with rollers kept sharp, that as many as possible of the weed seeds may be broken so that the digestive juices can get through the hard seed coatings, both to enable the animal to get the nourishment and to kill the weed seeds which might otherwise grow after passing through the animal. It is often wise or necessary to systematically compost all manure from animals fed screenings that the weed seeds may all be germinated and thus destroyed. Since screenings are such valuable foods and contain also such a large manurial value it is to be regretted that our system of marketing grains does not encourage or even make it necessary for farmers to keep all the screenings at home for feed and manure and take to market only grain entirely cleaned of weed seeds. A change in our manner of grading or inspecting grain throughout the entire country should be so made as to encourage marketing only well cleaned grain.

Screenings from the large mills are each year becoming poorer in quality as the manufacturers of flour constantly improve their means of separating out and utilizing the small kernels and pieces of wheat. Some of the machinery used in this separation of the small wheat crushes or grinds part of the weed seeds, and the screenings appear to be made up in part of floury particles.

No credit is given in this report for the value of the manure made of the several grain feeds consumed. Allowance for the manurial value would show the feeding even more profitable than the tables now represent.

TABLE I.—Analysis of Grains Fed.

	Total dry matter.	Ash.	Total nitrogen compd.	True albuminoids.	Fat.	Crude fiber.	Nitrogen free extract	‡Prices per ton.
Corn	89.27	1.46	10.25	9.60	3.88	2.25	70.40	$13.04
Barley	88.22	3.32	11.57	10.92	2.70	3.00	67.63	17.50
*Oil meal, O. P.	90.80	5.70	32.90	.....	7.90	8.90	35.40	27.87
Screenings composed of small wheat.	90.05	2.24	13.81	.....	2.96	4.25	66.85	10.56
Screenings composed of wild buckwheat	88.08	2.65	10.62	8.42	3.25	10.77	60.81	10.56
Screenings composed of pigeon grass seed	89.35	5.18	9.48	.....	5.50	15.15	54.52	10 56
†Screenings	87.50	2.69	11.84	.....	3.10	4.76	65.09	10.56
‡Timothy hay	.....	.....	.....	.....	.....	.....	.....	7.13

The corn, barley, wild buckwheat and pigeon grass seeds were anylyzed by Prof. Harry Snyder.

*Average from Hand Book of Experiment Station Work.

†Average from Bulletin No. 8, Minnesota Experiment Station.

‡The prices given here per ton are averages of reports made by many farmers during the winter of 1891-2.

TABLE II.—Food Eaten and Gains in First Period of Eight Weeks.

No. of pen.	Kind of Sheep.	Kind of grain fed.	Weight of sheep at beginning.	Weight at ending.	Gain in weight.	Hay eaten.	Grain eaten.
1	Lambs	Cracked corn	710	875	165	657	740
2	"	9-10 cracked corn, 1-10 oil meal	722	945	223	485	984
3	"	Barley	733	902	169	485	864
4	"	9-10 barley, 1-10 oil meal	757	946	189	449	1,088
5	"	Small wheat	737	905	168	560	1,043
6	"	Wild buckwheat	754	909	155	441	1,121
7	"	Pigeon grass	741	864	123	344	1,244
8	"	Screenings of wheat	736	862	126	498	1,138
9	Wethers	Screenings of wheat	1,068	1,173	105	447	1,404

TABLE III.—Food Eaten and Gains in Second Period of Four Weeks.

No. of pen.	Kind of Sheep.	Kind of grain fed.	Weight of sheep at beginning.	Weight at ending.	Gain in weight.	Hay eaten.	Grain eaten.
1	Lambs	Cracked corn	875	921	46	192	363
2	"	9-10 cracked corn, 1-10 oil meal	945	1,011	66	149	443
3	"	Barley	902	932	30	145	404
4	"	9-10 barley, 1-10 oil meal	946	1,031	85	154	503
5	"	Small wheat	905	939	34	182	462
6	"	Wild buckwheat	909	991	82	150	813
7	"	Pigeon grass seed	864	967	103	83	731
8	"	Screenings of wheat	862	980	118	111	638
9	Wethers	Screenings of wheat	1,173	1,240	67	95	706

TABLE IV.—Food Eaten and Gains During Entire Twelve Weeks.

No. of pen.	Kind of Sheep.	Kind of grain fed.	Weight of sheep at beginning.	Weight at ending.	Gain in weight.	Hay eaten.	Grain eaten.
1	Lambs....	Cracked corn.....	710	921	211	849	1,103
2	"	9-10 cracked corn.... 1-10 oil meal	722	1,011	289	634	1,427
3	"	Barley	733	932	199	630	1,268
4	"	9-10 barley..... 1-10 oil meal.....	757	1,031	274	603	1,591
5	"	Small wheat.....	737	939	202	742	1,595
6	"	Wild buckwheat	754	991	237	591	1,934
7	"	Pigeon grass seed.....	741	967	226	427	1,975
8	"	Screenings of wheat...	736	980	244	609	1,776
9	Wethers..	Screenings of wheat...	1,068	1,240	172	542	2,110

TABLE V.—Value of Foods and of Gains and Profits in Period I.

	Kind of Sheep.	Grain fed with hay.	Value of hay fed.	Value of grain fed.	Total cost of food.	Value of Increase in weight.	Profit or loss on gain in weight alone.
1	Lambs....	Cracked corn	$2.22	$4.82	$ 7.04	$9.90	+$2.86
2	"	9-10 cracked corn..... 1-10 oil meal.....	1.64	7.14	8.78	13 38	+4.60
3	"	Barley.....	1.64	6.39	8.03	10.14	+2.11
4	"	9-10 barley..... 1-10 oil meal..... ...	1.52	8.76	10.28	11.34	+1.06
5	"	Small wheat.....	1.89	5.51	7.40	10.08	+2.68
6	"	Wild buckwheat.....	1.49	5.92	7.41	9.30	+1.89
7	"	Pigeon grass.....	1.16	6.56	7.72	7.38	—.34
8	"	Screenings of wheat....	1.68	6.00	7.68	7.56	— 12
9	Wethers...	Screenings of wheat....	1.51	7.41	8.92	5.25	—3.04

TABLE VI.—Value of Foods and of Gains and Profits in Period II.

	Kind of sheep.	Grain fed with hay.	Value of hay fed.	Value of grain fed.	Total cost of food.	Value of Increase in weight.	Profit or loss on gain in weight alone.
1	Lambs....	Cracked corn.....	$.65	$2.37	$3.02	$2.76	$— .26
2	"	9-10 cracked corn..... 1-10 oil meal.....	.50	3.20	3.70	3.96	+ .26
3	" ...	Barley.....	.49	2.99	3.48	1 80	—1.68
4	"	9-10 barley..... ..... 1-10 oil meal.....	.52	3.98	4.50	5.10	+ .60
5	"	Small wheat.....	.62	2.44	3.06	2.04	—1.02
6	"	Wild buckwheat.....	.51	4.29	4.80	4.92	+ .12
7	"	Pigeon grass.....	.28	3.86	4.14	6.18	+2.04
8	"	Screenings of wheat....	.38	3.37	3.75	7.08	+4.33
9	Wethers...	Screenings of wheat....	.32	3.72	4.04	3.35	— .69

TABLE VII.—Financial Results for Entire Period of Twelve Weeks.

1	2. Kind of Sheep—10 in each pen.	3 Grain fed with Hay.	4 *Value of hay fed.	5 Value of grain fed.	6 Total cost of food.	7 Value of increase in weight.	8 Profit or loss on increase.	9 Increased value of original weight.	10 Total increase in value.	11 Total profit.	12 Prices paid for grain per ton.	13 Received from grain, eliminating hay at cost.	14 Proportion'te prices rec'd per ton for grain.
1	Lambs....	Cracked corn.....	$2.87	$ 7.19	$10.06	$12.66	+$2 60	$7.10	$19.76	$ 9.70	$13.04	$16.89	$25.60
2	" ..	*9-10 cracked corn, 1-10 oil meal	2.14	10.34	12.48	17.34	+ 4.86	7.22	24.56	12.08	14.52	22.42	28.52
3	"	Barley.....	2.13	9.38	11.51	11.94	+ .43	7.33	19.27	7.76	14.80	17.14	24.77
4	" ...	9-10 barley, 1-10 oil meal	2.04	12.74	14.78	16.44	+ 1.66	7.57	24.01	9.23	16.11	21.97	26.01
5	" ...	Small wheat.....	2.51	7.95	10.46	12.12	+ 1.66	7.37	19 49	9.03	10.56	16 98	19.66
6	"	Wild buckwheat.....	2.00	10.21	12.21	14.22	+ 2.01	7.54	21.76	9.55	10.56	19.76	18.81
7	" ...	Pigeon grass.....	1.44	10.42	11.86	13.56	+ 1.70	7.41	20.97	9.11	10.56	19.53	18.65
8	"	Screenings of wheat.....	2.06	9.37	11 43	14.64	+ 3.21	7.36	22.00	10.57	10.56	19.94	20.32
9	Wethers...	Screenings of wheat.....	1.83	11.13	12.96	8.60	+ 4.36	8.54	17.14	4.18	10.56	15.31	14.04

*The average price of $7.13 per ton for hay, as compiled from statistics received from farmers, was used for calculating the cost of the hay; and $27.87 was used in calculating the cost of the oil meal.

In column 13 the figures represent the total value received minus the cost of the hay fed. at $7.13 per ton. In column 14 the figures represent the price realized from the different grain rations when the profits are apportioned on hay and grain in proportion to the cost of the amount of each fed.

SUMMARY

(1.) Corn fed with hay produced 20 cents profit per lamb more than barley fed with hay, when corn was valued at $13.04, barley $14.52 and hay $7 per ton, average prices throughout the State at that time.

(2.) When one-tenth oil meal, costing $27.87 per ton, was added to the grain, the lambs fed corn with hay produced 27 cents profit more each than those fed barley, oil meal and hay.

(3.) Rating the profits proportionately on grain and hay according to the cost of the amounts of each fed, the corn fed with hay produced 80 cents per ton more than the barley when fed to lambs.

(4.) When both were thus fed and with an addition of one-tenth oil meal, about two dollars more per ton was received for the corn than for the barley.

(5.) With the corn worth $13 per ton, or 36½ cents per bushel, the barley was worth, as shown by the lambs, $12.30 per ton or 29½ cents ber bushel; the "screenings" (90 per cent. small wheat grains and edible weed seeds,) about $10.35 per ton; the small wheat (90 per cent small, shrunken wheat,) $10 per ton; the wild buckwheat (90 per cent. wild buckwheat,) $9.56 per ton; and the pigeon grass seed (90 per cent. pigeon grass seed) $9.40 per ton.

(6.) The feeding value per ton for sheep may be calculated with fair accuracy by first determining the total percentage of grains of wheat, oats, barley, and edible weed seeds, and floury particles of such grains and seeds, and give this three-fourths the value of corn or barley at ruling prices. If there are present enough mustard, pig-weed or other bitter weed seeds to make the flavor decidedly bad a less valuation must be made on account of less feeding value. Seeds of noxious weeds also count against the value of the sample as the manure will scatter them on the farm unless especial care be used. The straw, chaff, pieces of weeds and other similar materials forming a larger or smaller part of the screenings have little value on the farm where roughage is very cheap and hardly need be taken into account.

(7.) It paid well to feed one-tenth oil meal in the grain ration, both when feeding corn and when feeding barley.

(8.) The pens of lambs which made the most clear profits in increased value above cost of grain and hay at prices named in table, were those fed cracked corn with one-tenth oil meal and those given a fairly good sample of wheat screenings. The pen-fed barley gave the least profits per head.

(9.) While grade Shropshire lambs purchased at five cents per pound in the fall, and fed hay and screenings, and sold at six cents in the spring—made a profit of $1.05 each, western two years old wethers (evidently grade merinos) bought at $4.20 per hundred, and sold in the spring at five cents per pound, gave a profit of only 40 cents each. The lambs got a half more of value per ton out of the food they consumed than the wethers.

FIELD EXPERIMENTS IN 1893.

ANDREW BOSS.

The reports herewith of varieties of field crops, of tests of machinery and methods of cultivation, of depths of planting crops, time of seeding, and of heavy vs. light seed grain, are of work done during 1893 by the writer. Prof. C. D. Smith, then the director of the station, assisted in planning the most of these experiments. Much of the work of the season is reserved for duplication and further study.

VARIETIES OF WHEAT.

The following varieties of wheat were raised on the University Farm during the season of 1893 on a mixed clay and loam soil that had been plowed the previous fall. The plats were laid out as evenly as possible in regard to physical conditions of the soil and all varieties were sown at the rate of one and one-fourth bushel per acre:

TABLE I.—Trial of Varieties of Wheat.

No. of plat.	Variety.	Source Obtained.	Days to mature.	Yield, straw per acre.	Weight, per bushel.	Yield, grain per acre, bu
1	Red fife	Station	88	1,344	54	13.3
2	Saskatchewan	L. L. May, St. Paul	88	1,741	55	15.8
3	Bernard's hard red fife	J. J. Bernard, Pipestone	88	1,659	56	14
4	Wellman fife	Station	88	1,323	54	11.7
5	Ladoga	Station	82	1,290		2.8
6	Houston's blue stem		89	1,856	53	18.4
7	Haynes' pedigree blue stem	Haynes, Fargo, N D	89	1,653	53	16.4
Average—Fife, three plots, 1, 2, 3				1,517	54¾	14.4
Average—Blue stem, two plots, 6 and 7				1,759	53	17.4

The light yield of plot No. 4 was partly due to the fact that the seed was poor and did not germinate well and it is left out of the average at the bottom of the table. Each plat contained .476 of an acre. The result of the test of Ladoga is but another of many failures of this wheat to do as well as Red fife and Blue-stem.

OATS—VARIETIES.

During the season of 1893 seven varieties of oats were grown on rich clay soil under seemingly uniform conditions. All varieties were sown at the rate of two bushels per acre and the comparison was as good as can ordinarily be made.

TABLE II.—Oats—Variety Tests.

Plat No.	Variety.	Source Obtained.	Date Sown.	Days to Mature.	Yl'd of Straw per Acre. lbs.	W'ght Grain per Bush.	Yl'd of Grain per Acre. Bush.
1	North Star.....	L. L. May, St. Paul	May 11.	79	3,389	26.5	42.71
2	Great Northern..	Salzer, La Crosse.	May 11.	88	3,716	29	54.87
3	Lincoln	N. B. & G. Co....	May 11.	83	2,780	28.5	55.15
4	Am. White Banner	.....	May 11.	83	2,614	29.5	63.15
5	E'y White Russian	Station.....	May 11.	88	3,100	31.5	60.78
6	New York.....	.....	May 11.	79	4,489	29.5	54.50
7	Early Gothland..	L. L. May.....	May 11.	83	3,510	31.5	63.15

It will be seen by the above table that two varieties, American White Banner and Early Gothland, did a little better this year than our standard, White Russian, which is the most popular oat in Minnesota.

BARLEY—VARIETY TESTS.

Four varieties of barley were sown in the spring of 1893 on land in fairly good heart that had been spring plowed. The barley was sown at the rate of two bushels per acre.

TABLE III.—Variety Tests of Barley.

Plat No.	Variety.	Date Sown.	Days to Mature.	Yield per Acre. Straw, lbs.	Yield per Acre. Grain, Bu.
1	Black	May 19.....	68	1,507	24.16
2	Success	May 19.....	65	1,016	24.58
3	Bernard's.....	May 19.....	75	1,242	20.73
4	Highland Chief..	May 19.....	78	1,305	17.77

CORN—VARIETY TESTS, 1893.

In 1893 twenty-four varieties of corn were planted in hills three feet four inches apart each way, four kernels in a hill. The soil was a black loam, fall plowed and in fairly good heart. The yields are in case of a number of varieties most excellent. The Station now has several varieties of corn which should be propagated for general distribution. We have been making a success of corn crops for a number of years on the University Farm. The effort has been to find the best class of corn for each part of the State. We are now warranted in growing for distribution, or having grown, quantities of some of the best yielding early dents for the southern half of the State, that varieties thus tested and distributed may take the place of the low-yielding "scrub" kinds now to be found in the cribs of a very large per cent. of those who grow corn. Such dent varieties as that obtained some years since from M. H. Lamb, of Waseca, No. 3 in the table, with good height of stalk, ear well up from ground, few stools, uniform, so that nearly all ears are merchantable, early, and withal, large yielders, are what we want to grow in hills for ear and stover, for silage, and to clean our lands of weeds.

TABLE IV.—Varieties of Corn.

Plat No.	Variety.	Description.	Source Obtained.	Days to mature.	Per cent. germinated.	Date ripe. Sept.	Height of stalk. ft.	Height of stalk. in.	Distance of ear from ground Inch's.	Per cent. stools.	Per cent. m'rk't-able corn.	Stover per acre. lbs.	Shell'd corn per acre bu.
1	North Star.....	Yellow Dent.....	DeCou & Co., St. Paul, Minn	106	.77	12	6	6	36	.05	.90	3,000	61.9
2	Dakota.....	" "	NorthropB.&G. Co. Minneapolis, Minn	107	.90	13	7		48	.....	.90	3,800	57.8
3	Lamb's.....	" "	M. H. Lamb, Waseca, Minn	104	.90	10	6	4	33	.05	.80	3,400	67.5
4	Dakota Queen ...	" "	Northrop B.&G.Co. Minneapolis, Minn	105	.95	11	6	6	36	.05	.80	2,900	62.5
5	New York.....	" "	L. P. Smith, Trumansburg, N. Y.....	107	.67	13	6	4	36	.05	.80	3,800	55.
6	Queen of North...	" "	.....	106	.75	12	6	3	40	.05	.75	3,000	56.4
7	Gold Coin	" "	.....Clearwater, Minn.	106	.91	12	5	4	24	.05	.75	3,400	55.
8	King of the Earl't	" "	L. L. May, St. Paul, Minn.....	108	.62	14	5	4	24	.05	.75	3,200	47.8
9	Allyn's.....	" "	Joshua Allyn, Hastings, Minn.....	106	.96	12	6		28	.05	.70	3,100	54.2
10	Earl'est Canadian	" "	Salzer, La Crosse, Wis.....	110	.91	16	5	8	24	.05	.85	3,900	66.9
11	Boyd's.....	" "	....	100	.91	6	5		18	.05	.70	2,900	43.6
12	Minnesota King (horse tooth)...	" "	NorthropB.&G. Co. Minneapolis, Minn	105	.84	11	5	6	24	.05	.85	3,300	50.3
13	North Dakota ...	White Flint.....	Salzer, La Crosse, Wis.....	108	.91	14	5		18	.15	.90	5,600	59 2
14	Fosston.....	" "	.....Fosston, Minn.....	100	.84	6	4		9	.10	.80	1,800	79.5(?)
15	New York.....	" "	L. P. Smith, Trumansburg, N. Y.....	106	.76	12	6		20	.15	.90	4,400	58.3
16	Bull's...	Yellow Flint....	J. A. Bull, Edina Mills, Minn.....	105	.77	11	4	3	16	.20	.85	3,400	55.3
17	Mercer.....	" "	DeCow & Co., St. Paul, Minn	100	.71	6	5	3	15	.15	.85	2,600	42.2
18	New York.....	" "	L. P. Smith, Trumansburg, N. Y.....	106	.76	12	5		24	.20	.90	4,400	54.2
19	Longfellow.....	" "	Station, St. Anthony Park.....	110	.47	16	5	6	30	.20	.70	7,100	48.1
20	Lippet's	" "	Lippett.....	100	.54	6	4	4	18	.10	.80	2,600	45.
21	Minnesota Flint..	" "	Twombley, Wyoming, Minn	105	.46	11	4	2	20	.15	.85	2,800	43.6
22	Squaw Corn.....	Mixed Flint.....	Salzer, La Crosse, Wis.....	100	.65	6	4	3	15	.10	.85	2,700	40.3
23	Bull's.....	White Dent.....	J. A. Bull Edina Mills, Minn	106	.78	12	4	9	24	.24	.90	2,900	60.3
24	Elephant Fodder.	....	NorthropB.&G.Co. Minneapolis, Minn	.....	.51	.....	7	6	42	.....	.60	5,800	50.8

WHEAT—IMPLEMENTS FOR SEEDING.

During the winter of 1892 and 1893 an extensive experiment was planned for the trial of a number of different wheat seeding machines, but owing to our inability to get the implements wanted, the experiment was confined to trials of a Hoe drill, Broadcast seeder and a machine invented by W. H. Campbell, of Putney, S. D. This latter consists of two sets of narrow-tired wheels, one set of which runs two feet ahead of and alternates with the other, the whole following a seeding box and set of cultivators, the same as is on the ordinary broadcast seeder. The wheels, following the broadcast seeder, thus serve the double purpose of firming the under soil and forming a fine "dust blanket" on the surface, taking the place of the harrow.

TABLE V.—Implements for Seeding Wheat.

Plat No.	Machine Used.	Am't Seed Per Acre.	Days to Mature.	Straw Per Acre lbs.	lbs. Grain Per lb Seed.	Yield Per Acre, bu.
1	Hoe drill.....	84 lbs.	88	1,362	9.53	13.35
2	Campbell's seeder	87 lbs.	87	1,542	10.59	15.36
3	Broadcast seeder.	92 lbs.	88	1,575	10.27	15.56

While the yield per acre, as shown above, was a little smaller with Campbell's machine than with the Broadcast seeder, the conditions favorable to the largest yield with the former machine were lacking, and I am well satisfied that the machine is of merit on dry, loose soil, where the lower part of the furrow slice needs compacting.

OATS.—IMPLEMENTS FOR SEEDING.

In conjunction with the tests of implements for seeding wheat three plats were similarly seeded with oats in the same field where varieties of oats were grown.

TABLE VI.—Implements for Seeding Oats.

No.	Machine used.	Date sown.	Amount of seed per acre.	Days to mature.	Straw per acre lb	Grain per acre. Bu.
1	Hoe Drill.....	May 11.	89 lbs.	83	3085	57.46
2	Campbell's Seeder	" 11.	102 lbs.	83	3278	61.03
3	Broadcast Seeder	" 11.	100 lbs.	83	3221	61.25

In the trial of seeding oats, as in the trial of these three implements for seeding wheat, Campbell's seeder, "The North Star Roller and Seeder" gave the same yield as did the Broadcast seeder followed twice with the harrow. The land used was compact fall plowing on which broadcasted grain could do well, and here it seems that Campbell's seeder had no especial merit. Its utility will doubtless be found where spring grain is sowed on very loose fall-plowing or on spring-plowing in dry sections of country or in dry spring seasons.

OATS—METHODS OF PREPARING LAND FOR.

An experiment to test methods of preparing land for oats and the effect of cultivation on the amount of water in the soil was undertaken on a field that had been pastured several years but had been broken up in the fall of 1891 and raised a crop of corn in 1892. The soil was a light sandy loam with a gravelly subsoil. The plats contained nearly one and one half acres each, were nearly even in general characteristics and were all sown at the rate of two bushels of oats per acre. All plats were seeded with a hoe-drill after preparing the corn ground as described in the table. In our dry climate methods of cultivation designed to conserve moisture in the furrow slice, so that plants can have food elaborated and furnished to them by this richest part of the soil where they best like to feed, are worthy of critical study. In this experiment where oats were sown on corn stubble which was simply disked; on corn stubble plowed shallow; on corn stubble plowed deep; and on corn stubble plowed deep and then rolled down solid, we had a good opportunity to study the water held in the upper and lower soil at different seasons during the growth of the crop.

TABLE XIII.—Effects of Cultivation on Soil Moisture.

Plat No.	Method of Preparation.	Pounds of Moisture in one acre of Soil and Lower Soil.										Average yield of straw per acre.	Average yield of Grain per acre.
		June 20.		June 30.		July 22.		August 5.		Average for Season.			
		Soil.	Lower Soil.	Soil.	Lower Soil.	Soil.	Lower Soil.	Soil.	Lower Soil.	Soil.	Lower Soil.	Lbs.	Bush.
1 and 5.	Disced twice; harrowed twice; drilled.....	51,823	114,264	46,391	97,786	31,853	80,042	24,194	79,224	38,565	92,828	1,431	37.53
2 and 6.	Plowed four inches deep; harrowed twice; drilled..	58 928	127,332	49,095	106,014	35,120	78,774	34,274	79,224	44,331	97,336	1,738	38.7
3 and 7.	Plowed seven inches deep. har. twice and drilled..	55,049	118,264	50,230	111,568	32,670	83,308	36,345	70,240	43,573	95,844	2,051	39.52
4.....	Plowed seven inches deep; rolled till very firm; drilled; harrowed.....	59,214	131,006	45,901	104,218	29,403	75,142	25.319	80,042	39,959	97,602	2,920	45.25

The samples for determination of water in the soil were taken on top of a hill running at a slight angle with the plats but as they were all taken on the same line, they may be considered as fairly representative of each plat although all would have shown a large amount of moisture if taken on lower land.

The samples of top soil were taken by boring down to a depth of three inches with a common post-hole auger, after first carefully removing all stubble on the surface. The samples of lower soil were taken from these same holes by boring down six inches further, using all the soil from three to nine inches deep from which to take the samples. All samples were taken and determinations made by the Chemical Division of the Experiment Station.

An acre of soil in the table means a layer of soil three inches deep, covering the surface of one acre. An acre of lower soil means the layer of soil between three and nine inches in depth, covering an area of one acre. The determinations made August 5th were from samples taken after the grain was cut. It will be seen by table No. XIII that plats Nos. 1 and 5, corn stubble disked, contained the lowest average amount of water in both surface and lower soil and gave the smallest yield of grain and straw. Plats Nos. 1 and 5 contained the least moisture in the early part of the season when plant growth was starting, but contained as much water in the lower soil at the end of the season as plats 2 and 6, plowed shallow; more than 3 and 7, plowed deep; and nearly as much as plat No. 4, plowed deep and rolled hard. At the time of seeding the already dry surface soil of the disked plats, 1 and 5, was thoroughly stirred up and dried out to a depth of three inches by the frequent discing and did not contain the necessary amount of moisture to germinate the seed placed in this loose dust blanket and to start a full growth of grain. On account of the lighter crop growing on these disked plots there was apparently not so much water pumped up from the lower soil by the plants during the latter part of the season as in the rest of the field. This allowed the accumulation of as much water in this lower soil as in the lower soil of the other while the surface soil remained

driest through the entire season, probably because of the thorough loosening in the preparation. The corn-stubble land by deeper plowing produced more grain and straw than that plowed shallow or that simply disked.

In plats 2 and 6, plowed shallow, and in 3 and 7, plowed deep, the seed was deposited in soil freshly turned up by the plow, and the shallow cultivation given by the harrow and drill did not seem to allow it to dry out so much as in the plats heretofore mentioned. They had moisture enough left to start a fair growth, though not so large as in plat No. 4, which was rolled down hard after deep plowing. Nor did they require so much water to support their less growth of grain as did the heavier yielding plat No. 4, thus leaving more moisture in the entire soil at the end of the season.

In plat No. 4, which gave the largest yield of grain and straw, the moisture was more nearly all retained by the process of rolling, and then harrowing lightly to form a "dust blanket". The water thus conserved started a strong growth of grain, which later in the season required a much larger amount of water than the lighter growth on the other plats, and brought the average amount of water down practically to that of the rest of the field.

The lessons to be drawn from this experiment, so far as a single trial can be relied upon, are that the more compact we make our seed bed and lower part of the furrow slice, and the more perfect the shallow "dust blanket," the better we can save what moisture is in the soil and apply it to the use of the growing crop at the time of germination and stooling when it needs most water. By the time the grain has gotten past the germinating and stooling period the capillary action which was interrupted by the plow has practically resumed operation and is ready to supply moisture from below. While a shallow "dust blanket" is evidently a benefit to dry soils, it can readily be seen that a "blanket" three inches deep in which to deposit seed may be a detriment.

POTATOES—METHOD OF PLANTING.

Potatoes planted so as to test several methods were planted in clover sod broken the fall previous. The rows were forty inches apart and seed pieces cut to one or two eyes were planted, as shown in tables XVI and XVII. The results illustrate the generally accepted fact that in our climate, subject to drouth, potatoes should not be planted shallow. The potatoes planted shallow not only yielded less but they were not of such good quality, having more branches or "fingers and toes." The potatoes planted deeper were comparatively free from these wart like growths, which sometimes are produced by the tubers taking on a second growth when a period of drouth is succeeded by a period when the soil is again moist.

TABLE XIV.—Methods of Planting Potatoes.

Plat No.	METHOD OF PLANTING.	Amount seed per acre. Bushels.	Days to mature.	Bushels per acre not salable.	Bushels per acre salable.	Bushels harvest'd, per bushel planted.	Total yield per acre. Bushels.
1...	Land plowed five inches deep, harrowed, marked three inches deep, hills thirty-two inches apart in the row, two seed pieces in each hill covered three inches deep with hoe.....	8.9	122	35.8	120.7	17.6	156.5
2...	Furrows drawn six inches deep, potatoes planted in furrows, one seed piece every fifteen inches. Furrow turned back to cover seed....	11.4	122	17.2	190.3	18.2	207.5
3...	Potatoes dropped in every third furrow as the piece was plowed. Furrows six inches deep, one seed piece every fifteen inches.....	10.1	122	20.	180.	19.8	200

TABLE XV.—Potatoes; Depth of Planting.

Plot No.	DEPTH PLANTED.	Amount of seed per acre.	Bu. per acre not saleable.	Bu. saleable per acre.	Bu. harvested. per bushels planted.	Total bushels per acre.
1	Plowed under two inches deep and harrowed as the potatoes came up.	9.8	28.9	184.5	21.7	213.1
2	Plowed under four inches deep and harrowed as the potatoes came up.	8.9	22.	171.1	22	196.1
3	Plowed under six inches deep and harrowed as the potatoes came up.	7.7	32.9	179.7	27.6	212.6
4	Plowed under eight inches deep and harrowed as the potatoes came up.	9.3	29.4	162.3	20.6	191.7
5	Dropped in furrows eight inches deep and covered lightly, leaving soil to pull down as potatoes came up.	10.1	20.8	175.4	19.4	196.2
6	Plowed under eight inches deep and harrowed as the potatoes came up.	9.2	15.4	188.6	22.2	204.
7	Dropped in furrows eight inches deep, covered one inch deep with straw and furrow turned harrowed as the potatoes came up.	8.6	12.1	142.5	18.	154.6

OATS.

STUDY OF PER CENT. OF GERMINATION AND STOOLING OF OATS AT DIFFERENT DEPTHS OF PLANTING.

TABLE VII.—Germination of Oats at Different Depths.

Hill No.	Depth sown.	Date sown.	Per cent Seeds grown	No. of heads on plat when matured.
1	¼ inch	May 6	86	111
2	½ inch	May 6	81	127
3	¾ inch	May 6	90	103
4	1 inch	May 6	85	119
5	1¼ inches	May 6	76	112
6	1½ inches	May 6	79	113
7	1¾ inches	May 6	82	112
8	2 inches	May 6	59	125
9	2¼ inches	May 6	60	102
10	2½ inches	May 6	72	...
11	2¾ inches	May 6	60	...
12	3 inches	May 6	30	17

One hundred kernels were planted in each hill of one square foot.

The oats were able to come up nearly equally well at all depths from 1¼ inch to 1¾ inches deep, and the production of strong culms was quite as good with the deeper of these plantings. Oats planted 1½ to 2 inches deep germinated well.

BARLEY.

STUDY OF PER CENT. OF GERMINATION AND STOOLING OF BARLEY PLANTED AT DIFFERENT DEPTHS.

As in the case of oats, each hill was one foot square and was planted in depths running from ¼ to 3 inches. One hundred kernels were planted in each hill.

TABLE VIII.—Germination of Barley at Different Depths.

Hill No.	Depth sown.	Date sown.	Seeds germinated.	Heads on plot when matured
1	¼ inch	May 19	79	112
2	½ inch	May 19	92	117
3	¾ inch	May 19	84	105
4	1 inch	May 19	79	104
5	1¼ inch	May 19	63	79
6	1½ inch	May 19	62	57
7	1¾ inch	May 19	27	23
8	2 inches	May 19	33	44
9	2¼ inches	May 19	28	30
10	2½ inches	May 19	30	14
11	2¾ inches	May 19	12	0
12	3 inches	May 19	19	1

The barley planted only one inch and less in depth germinated better and produced more culms than that planted deeper.

OATS.

YIELD OF OATS SOWN AT DIFFERENT DEPTHS.

This experiment was to ascertain the yield per acre of oats sown at different depths. The plats were one rod square and the oats were sown by hand in drills six inches apart, varying in depths from one-half to three inches. Two bushels of seed per acre were used.

TABLE IX.—Oats Sown at Different Depths.

Plot No.	Depth sown.	Date Sown.	Days to mature.	Yield of straw per acre, lbs.	Yield of grain per acre, bu.
1	½ inch	May 16	76	3,200	26
2	1 inch	May 17	75	3,296	27
3	1½ inches	May 17	75	3,424	28
4	2 inches	May 17	75	3,424	28
5	2½ inches	May 17	77	3,120	32 5
6	3 inches	May 17	77	3,248	32

This date of seeding was medium as to earliness in the progress of the season. The oats sown two and one-half and three inches deep yielded the most grain and that seeded one-half and one inch yielded least, while that one and one half and two inches deep produced the most straw.

BARLEY.

YIELD WHEN SOWN AT DIFFERENT DEPTHS.

TABLE X.—Yield of Barley at Different Depths.

Plot No.	Depth sown.	Date sown.	Days to mature.	Yield of straw per acre, lbs.	Yield of grain per acre, bu.
1	½ inch	May 18	68	2,720	20.7
2	1 inch	May 18	68	2,880	26.7
3	1½ inches	May 18	68	2,918	28.
4	2 inches	May 18	68	2,848	26.
5	2½ inches	May 18	69	2,800	24.
6	3 inches	May 18	69	2,784	22.6

From the above table it will be seen that barley did best when planted one to two inches deep.

OATS—HEAVY VS. LIGHT FOR SEED.

The practice of many of the farmers of Minnesota in using their light grain for seed led to a comparison of heavy and light oats for seed. To obtain the heavy seed, oats of good weight were run through the fanning mill using all the wind possible to blow out the light oats and chaff. For light seed the oats thus blown out were recleaned using only enough wind to blow out the chaff and very lightest kernels.

TABLE XI.—Heavy vs. Light Oats for Seed.

Plot No.	Seed used.	Rate per acre.	Weight of seed per measured bushel.	Pounds seed on plot.	Kernels per bush. of 32 pounds.	Kernels on plot.	Yield of straw per acre, lbs.	Yield of grain per acre. Bushels.
1	Heavy	2 bush.	37 lbs.	31	567,296	549,568	3,389	64.09
2	Light	2 bush.	21 lbs.	14	911,872	398,944	2,492	54.59

This experiment does not show as radical a difference in the product of light and heavy seed as is usual, though the heavier seed produced 9½ bushels more of oats than the light seed. When the season and soil furnish poor seeds of good parentage, with the best of conditions, the young plants are enabled very soon to get nourishment from the soil in ample quantities and do not need a large supply stored up in the seeds for their use. But heavy seed will pay as a rule, and pay well.

OATS—EARLY VS. LATE SEEDING.

To determine the relative value of early and late seeding of oats, three plats of equal size were laid out in the same field with the experiment on "Methods of Preparing Lands for Oats." Three plots of oats were sown at intervals of about ten days, at the rate of about two bushels per acre.

TABLE XII.—Early vs. Late Seeding of Oats.

Plot No.	Date sown.	Days to mature.	Yield of straw per acre. pounds.	Yield of grain per acre. Bushels.
1	April 18	99	1,926	47.59
2	April 29	88	1,486	37.61
3	May 11	83	1,199	25.37

On the night of April 18th six inches of snow fell and remained until April 28. This retarded the germination of the grain sown on the 18th and partially accounts for the greater length of time taken to mature, while the amount of moisture stored up at that time doubtless had some influence in the increased yield.

This experiment suggests that in our extensive system of farming a great loss is sustained annually by leaving the seeding of oats until all other grain is seeded. It has been our experience that the sooner most of the small grains are put in the ground after the frost is out the better.