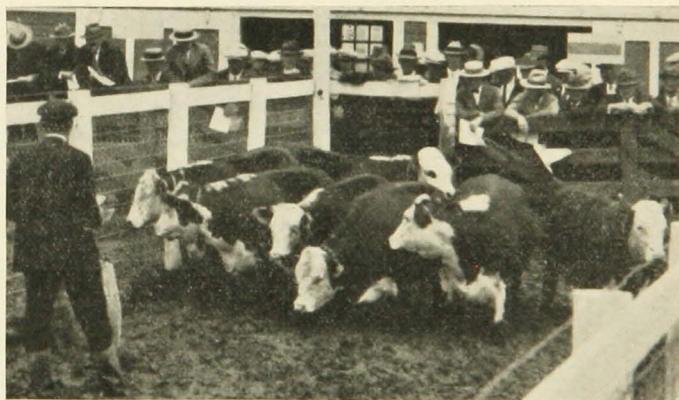


UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

SWEET CLOVER HAY FOR BEEF CAT-
TLE—FATTENING BABY BEEVES
AND TWO-YEAR-OLD STEERS

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UNIVERSITY FARM, ST. PAUL

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SWEET CLOVER HAY FOR BEEF CATTLE—FATTENING BABY BEEVES AND TWO-YEAR-OLD STEERS

O. M. KISER and W. H. PETERS

INTRODUCTION

Beef cattle feeding investigations have been conducted at the Northwest Experiment Station, Crookston, Minnesota, in co-operation with the Division of Animal Husbandry, University of Minnesota, University Farm, St. Paul, for seven years. The primary purpose of these trials has been to secure accurate information on beef cattle production under Red River Valley conditions.

Farmers throughout northwestern Minnesota are finding that they cannot rely on continuous grain cropping, and, hence, are gradually introducing livestock as a practical means of utilizing the hay, forage, and silage crops so well adapted to an efficient system of crop rotation and as a means of marketing the coarse grains to better advantage.

Feeds suitable for beef production such as alfalfa, sweet clover, corn silage, and oats and barley are produced in abundance throughout this area. The roughages are well adapted to the wintering of breeding beef cows or young stocker cattle, while the grains can be condensed and marketed to advantage in the form of finished beef.

The beef producers of northwestern Minnesota are confronted with a longer winter feeding period than is the case farther south, they do not have to contend with alternate periods of freezing and thawing. Cattle housed in properly constructed straw sheds or more permanent frame buildings will make satisfactory gains, as the continuous dry cold is conducive to the health of the animals and prevents wide variations in feed consumption.

The investigations to date have covered principally a study of the utilization of sweet clover as pasture and hay and a study of the fattening of baby beef calves for market.

METHOD OF PROCEDURE

Purchase and preparation of cattle.—The yearling cattle used in the trials were purchased on the market at South St. Paul. The calves used in three baby beef trials were purchased from farmers in northern Minnesota, while those used in one trial were purchased on the market at South St. Paul. All the cattle were of high-grade, beef-breeding and during the seven years' work, Shorthorn, Hereford, and

Aberdeen Angus cattle were used. Animals of the same breeding were used for all comparisons—no attempt being made at any time to compare the breeds. In every trial the cattle were rested from one to two weeks after arrival at the station before being placed in their respective lots. During this preliminary period they were either pastured or fed lightly on hay with very little grain and those with horns were dehorned. In every trial with the baby beef calves, some bull calves had to be castrated after arrival.

Allotment of cattle.—In each trial, the cattle were divided into lots as evenly as possible with respect to size, form, quality, thrift, condition, breeding, and sex, so that each lot contained the same number of large and small animals, blocky and rangy animals, fleshy and thin animals, and steer and heifer calves. Eight animals were used per lot.

Shelter and yards.—The groups of animals in each trial occupied similar quarters. These consisted of an open lot 20x100 feet, and a shed 20x16 feet, opening southward into the lot by means of a sliding door. The hay racks, feed bunk, water tank, and salt box were all inside the shed. The floors of the sheds were bedded with straw as needed, to keep the cattle comfortable, and were cleaned out at intervals of one to two weeks.

Weighing the cattle.—Each animal was identified by a neck chain bearing an individual number. Each was weighed on three consecutive days at the beginning of the trial and the average was taken as his initial weight at noon of the middle day. This method also was used to determine the final weight at the end of the trial. During the trial each animal was weighed individually at the end of each 28-day period.

Valuation of cattle.—The cost of the cattle delivered to the station farm at Crookston plus cost of feed from time of arrival to the date of beginning the trial was used as the initial valuation. Final values were determined by a commission man from the South St. Paul market. The value was based on cattle prices at the South St. Paul market for that day.

Method of feeding.—All feeding was done inside the sheds. Hay was fed in racks usually twice a day and generally in amounts that the animals would clean up by the next feeding time. This plan was followed so that practically complete consumption of the hay fed could be secured. Silage was fed in the grain bunks, and the grain and protein supplement were usually mixed together and fed by spreading over the silage. All lots had access to water and salt at all times. In several of the trials, animal feed bonemeal was mixed with the salt, half and half.

Getting cattle on feed.—As a rule the cattle used in the trials of this report had not been receiving grain immediately preceding the beginning of the trial. Lots that were to receive a full feed of grain were usually started on a small amount of grain and were gradually worked up to a full feed of grain in from four to six weeks.

Keeping feed records.—All feeds were weighed, and a complete daily feed record was kept.

Feed prices.—The prices charged for the various feeds in each trial were established by obtaining the average of prices for feeds of similar quality received by farmers in the vicinity of Crookston. The charge for corn silage was an estimated price approximating as closely as possible the cost of production.

Hogs following cattle.—Hogs were placed with the cattle in only one trial—that of fattening two-year-old steers. This was done because one lot of cattle was fed whole barley. It has been shown by trials at the Minnesota Experiment Station, University Farm, that hogs following cattle fed on ground barley do not make sufficient gains from feed salvaged from the cattle to warrant the practice. It was thought, however, that hogs might salvage a great deal more feed from cattle receiving whole barley.

UTILIZATION OF SWEET CLOVER IN NORTHWEST MINNESOTA

It is not often that a valuable plant introduces itself into a locality as a weed, later to be cultivated and grown as a desirable and profitable farm crop, yet that is the story of sweet clover. Once despised as a more or less troublesome weed, it is now grown upon thousands of farms throughout many sections of the United States and Canada as an important crop. It contributes to the farm income sometimes only because of its beneficial fertilizing effect upon the soil when turned under as green manure, and sometimes because it is found profitable for seed production. Early in the development of the crop in northwestern Minnesota, it became evident that livestock, notably cattle and sheep, would pasture on sweet clover successfully and would eat sweet clover hay.

Sweet Clover Pasture

Early in its development in northwestern Minnesota, sweet clover was given a trial at the Northwest Experiment Station both as a pasture and a hay crop. The first use of sweet clover as a pasture proved so satisfactory and successful that it became practically the only pasture provided for cattle, sheep, and horses maintained at the station. It has now been pastured regularly by cattle at this station for ten years, the herd on sweet clover pasture varying from forty to sixty cattle. A check of the acreage used with the number of cattle pastured shows that an acre of sweet clover will provide feed for about two mature animals beginning June 1 to 10, and closing September 1 to 30.

Many statements have been made for and against sweet clover as pasture. It is our observation that as a pasture, its greatest merit is the large yield of forage per acre, giving it a carrying capacity of double the number of animals that can be carried on the best native or wild grass pasture in this section. While low in palatability, livestock of all kinds will eat sweet clover readily once they become accustomed to it and will eat enough to produce satisfactory daily gains as well as larger total gains per acre of pasture than any other pasture common to the region.

Of the objections voiced against sweet clover pasture by those who have had experience with it, there is but one that can be considered serious; that is, cattle and sheep on sweet clover pasture are more susceptible to bloat than are cattle and sheep pasturing the common grasses. Yet in all our experience with sweet clover pasture at this station, less than one-half dozen cases of bloat have been observed. These were nearly all with sheep and only two or three of them resulted

fatally. However, the tendency of sweet clover to cause bloat must be acknowledged, even by those who have pastured it through several seasons without actually having experienced a single case of bloat. Instances have come to our attention of persons who had their first experience of bloat in animals pasturing sweet clover, after four, five, or six years. Losses from this cause to date, however, have been so small that sweet clover remains unchallenged by any grass or other crop with respect to its suitability and productivity as a pasture for cattle, sheep, and horses in northwestern Minnesota.

Sweet Clover Hay

What are the possibilities of sweet clover as a hay crop? This was one of the first questions asked when sweet clover first began to receive consideration as a cultivated crop. Experience in feeding sweet clover hay has developed numerous opinions about it, owing probably to the wide variation in the quality of the hay itself. Sweet clover hay may range in quality from extremely coarse, first-cutting hay which has lost nearly all its leaves or which has molded badly, to sweet clover hay that is fine in stem, leafy, and quite palatable to livestock. Among the objections raised against it, those most commonly heard are that it is too coarse and that animals are likely to develop what is commonly referred to as sweet clover sickness. The actual cause of sweet clover sickness is not yet known, but generally it occurs if a low quality, usually moldy, hay is used as the only feed. It is advisable, therefore, to feed some other hay, silage, or grain with the sweet clover hay.

ROUGHAGES FOR WINTERING STOCKER CATTLE

Sweet Clover Hay for Wintering Stocker Cattle

Two trials in feeding sweet clover hay as the principal feed for wintering yearling steers were conducted at this station. In the first trial, extending from November 14, 1922, to May 8, 1923, a period of 176 days, two lots of seven high-grade yearling beef steers were fed with a view to wintering them in suitable condition to go on grass in the spring. Lot 1 was fed alfalfa hay, 15 pounds of corn silage per head per day, and oat straw. Lot 2 received sweet clover hay, 15 pounds of corn silage per head per day, and oat straw. The second trial extended from November 1, 1923, to May 14, 1924, a period of 196 days. It was an exact duplicate of the first trial except that the steers were allowed all the corn silage they would clean up readily in two feeds per day. Results for the two trials are given in Table I.

TABLE I*
ALFALFA AND SWEET CLOVER HAYS IN A WINTERING RATION
First Trial—November 14, 1922 to May 8, 1923—176 days
Second trial—November 1, 1923 to May 14, 1924—196 days

Rations	First trial Limited silage		Second trial Full feed silage		Average of two trials	
	Alfalfa Oat straw	Sweet clover Oat straw	Alfalfa Oat straw	Sweet clover Oat straw	Alfalfa	Sweet clover
Initial weight, lbs.	658.38	648.44	688.47	688.57	673.42	668.50
Final weight, lbs.	839.44	852.40	1001.12	970.19	920.28	911.29
Total gain, lbs.	181.06	203.96	312.65	281.62	246.86	242.79
Av. daily gain, lbs.	1.03	1.16	1.59	1.44	1.31	1.30
Av. daily feed, lbs.						
Alfalfa hay	17.44	....	11.52	....	14.48	....
Sweet clover hay ....	....	18.66	....	8.08	....	13.37
Corn silage	14.51	14.74	30.32	31.80	22.41	23.27
Oat straw	2.58	2.85	2.73	3.44	2.65	3.15
Total feed per day	34.53	36.25	44.57	43.32	39.55	39.79
Total feed cost	\$28.79	\$20.78	\$34.40	\$22.82	\$31.59	\$21.80
Feed cost per lb. gain ..	.17	.10	.11	.08	.14	.09

Feed prices charged: (First trial) Alfalfa hay \$15 per ton, sweet clover hay \$8 per ton, corn silage \$4.25 per ton, oat straw \$1.50 per ton. (Second trial) Alfalfa hay \$17 per ton, sweet clover hay \$8.50 per ton, corn silage \$5 per ton, oat straw \$1.50 per ton.

* In all trials reported in this bulletin, figures are given on the single animal basis, pounds, and dollars.

Good quality sweet clover hay was fed in both trials. It will be noticed from Table I that steers getting alfalfa hay ate somewhat more hay and gained somewhat faster than steers on sweet clover hay when a full feed of silage was fed. Cattle receiving sweet clover hay ate a little more silage and a little more straw to make up for the smaller amount of hay consumed. Sweet clover hay, therefore, even tho of good quality, is not quite as palatable to cattle as alfalfa hay. However, the significant thing about the results of these two trials is

that steers getting sweet clover hay wintered successfully and, in all respects, compared favorably with the cattle receiving alfalfa hay.

Value of Corn Silage in the Wintering Ration

The addition of corn silage to a ration of sweet clover hay and oat straw increased the rate of gain and lessened the wintering cost. A study of Table II shows that the steers receiving sweet clover hay and oat straw without corn silage made an average daily gain of .77 pound, while those receiving corn silage in addition to sweet clover hay and oat straw made an average daily gain of 1.30 pounds. It will be noticed further that with corn silage at \$4.25 per ton (first trial), \$5 per ton (second trial); sweet clover at \$8 per ton (first trial), \$8.50 per ton (second trial); and oat straw at \$1.50 per ton, the cost per pound gain, without corn silage in the ration, was 11.7 cents, and with corn silage 9 cents, a reduction of nearly 3 cents in the cost per pound of gain, due to the addition of corn silage to the ration.

TABLE II
CORN SILAGE IN A WINTERING RATION OF SWEET CLOVER HAY AND OAT STRAW
First trial—November 14, 1922 to May 8, 1923—176 days
Second trial—November 1, 1923 to May 14, 1924—196 days

Rations	First trial		Second trial		Average of two trials	
	Silage	No silage	Silage	No silage	Silage	No silage
Initial weight, lbs.	648.44	687.16	688.57	688.63	668.50	687.89
Final weight, lbs.	852.40	800.77	970.19	863.80	911.29	832.28
Total gain, lbs.	203.96	113.61	281.62	175.17	242.79	144.39
Av. daily gain, lbs. ...	1.16	.65	1.44	.89	1.30	.77
Av. daily feed, lbs.						
Sweet clover hay ..	18.66	19.65	8.08	20.31	13.37	19.98
Corn silage	14.74	....	31.80	....	23.27	....
Oat straw	2.85	5.87	3.44	10.72	3.15	8.29
Total feed cost	\$20.78	\$15.18	\$22.82	\$18.49	\$21.80	\$16.83
Feed cost per lb. gain	.10	.13	.08	.105	.09	.117

Feed prices charged: (First trial) Sweet clover hay \$8 per ton, corn silage \$4.25 per ton, oat straw \$1.50 per ton. (Second trial) Sweet clover hay \$8.50 per ton, corn silage \$5 per ton, oat straw \$1.50 per ton.

A limited ration of silage was fed in the first trial and a full feed of silage in the second trial. Second cutting of sweet clover hay was used in the first trial and the first cutting of this hay fed in the second. The steers fed no silage made an average daily gain of .65 pound in the first trial on second cutting of sweet clover hay, and .89 pound per day in the second trial on first cutting. A good quality of sweet clover hay was used in both trials. Due to the rank growth, first cutting sweet clover is more difficult to cure than hay made from the smaller growth of the second cutting. These trials indicate that the coarser hay from the first cutting of sweet clover, if properly cured, is equal in feeding value to the finer stemmed hay of the second cutting.

Cattle fed silage came through the winter in better condition than those receiving no silage. The results are given in Table II.

Sweet Clover vs. Prairie Hay

Much prairie hay or wild hay, as it is sometimes called, is harvested and fed in Minnesota but thin growth, expense of harvesting, and often long haulage usually make it an expensive feed.

During the winter of 1923-24, one lot of steers was fed exclusively on sweet clover hay and oat straw and a similar lot, on oat straw and prairie hay—an average representative quality of prairie hay being fed. The comparative efficiency of sweet clover and prairie hay as shown by this trial is reported in Table III.

TABLE III
SWEET CLOVER VS. PRAIRIE HAY FOR WINTERING CATTLE
November 1, 1923 to May 14, 1924—196 days

Rations	Sweet clover hay Oat straw	Wild hay Oat straw
Initial weight, lbs.	688.63	688.61
Final weight, lbs.	863.80	814.28
Total gain, lbs.	175.17	125.67
Average daily gain, lbs. ....	.89	.64
Average daily feed, lbs.		
Sweet clover hay	20.31	....
Wild hay ....	....	16.54
Oat straw	10.72	9.52
Total feed per day	31.03	26.06
Total feed cost	\$18.49	\$13.37
Feed cost per lb. gain ....	.105	.106

Feed prices charged: Sweet clover hay \$8.50 per ton, wild hay \$8 per ton, oat straw \$1.50 per ton.

The noticeable differences in the results secured are: (1) that cattle receiving wild hay required considerably less than those on sweet clover; (2) that cattle on sweet clover hay made noticeably larger daily gains than those receiving prairie hay. With sweet clover hay and wild hay at approximately the same price per ton, there was no difference in the cost of gain per pound. Because of the other advantages of growing sweet clover, the farmer can well afford to grow it for hay on his farm in preference to traveling a considerable distance to obtain prairie hay.

FATTENING BABY BEEF CALVES

It is now generally acknowledged that one of the best management plans for production of beef cattle in the midwest is that of producing feeder calves and fattening them to be marketed as baby beef at the age of 12 to 18 months. Purchasing calves at, or soon after, weaning time and putting them on feed at once to be fattened and sold as baby beef is also being practiced by many cattle feeders in preference to purchasing of yearlings or two-year-old feeder steers. Producing feeder calves and fattening them as baby beef is an enterprise that is being carried on with a high degree of success by a few farmers in the Red River Valley of Minnesota.

A study of the problems involved and of the most suitable home grown feeds for fattening calves for baby beef was begun at the Northwest Experiment Station in the fall of 1925. Altogether four groups of calves of four lots each, with eight calves to the lot, have now been fattened and, in general, the results secured to date indicate that feeds available in northwestern Minnesota are highly suitable for fattening calves for baby-beef, and that this enterprise can be carried on with a high degree of success and with substantial profit.

Barley As a Substitute for Corn

Corn has long been recognized as the grain pre-eminently suited to the fattening of cattle. Barley also has long been used as a fattening grain, but in sections not so well adapted to corn production. Just how these two grains compare when checked directly against one another in the fattening ration for baby beef calves is a question of importance because barley must be relied upon as the principal fattening grain in northern Minnesota.

During the winter of 1926-27, two lots of high-grade mixed steer and heifer calves were fattened. Each lot contained eight calves lotted as nearly equal as possible at the beginning of the trial. They were started on feed November 9, 1926, and continued to June 14, 1927—a period of 217 days. Lot 1 was fed ground barley, linseed oilmeal, corn silage, and alfalfa hay; while lot 2 had shelled corn, linseed oilmeal, corn silage, and alfalfa hay. The barley for this trial was home grown but to secure a good quality, the corn was shipped in. Table IV gives the results secured.

The most striking observation made on this trial was the closeness to which the barley-fed cattle approximated the corn-fed cattle in every respect. One of the principal differences in chemical composition between good, sound mature corn and barley is that corn is lower in fiber content. Another difference is that corn is more palatable and hence cattle will consume more of it than barley. These two factors account

for a slight advantage in rate of gain and degree of fatness at the finish in favor of the corn-fed cattle. Charging other feeds at cost and applying the remainder of the selling price to the grain fed, we find in this trial that cattle fed ground barley returned 77.6 cents for each bushel of barley and cattle fed shelled corn returned 95.8 cents per bushel for the corn. This is, indeed, a creditable showing for barley and indicates that the northern farmer need not hesitate to compete with the cornbelt farmer in fattening cattle for market because it is necessary to substitute barley for corn as the grain feed.

TABLE IV
BARLEY VS. CORN FOR FATTENING BABY BEEVES
November 9, 1926 to June 14, 1927—217 days

Rations	Ground barley Linseed Corn silage Alfalfa hay	Shelled corn Linseed Corn silage Alfalfa hay
Initial weight, lbs.	372.49	374.99
Final weight, lbs.	853.37	883.99
Average daily gain, lbs.	2.21	2.34
Average daily feed		
Barley, lbs.	10.53	....
Corn, lbs. ....	....	11.16
Linseed meal, lbs.	1.5	1.5
Corn silage, lbs.	9.55	9.71
Alfalfa hay, lbs.	2.53	2.78
Feed per 100 pounds gain		
Barley, lbs.	475.59	....
Corn, lbs. ....	....	475.78
Linseed meal, lbs.	67.61	63.87
Corn silage, lbs.	431.14	414.04
Alfalfa hay, lbs.	114.32	118.90
Feed costs per 100 pounds gain	\$9.45	\$10.29
Initial cost per cwt.	\$ 8.50	\$ 8.50
Initial cost per head	31.66	31.87
Total cost of feeds	45.44	52.37
Final cost per head	77.10	84.24
Selling price per cwt., South St. Paul	\$11.00	\$11.25
Selling price per cwt., Crookston	10.30	10.55
Value per head, Crookston	87.89	93.26
Margin per head over feed cost	\$10.79	\$9.02

Feed prices charged: Barley 55 cents per bushel, corn 75 cents per bushel, linseed meal \$47 per ton, corn silage \$5 per ton, alfalfa hay \$17 per ton. Cost of grinding grain, 8 cents per hundredweight.

Oats As a Substitute for Barley

Oats have been recognized as a highly suitable feed for practically all types of young, growing animals. It is principally because of this that many feeders of baby beef calves have included some oats in the fattening ration, the idea being that calves are so young when started on feed that oats help to promote growth. It is true that ground oats, or a grain ration including one-third to one-half ground oats, is an excellent

feed on which to start any type of cattle. Whether or not it is desirable to continue the use of some ground oats in the ration throughout the fattening period is one of the questions that has been studied in the feeding trials at this station.

TABLE V
GROUND OATS AS A SUBSTITUTE FOR GROUND BARLEY IN FATTENING
BABY BEEF CALVES FOR MARKET
November 1, 1927 to June 12, 1928—224 days

Lot no.*	I	II	III	IV
Rations	Ground barley Linseed meal Corn silage Alfalfa hay	Ground barley, 2/3 Ground oats, 1/3 Linseed meal Corn silage Alfalfa hay	Ground barley, 1/3 Ground oats, 2/3 Linseed meal Corn silage Alfalfa hay	Ground oats Linseed meal Corn silage Alfalfa hay
Initial weight, lbs.	395.23	378.95	380.23	379.03
Final weight, lbs.	897.61	862.49	838.80	848.33
Average daily gain, lbs.	2.24	2.15	2.05	2.09
Average daily feed				
Ground barley, lbs.	10.72	7.00	3.49	....
Ground oats, lbs. ....	....	3.50	6.98	10.24
Linseed meal, lbs.	1.45	1.45	1.45	1.45
Corn silage, lbs.	7.92	7.09	7.80	7.20
Alfalfa hay, lbs.	2.47	2.11	2.37	2.13
Feed per 100 lbs. gain				
Ground barley, lbs.	478.35	324.51	170.46	....
Ground oats, lbs. ....	....	162.21	340.87	488.90
Linseed meal, lbs.	64.94	67.16	70.65	69.20
Corn silage, lbs.	353.57	328.48	381.21	343.78
Alfalfa hay, lbs.	110.50	97.89	115.82	101.93
Feed costs per 100 lbs. gain	\$10.60	\$10.68	\$11.37	\$10.82
Initial cost per cwt.				
Initial cost per head	\$11.60	\$11.60	\$11.60	\$11.60
Total cost of feed	45.84	43.96	44.10	43.96
Final cost per head	53.25	51.64	52.13	50.77
Value per head, Crookston	99.09	95.60	96.23	94.73
Selling price per cwt., South St. Paul				
Selling price per cwt., Crookston...	\$13.75	\$13.50	\$13.20	\$12.75
Value per head, Crookston	13.00	12.75	12.45	12.00
Margin per head over feed cost	116.68	109.97	104.40	101.80
Margin per head over feed cost	\$17.59	\$14.37	\$8.20	\$7.07

Feed prices charged: Barley 72 cents per bushel, oats 48 cents per bushel, linseed meal \$50 per ton, corn silage \$5 per ton, alfalfa hay \$10 per ton. Cost for grinding grain, 8 cents per hundredweight.

* Eight calves per lot in lots 2 and 4; seven calves at close of trial in lots 1 and 3, as one calf, lot 3, died from bloat December 23, and one calf was removed from lot 1 March 21, because of bloat.

During the winter of 1927-28, four lots of eight head each of high-grade Hereford calves, mixed steers and heifers, were fed from November 1, 1927 to June 12, 1928, a period of 224 days. Lot 1 was fed ground barley, linseed oilmeal, corn silage, and alfalfa hay, while lot 2 received ground barley, two thirds, ground oats, one third, linseed oilmeal, corn silage, and alfalfa hay; lot 3, ground barley, one third, ground oats, two thirds, linseed oilmeal, corn silage, and alfalfa hay;

and lot 4, ground oats, linseed oilmeal, corn silage, and alfalfa hay. The results of this comparison are given in Table V.

A study of Table V shows that barley-fed calves made appreciably larger daily gains, with very little difference in the amounts of feed eaten, as compared to each of the other three lots. The larger gains of barley-fed calves were, no doubt, due to lower fiber content of the barley as contrasted with fiber content of the oats. After 224 days on feed, the barley-fed calves showed quite a desirable market finish while the oats-fed calves were still underfinished from the market buyers' viewpoint. This difference in finish was so great that barley-fed calves were valued a full dollar per hundredweight higher than the calves fed entirely on oats resulting in a margin of \$10.52 per head over feed cost for the barley-fed calves as against the oats-fed calves.

This striking difference should lead the feeder of baby beef calves to consider pretty carefully the extent to which oats should be used in preference to barley in the fattening ration. It seems that calves receive sufficient growth-producing feed when barley is fed as the only grain in a ration supplemented with a sufficient amount of high protein feed, together with a legume hay and corn silage, while oats alone will not produce the necessary finish in a reasonable length of time. Substituting one third of the barley with oats closely approached the barley-alone ration in margin over feed cost, while substituting two thirds of the barley with oats brought the margin over feed cost down almost as low as the oats-alone ration.

Substituting One-Half the Barley with Oats

During the winter of 1925-26, a ration of one-half ground barley, one-half ground oats, linseed oilmeal, corn silage, and alfalfa hay was checked against a ration of ground barley only, linseed oilmeal, corn silage, and alfalfa hay. Two lots of eight head each of high-grade Hereford, mixed steer and heifer calves were fed from November 10, 1925 to June 8, 1926, a period of 210 days. Results are reported in Table VI.

The two lots of calves compare so closely in every respect that in this trial, barley alone can hardly be credited with any important advantages over the ration of barley, one-half, oats, one-half. The one noticeable advantage for the barley-fed calves was the appearance of a slightly higher finish and less fullness of middle than was the case with the lot receiving one-half barley and one-half oats. This resulted in a higher valuation of 15 cents per hundredweight for calves receiving barley alone. The slightly larger feed consumption of the barley-fed calves gave them a higher feed cost, however, resulting in a very small financial advantage favoring the barley- and oat-fed cattle. It would seem from this that there is much more merit in a one-half barley, one-half oats ration than there is in a ration of oats alone, but that the one-

half barley, one-half oats ration had practically no advantage over the barley-alone ration.

TABLE VI
REPLACING FIFTY PER CENT GROUND BARLEY WITH GROUND OATS
November 10, 1925 to June 8, 1926—210 days

Rations	Ground barley, 1/2 Ground oats, 1/2 Linseed Corn silage Alfalfa	Ground barley Linseed Corn silage Alfalfa
Initial weight, lbs.	482.87	*465.71
Final weight, lbs.	897.58	883.09
Average daily gain, lbs.	1.97	1.98
Average daily feed		
Barley, lbs.	5.17	10.40
Oats, lbs.	5.17	....
Linseed meal, lbs.	1.94	1.97
Corn silage, lbs.	9.40	10.32
Alfalfa hay, lbs.	2.45	2.79
Feed per 100 lbs. gain:		
Barley, lbs.	261.77	523.40
Oats, lbs.	261.77	....
Linseed meal, lbs.	98.38	99.46
Corn silage, lbs.	480.60	519.29
Alfalfa hay, lbs.	124.24	140.57
Feed cost per 100 lbs. gain	\$10.46	\$10.56
Initial cost per cwt.	\$ 7.35	\$ 7.35
Initial cost per head	35.66	34.22
Total cost of feeds	43.37	44.07
Final cost per head	78.03	78.29
Selling price per cwt., South St. Paul	\$ 9.50	\$ 9.65
Selling price per cwt., Crookston	8.80	8.95
Value per head, Crookston	78.99	79.03
Margin per calf over feed cost	\$.96	\$.74

Feed prices charged: Barley 45 cents per bushel, oats 32 cents per bushel, linseed meal \$58 per ton, corn silage \$5 per ton, alfalfa hay \$15 per ton. Cost of grinding grain, 8 cents per hundredweight.

* The initial weight for the barley-fed calves is given for seven calves, averaging 465.71 pounds. The average initial weight of this lot on November 10 was 485.62 pounds. One of the original eight calves died on November 21. Its initial weight was deducted and the trial continued with seven calves.

Comparison of Barley Alone with Barley Two-Thirds, Oats One-Third, and with Oats the First Half and Barley the Last Half of the Feeding Period

During the winter of 1928-29, three lots, of eight high-grade Short-horn steer calves each, were fed for a 196-day feeding period as follows: Lot 1 received ground barley, linseed oilmeal, corn silage, and alfalfa hay. Lot 2 received two-thirds ground barley, one-third ground oats, linseed oilmeal, corn silage, and alfalfa hay; while lot 3 received ground oats alone during approximately the first half of the feeding period and ground barley alone during the last half of the feeding period with

linseed oilmeal, corn silage, and alfalfa hay. The results are given in Table VII.

TABLE VII
BARLEY ALONE VS. BARLEY AND OATS FOR FATTENING CALVES
November 27, 1928 to June 11, 1929—196 days

Rations	Barley Linseed meal Corn silage Alfalfa	Barley, 2/3 Oats, 1/3 Linseed meal Corn silage Alfalfa	Oats, first half Barley, second half Linseed meal Corn silage Alfalfa
Initial weight, lbs.	463.12	463.95	467.64
Final weight, lbs.	917.29	920.83	930.20
Total gain, lbs.	454.17	456.88	462.56
Av. daily gain, lbs.	2.31	2.33	2.36
Av. daily feed			
Ground barley, lbs.	12.70	8.59	*14.42
Ground oats, lbs. ....	....	4.29	*11.66
Linseed meal, lbs.	1.41	1.41	1.41
Corn silage, lbs.	6.02	6.05	6.17
Alfalfa hay, lbs.	2.73	2.66	2.66
Feed per 100 lbs. gain			
Ground barley, lbs.	548.14	368.80	306.17
Ground oats, lbs. ....	....	184.40	247.80
Linseed meal, lbs.	61.26	60.90	60.29
Corn silage, lbs.	260.06	259.83	262.37
Alfalfa hay, lbs.	118.10	114.41	112.98
Feed costs per 100 lbs. gain.....	\$9.76	\$9.95	\$10.00
Initial cost per 100 lbs.	\$ 12.25	\$ 12.25	\$ 12.25
Initial cost per head	56.73	56.83	57.28
Total cost of feeds	44.33	45.46	46.25
Final cost per head	101.06	102.29	103.53
Selling price per cwt., South St. Paul	\$ 14.15	\$ 14.00	\$ 13.90
Selling price per cwt., Crookston	13.45	13.30	13.20
Value per head, Crookston	123.37	122.47	122.78
Margin per head over feed cost.....	\$22.31	\$20.18	\$19.25

Feed prices charged: Barley 52 cents per bushel, oats 38 cents per bushel, linseed meal \$60 per ton, corn silage \$5 per ton, alfalfa hay \$15 per ton. Cost of grinding grain, 8 cents per hundredweight.

* For a period of ninety-eight days.

In this trial, results for the three lots were so similar in rate of gain that none of the three rations can be said to have an advantage over the others in so far as rate of gain is concerned. There was a slight difference in finish in favor of the calves fed barley alone, resulting in a small advantage in selling price for this lot over both the others. Again it must be concluded that the substitution of a part of the barley with oats in the ration for fattening the baby beef calf has no definite advantage and with the two grains at approximately the same price per pound, the barley-alone ration is slightly preferable. Substituting a large percentage of the barley with oats would prove most detrimental in a short feeding period of less than 200 days, while it would prove least detrimental in a long feeding period of considerably more than 200 days. If a good quality of feed oats is underselling barley pound for pound

by an appreciable difference, it would be desirable to replace anywhere up to 50 per cent of the barley with oats.

Wheat Screenings for Fattening Baby Beef Calves

During the winter of 1925-26, one lot of eight high-grade Aberdeen Angus mixed steer and heifer calves was fed a ration of one-half ground barley, one-half wheat screenings, linseed oilmeal, corn silage, and alfalfa hay as contrasted to another lot receiving ground barley alone, linseed oilmeal, corn silage, and alfalfa hay. Table VIII shows the results secured with the two lots.

TABLE VIII
REPLACING 50 PER CENT OF GROUND BARLEY WITH WHEAT SCREENINGS
November 10, 1925 to June 8, 1926—210 days

Rations	Barley, 1/2 Wheat screenings, 1/2 Linseed meal Corn silage Alfalfa	Ground barley Linseed Corn silage Alfalfa
Initial weight, lbs.	486.66	*465.71
Final weight, lbs.	882.33	883.09
Average daily gain, lbs.	1.88	1.98
Average daily feed		
Barley, lbs.	5.16	10.40
Wheat screenings, lbs.	5.16	....
Linseed meal, lbs.	1.94	1.97
Corn silage, lbs.	9.30	10.32
Alfalfa hay, lbs.	2.45	2.79
Feed for 100 lbs. gain		
Barley, lbs.	274.18	523.40
Wheat screenings, lbs.	274.18	....
Linseed meal, lbs.	103.37	99.46
Corn silage, lbs.	493.59	519.29
Alfalfa hay, lbs.	130.44	140.57
Feed costs per 100 lbs. gain	\$9.83	\$10.56
Initial cost per cwt.	\$ 7.35	\$ 7.35
Initial cost per head	35.76	34.22
Total cost of feeds	38.89	44.07
Final cost per head	74.65	78.29
Selling price per cwt., South St. Paul	\$ 9.35	\$ 9.65
Selling price per cwt., Crookston	8.65	8.95
Value per head, Crookston	76.32	79.03
Margin per calf over feed cost	\$1.67	\$.74

Feed prices charged: Barley 45 cents per bushel, linseed meal \$58 per ton, wheat screenings \$12 per ton, corn silage \$5 per ton, alfalfa hay \$15 per ton. Cost of grinding grain, 8 cents per hundredweight.

* The initial weight for the barley-fed calves is given for seven calves, averaging 465.71 pounds. The average initial weight of this lot on November 10 was 485.62 pounds. One of the original eight calves died on November 21. Its initial weight was deducted and the trial continued with seven calves.

The wheat screenings gave very satisfactory results in this trial and due to their lower cost per pound resulted in somewhat cheaper gains and a modest advantage in profit for the ration of one-half ground bar-

ley, one-half ground wheat screenings over the ration of ground barley alone. The fact that the cattle receiving the grain ration composed of part wheat screenings made slower gains and showed less finish than the barley-fed cattle would indicate that while the screenings can be used to good advantage in fattening baby beef calves, it might be preferable to retain a good percentage of barley along with the screenings rather than to depend on screenings alone. The availability, quality, and price of the screenings compared to barley needs to be considered to determine to what extent screenings should be used.

Is a Protein Supplement Necessary?

Whether or not to purchase a high protein supplemental feed to add to the ration of home-grown feeds for the fattening of baby beef calves, and which if any of the feeds to use were other questions for north-western cattle producers to settle. Several trials have been conducted in an effort to answer them. Because of its availability and because it is so generally considered one of the most economical of the high protein concentrates, linseed oilmeal was used in most of the trials where home-grown grains were compared. The value and importance of linseed oilmeal was also checked against rations from which it was omitted.

The first trial was conducted from November 10, 1925 to June 8, 1926, a period of 210 days. One lot of eight high-grade Aberdeen Angus mixed steer and heifer calves was fed ground barley, corn silage, alfalfa hay, and 2 pounds of linseed oilmeal per head daily; while a second lot received ground barley, corn silage, and alfalfa hay without the linseed oilmeal.

The second trial extended from November 9, 1926 to June 14, 1927, a period of 217 days. In this trial, one lot of eight high-grade Hereford mixed steer and heifer calves was fed ground barley, corn silage, alfalfa hay and 1½ pounds of linseed oilmeal per head daily; while a second lot was fed ground barley, corn silage, and alfalfa hay without the linseed oilmeal. Results for the two trials are reported and averaged in Table IX.

It will be noticed from Table IX that calves receiving linseed meal in each trial gained more rapidly and were valued at a higher price per pound at the close of the feeding period. In appearance, they were fatter and showed more bloom. Counter-balancing these advantages, however, calves receiving linseed meal in each trial showed a higher feed cost per 100 pounds gain.

The final profit in each trial favored by a small margin the calves fed linseed meal over those not receiving it. In these trials, no digestive disturbances were experienced in any of the lots, however, it is generally found that linseed oilmeal is valuable in eliminating risk of digestive disturbances during the fattening period. It may be inferred from the

results of these two trials that it is advisable to add $1\frac{1}{2}$ to 2 pounds of linseed meal per head per day to a ration of ground barley, corn silage, and alfalfa hay for fattening baby beef calves. The only condition under which it might not pay to feed linseed meal would be when barley was extremely low and linseed oilmeal extremely high in price.

TABLE IX
 ADDING LINSEED MEAL TO A BARLEY, SILAGE, AND ALFALFA RATION
 First trial—November 10, 1925 to June 8, 1926—210 days
 Second trial—November 9, 1926 to June 14, 1927—217 days

Rations	First trial		Second trial		Average of two trials	
	Ground barley Linseed Alfalfa Corn silage	Ground barley Alfalfa Corn silage	Ground barley Linseed Alfalfa Corn silage	Ground barley Alfalfa Corn silage	Linseed	No linseed
Initial weight, lbs.	465.71	479.99	372.49	375.20	419.10	427.59
Final weight, lbs.	883.09	833.45	853.37	789.95	868.23	811.70
Av. daily gain, lbs.	1.98	1.68	2.21	1.91	2.09	1.79
Average daily feed						
Barley, lbs.	10.40	10.52	10.53	10.22	10.47	10.37
Linseed meal, lbs.	1.97	....	1.5	....	1.73	....
Corn silage, lbs.	10.32	10.12	9.55	9.52	10.48	9.82
Alfalfa hay, lbs.	2.79	2.56	2.53	3.22	2.66	2.89
Feed for 100 lbs. gain						
Barley, lbs.	523.40	625.53	475.59	534.80	499.49	580.66
Linseed meal, lbs.	99.46	....	67.61	....	83.53	....
Corn silage, lbs.	519.29	601.55	431.14	498.13	475.22	549.84
Alfalfa hay, lbs.	140.57	152.21	114.32	168.59	127.45	160.45
Feed costs per 100 lbs. gain	\$10.56	\$9.00	\$9.45	\$9.23	\$10.01	\$9.34
Initial cost per cwt.	\$ 7.35	\$ 7.35	\$ 8.50	\$ 8.50	\$ 7.93	\$ 7.93
Initial cost per head	34.22	35.28	31.66	31.89	32.94	33.58
Total cost of feeds	44.07	31.81	45.44	38.28	44.75	35.05
Final cost per head	78.29	67.09	77.10	70.17	77.69	68.63
Selling price per cwt., South						
St. Paul	\$ 9.65	\$ 8.80	\$11.00	\$10.60	\$10.33	\$ 9.70
Selling price per cwt.,						
Crookston	8.95	8.10	10.30	9.90	9.63	9.00
Value per head, Crookston	79.03	67.51	87.89	78.20	83.46	72.86
Margin per head over feed						
cost	\$.74	\$.42	\$10.79	\$8.03	\$5.77	\$4.23

Feed prices charged: (First trial) Barley 45 cents per bushel; linseed meal \$58 per ton, corn silage \$5 per ton, alfalfa hay \$15 per ton. (Second trial) Barley 55 cents per bushel, linseed meal \$47 per ton, corn silage \$5 per ton, alfalfa hay \$17 per ton. Cost of feed grinding, both trials, 8 cents per hundredweight.

Corn Gluten Feed As a High Protein Supplement

During the winter of 1926-27, one lot of eight high-grade Hereford mixed steer and heifer calves was fed corn gluten feed as the protein supplement in contrast with another lot receiving linseed oilmeal, and a third lot receiving no high protein supplement. Since corn gluten feed contains about 22 per cent of protein and linseed oilmeal 34 per cent, enough more corn gluten feed was fed per head per day so that the

calves in each lot would receive the same amount of protein from the respective supplements. On this basis, $2\frac{1}{4}$ pounds of corn gluten feed per head per day was fed against $1\frac{1}{2}$ pounds of linseed oilmeal. Results of the trial are given in Table X.

TABLE X
CORN GLUTEN FEED AS A PROTEIN SUPPLEMENT
November 9, 1926 to June 14, 1927—217 days

Rations	Ground barley Linseed meal Corn silage Alfalfa	Ground barley Gluten feed Corn silage Alfalfa	Ground barley Corn silage Alfalfa
Initial weight, lbs.	372.49	374.37	375.20
Final weight, lbs.	853.37	826.91	789.95
Average daily gain, lbs.	2.21	2.08	1.91
Average daily feed			
Barley, lbs.	10.53	10.06	10.22
Linseed meal, lbs.	1.5	....	....
Gluten feed, lbs. ....	....	2.25	....
Corn silage, lbs.	9.55	9.69	9.52
Alfalfa hay, lbs.	2.53	3.01	3.22
Feed per 100 pounds gain			
Barley, lbs.	475.59	482.49	534.80
Linseed meal, lbs.	67.61	....	....
Gluten feed, lbs. ....	....	107.64	....
Corn silage, lbs.	431.14	465.01	498.13
Alfalfa hay, lbs.	114.32	144.66	168.59
Feed costs per 100 lbs. gain	\$9.45	\$10.72	\$9.23
Initial cost per cwt.	\$ 8.50	\$ 8.50	\$ 8.50
Initial cost per head	31.66	31.82	31.89
Total cost of feeds	45.44	48.51	38.28
Final cost per head	77.10	80.33	70.17
Selling price per cwt., South St. Paul	\$11.00	\$11.00	\$10.60
Selling price per cwt., Crookston	10.30	10.30	9.90
Value per head, Crookston	87.89	85.17	78.20
Margin per head over feed cost.	\$10.79	\$ 4.84	\$ 8.03

Feed prices charged: Barley 55 cents per bushel, linseed meal \$47 per ton, gluten feed \$45 per ton, corn silage \$5 per ton, alfalfa hay \$17 per ton. Cost of grinding grain 8 cents per hundredweight.

The additional protein supplied to the home-grown ration of ground barley, corn silage, and alfalfa hay, by feeding corn gluten feed resulted in a larger daily gain, fatter calves at the finish, and a higher selling price than when no protein supplement was fed. In this respect the corn gluten feed ration was about midway between the linseed ration and the no-protein-supplement ration.

The feeding of corn gluten feed, however, increased the feed cost so much that the increased gains and increased selling price were not sufficient to make up the difference. The gluten feed lot showed a decidedly smaller margin per head over feed cost than the lot receiving linseed meal and even a smaller margin per head over feed cost than the lot receiving the home-grown ration with no protein supplement. Under

the conditions prevailing in this trial, baby beef calves might better be fed the home-grown ration of ground barley, corn silage, and alfalfa hay without a protein supplement than to add a supplement in the form of corn gluten feed.

Gains Made by Steer and Heifer Calves

Inasmuch as all the calves fed in the trials in this report were weighed individually at the beginning of the trial, at the end of each 28-day period, and at the close of the trial, and since in three of the trials, lots composed of mixed steer and heifer calves were used, the record of weights and gains made afford an excellent opportunity to compare the rate of gain of heifer calves with the rate of gain of steer calves. Gains made by the calves of the two sexes by 28-day periods are listed in Table XI.

TABLE XI
AVERAGE DAILY GAIN OF STEERS AND HEIFERS EACH 28-DAY PERIOD
First trial—November 10, 1925 to June 8, 1926—210 days
Second trial—November 9, 1926 to June 14, 1927—217 days
Third trial—November 1, 1927 to June 12, 1928—224 days

Average initial weight	First trial	Second trial	Third trial	Grand averages
Steers, lbs.	481.35	375.94	381.15	412.81
Heifers, lbs.	486.22	371.05	373.59	410.28
First period	Nov. 10-Dec. 7	Nov. 9-Dec. 6	Nov. 1-Nov. 28	
Steers, lbs.	1.80	2.39	1.69	1.96
Heifers, lbs.	1.64	2.12	1.65	1.80
Second period	Dec. 7-Jan. 4	Dec. 6-Jan. 3	Nov. 28-Dec. 27	
Steers, lbs.	1.69	2.20	2.22	2.04
Heifers, lbs.	1.55	1.93	2.00	1.83
Third period	Jan. 4-Feb. 1	Jan. 3-Jan. 31	Dec. 27-Jan. 24	
Steers, lbs.	1.87	1.63	1.10	1.53
Heifers, lbs.	1.44	1.37	1.09	1.30
Fourth period	Feb. 1-Mar. 1	Jan. 31-Feb. 28	Jan. 24-Feb. 21	
Steers, lbs.	2.12	1.89	2.19	2.07
Heifers, lbs.	1.65	1.39	1.39	1.54
Fifth period	Mar. 1-Mar. 29	Feb. 28-Mar. 28	Feb. 21-Mar. 20	
Steers, lbs.	1.93	2.68	2.50	2.37
Heifers, lbs.	1.35	2.69	2.14	2.06
Sixth period	Mar. 29-Apr. 26	Mar. 28-Apr. 25	Mar. 20-Apr. 17	
Steers, lbs.	2.49	2.22	3.45	2.72
Heifers, lbs.	2.46	2.16	3.29	2.64
Seventh period	Apr. 26-May 24	Apr. 25-May 23	Apr. 17-May 15	
Steers, lbs.	2.00	2.75	2.32	2.36
Heifers, lbs.	1.61	2.16	2.00	1.92
Eighth period	May 24-June 8	May 23-June 14	May 15-June 12	
Steers, lbs.	2.11	1.82	2.19	2.04
Heifers, lbs.	1.67	1.66	1.76	1.69

The average initial weight of steer and heifer calves was very nearly the same in each trial. With the exception of one 28-day period (Febru-

ary 28 to March 28) in the second trial, the steer calves made larger average daily gains.

At the close of each of the three trials the heifer calves were fatter than the steer calves. Evidently the steers had a tendency to grow more during the fattening period while gains made by the heifers were more in fat and less in growth. The heifer calves were usually inclined to be more patchy than the steer calves, with a result that they were somewhat over-finished for the highest quality beef carcass.

The combined steer and heifer daily gains during the third 28-day period averaged considerably lower than for any other 28-day period. The third period came during January for the first two trials and the latter part of December, 1927, and January, 1928, for the third trial. Weather conditions is probably the principal cause of low gains made as December and January are the coldest winter months. The third period proved to be the most expensive due to large feed consumption and low average daily gain.

We may conclude from this that steer calves of the same age and quality as heifer calves make continuous larger average daily gains than heifer calves. Due to the fact that heifers finish more rapidly than steers, when large numbers are fed together, the heifers should be marketed when ready which will usually be from one to two months ahead of the steers.

FATTENING TWO-YEAR-OLD STEERS

Can Whole Barley Be Fed to Fattening Cattle?

While it is generally believed that barley must be ground to give satisfactory results in feeding any kind of livestock, there was a possibility that whole barley might be fed to fattening cattle with success similar to that attending the feeding of shelled corn or ear corn, thus effecting a considerable saving in the labor and expense of grinding.

To answer this question, one lot of fattening two-year-old steers was fed a ration of whole barley, linseed meal, corn silage, and alfalfa hay and a second lot received ground barley, linseed meal, corn silage, and alfalfa hay. This trial was conducted during the winter of 1924-25, and was a part of the trial in feeding sweet clover hay to fattening two-year-old steers. In order to give the steers receiving whole barley the advantage of gains made by pigs in salvaging the droppings, one pig to each two steers was placed in each of the lots. Results of this comparison are reported in Table XII.

TABLE XII
WHOLE BARLEY OR GROUND BARLEY FOR FATTENING STEERS
October 15, 1924 to February 3, 1925—112 days

Rations	Whole barley Linseed Corn silage Alfalfa	Ground barley Linseed Corn silage Alfalfa
Initial weight, lbs.	1116.66	1113.38
Final weight, lbs.	1355.27	1458.88
Total gain, lbs.	238.61	345.50
Average daily gain, lbs.	2.13	3.08
Average daily feed		
Ground barley, lbs. ....	....	15.05
Whole barley, lbs.	17.45	....
Linseed meal, lbs.	1.82	1.67
Alfalfa hay, lbs.	8.29	8.67
Corn silage, lbs.	28.38	28.62
Feed per 100 lbs. gain		
Ground barley, lbs. ....	....	488.34
Whole barley, lbs.	765.56	....
Linseed meal, lbs.	85.06	54.25
Corn silage, lbs.	1332.02	927.25
Alfalfa hay, lbs.	389.26	281.33
Feed costs per 100 lbs. gain	\$20.19	\$13.79
Pork credit per steer at \$9.75 per cwt.	5.83	1.17
Selling price per cwt., So. St. Paul market	8.60	8.90
Selling price at Crookston	7.90	8.20
Margin per steer over feed cost	-\$7.82*	\$7.6

Feed prices charged: Barley 72 cents per bushel, linseed meal \$50.50 per ton, tankage (fed to pigs following steers) \$74 per ton, alfalfa hay \$17 per ton, corn silage \$5 per ton. Cost of grinding grain 8 cents per hundredweight.

* Loss.

It can readily be seen by a brief survey of the figures in the above table that whole barley is not nearly so efficient as ground barley for fat-

tening two-year-old steers. One striking feature of the comparison is that the steers on whole barley ate considerably more grain than those receiving ground barley. They ate an average of 17.45 pounds of whole barley per head per day as compared to 15.05 pounds of ground barley or 2.40 pounds per head per day more. One's first thought would be that because of its hardness and lack of palatability, cattle would not eat whole barley readily. As it worked out, they were able to eat it in large amounts but failed to digest it thoroly. Most barley grains were swallowed whole and a very high percentage passed through the system without being fully acted upon by the digestive juices. Cattle on ground barley gained an average of 3.08 pounds per head per day while those on whole barley gained 2.13 pounds, a difference of nearly a pound per head per day in favor of the ground barley. Cattle on ground barley showed considerably more finish at the end of 112 days and were valued 30 cents per hundredweight higher. Altho the pigs following the cattle on whole barley returned \$5.83 worth of pork per steer from the feed wasted by the steers, they were not able to bring the total returns up to the level of the ground-barley-fed lot. On checking the returns per steer over feed cost including pork credit, it is found that cattle on whole barley showed a loss of \$7.82 per head, while the lot on ground barley showed a profit of 76 cents per head. This is a difference of \$8.58 per head in favor of the ground barley even after the cost of grinding had been deducted. Evidently it pays better to grind barley for fattening cattle than to feed it whole.

Wheat Screenings for Fattening Two-Year-Old Steers

When barley is high in price, can a cheaper feed such as good wheat screenings be profitably used for part of the grain ration?

One trial in the use of wheat screenings to replace one half of the barley in fattening baby beef calves has already been reported. In that trial the use of the wheat screenings proved quite satisfactory. In this trial, one lot of six two-year-old steers was fed a ration of 45 per cent ground wheat screenings, 45 per cent ground barley, and 10 per cent linseed oilmeal, together with alfalfa hay and corn silage. Another lot of similar steers was fed 90 per cent ground barley and 10 per cent linseed oilmeal plus alfalfa hay and corn silage. The results are given in Table XIII.

Rate of gain, average daily amounts of each feed consumed, and feed requirements for 100 pounds gain is noticeably similar for both lots of steers. Replacing one half of the ground barley with ground wheat screenings reduced the cost of feed for 100 pounds gain. The ground barley, on the other hand, produced a more satisfactory market finish and a higher selling price.

Pigs following the steers, fed ground wheat screenings, were able to make larger gains from wasted feed gathered in the droppings or thrown out of the feed bunk by the steers. The value of the pork credit per steer receiving ground barley was only \$1.17, as compared to \$4.36 per steer for the other lot.

TABLE XIII
WHEAT SCREENINGS AND BARLEY VS. BARLEY FOR FATTENING STEERS
October 15, 1924 to February 3, 1925—112 Days

Rations	Wheat screenings, 45%		Barley, 90% Linseed meal, 10%
	Barley, 45% Linseed meal, 10%	Alfalfa hay Corn silage	
Initial weight, lbs.	1115.41	1113.38	
Final weight, lbs.	1466.10	1458.88	
Total gain, lbs.	350.69	345.50	
Average daily gain, lbs.	3.13	3.08	
Average daily feed			
Ground wheat screenings, lbs.	7.53	....
Ground barley, lbs.	7.53	15.05	
Linseed meal, lbs.	1.68	1.67	
Alfalfa hay, lbs.	8.56	8.67	
Corn silage, lbs.	28.23	28.62	
Feed per 100 lbs. gain			
Ground wheat screenings, lbs.	240.70	....
Ground barley, lbs.	240.70	488.34	
Linseed meal, lbs.	53.49	54.25	
Alfalfa hay, lbs.	273.55	281.33	
Corn silage, lbs.	901.93	927.83	
Feed costs per 100 lbs. gain	\$11.36	\$13.79	
Crediting hog gains at \$9.75 per cwt.	10.12	13.46	
Selling price per cwt., South St. Paul market	8.75	8.90	
Selling price at Crookston	8.05	8.20	
Margin per steer over feed cost	\$10.03	\$7.6	

Feed prices charged: Barley 72 cents per bushel, wheat screenings \$12 per ton, linseed meal \$50.50 per ton, tankage (fed to pigs following steers) \$74 per ton, alfalfa hay \$17 per ton; corn silage \$5 per ton. Cost of grinding grain 8 cents per hundredweight.

In this trial with two-year-old steers the use of the wheat screenings so cheapened the cost of gains that the advantage in finish and selling price for the barley-fed cattle was unable to overcome the advantage of lower cost secured with the screenings. The economic advantage in this trial in replacing one-half the barley with screenings again favored the use of screenings just as was the case with the baby beef calves. It may be concluded from these two trials that with high priced barley, wheat screenings may be used to replace part of the barley to advantage.

Sweet Clover Hay in the Fattening Ration

During the winter of 1924-25, sweet clover hay was given a trial as the dry roughage in the ration for fattening two-year-old steers. The same steers used in the yearling wintering trial the previous winter

were used in this fattening trial. They had been carried through the summer on pasture only, most of them having been pastured on sweet clover. They went into the fattening trial as heavy fleshy two-year-old steers and were given a short feeding period of 112 days. The sweet clover hay was again contrasted with alfalfa—corn silage being fed to both lots together with a grain ration of 90 per cent ground barley and 10 per cent linseed oilmeal. Each lot contained six steers. All feeds were hand-full-fed to both lots. Table XIV gives the results of this trial.

TABLE XIV
ALFALFA AND SWEET CLOVER HAYS FOR FATTENING TWO-YEAR-OLD STEERS
October 15, 1924 to February 3, 1925—112 days

Rations	Ground barley, 90% Linseed, 10% Alfalfa hay Corn silage	Ground barley, 90% Linseed, 10% Sweet clover hay Corn silage
Initial weight, lbs.	1113.38	1115.62
Final weight, lbs.	1458.88	1432.11
Total gain, lbs.	345.50	316.49
Average daily gain, lbs.	3.08	2.86
Average daily feed		
Ground barley, lbs.	15.05	15.65
Linseed meal, lbs.	1.67	1.73
Alfalfa hay, lbs.	8.67	....
Sweet clover hay, lbs. ....	....	7.78
Corn silage, lbs.	28.62	29.18
Feed per 100 lbs. gain		
Ground barley, lbs.	488.34	543.52
Linseed meal, lbs.	54.25	61.50
Alfalfa hay, lbs.	281.33	....
Sweet clover hay, lbs. ....	....	275.99
Corn silage, lbs.	927.83	1032.79
Feed costs per 100 lbs. gain	\$13.70	\$13.95
Crediting hog gains at \$9.75 per cwt.	13.46	13.53
Selling price per cwt., South St. Paul market	8.90	8.90
Selling price at Crookston	8.20	8.20
Margin per steer over feed cost	\$7.76	\$2.10

Feed prices charged: Barley 72 cents per bushel, linseed meal \$50.50 per ton, tankage (fed to pigs following steers) \$74 per ton, alfalfa hay \$17 per ton, sweet clover hay \$9 per ton, corn silage \$5 per ton. Cost of grinding grain 8 cents per hundredweight.

Again it is seen that in the fattening ration for two-year-old cattle, just as in the wintering ration for yearlings, sweet clover hay gave just about as good an account of itself as alfalfa hay. The cattle receiving alfalfa made slightly larger daily gains and ate a little more hay than did the cattle receiving sweet clover, showing again a slight preference for alfalfa or, in other words, demonstrating the fact that cattle do not relish sweet clover hay quite as much as alfalfa. In spite of this fact, sweet clover hay can almost hold its own against alfalfa for beef cattle.

SUMMARY

1. Good quality legume roughages common to northwestern Minnesota are quite satisfactory for wintering stocker cattle. Table I.

2. Sweet clover hay of good quality proved to be almost equal to alfalfa hay in rations for wintering cattle. Table I.

3. The cost of wintering stocker cattle was materially reduced by the addition of corn silage to a ration of sweet clover hay and oat straw when the silage was charged at \$4.25 per ton compared to \$8 per ton for sweet clover hay as in the first trial, or corn silage at \$5 per ton, and sweet clover hay at \$8.50 per ton in the second trial. Table II.

4. Stocker cattle wintered on sweet clover hay made considerably larger average daily gains than cattle receiving wild hay. Table III.

5. Ground shelled corn produced slightly higher average daily gains and a somewhat higher degree of finish than ground barley in rations for fattening baby beefs. However, with barley at 55 cents per bushel and corn at 75 cents, the barley-fed calves returned a larger margin of profit. Table IV.

6. Ground barley alone proved to be a more satisfactory grain in fattening baby beef calves than ground oats. Table V.

7. Replacing one-half the barley ration with an equal weight of oats did not improve the ration. Table VI.

8. When feed oats is underselling barley, pound for pound, by an appreciable difference, it would be desirable to replace part of the barley with oats. Table VII.

9. Baby beef calves receiving a grain ration of one-half wheat screenings and one-half barley showed less finish than a similar lot fed barley alone, but returned a slightly larger profit, when barley was charged at 45 cents per bushel and wheat screenings at \$12 per ton. Table VIII.

10. Profits in fattening baby beef calves were increased by the addition of linseed oilmeal to a ration of ground barley, corn silage, and alfalfa hay. Table IX.

11. Linseed oilmeal proved to be a more satisfactory protein supplement than corn gluten feed. Table X.

12. Steer calves made greater average daily gains than heifer calves. Table XI.

13. Two-year-old steers on a fattening ration of whole barley, linseed oilmeal, corn silage, and alfalfa hay consumed more grain per head daily but made slower gains at a higher cost per pound than steers fed ground barley. Table XII.

14. From the standpoint of rate of gain, and feed requirement per 100 pounds gain, a ration of one-half ground barley and one-half wheat screenings proved to be just as satisfactory as barley alone, when fed

with linseed oilmeal, alfalfa hay, and corn silage to fattening two-year-old steers. With barley charged at 72 cents per bushel and wheat screenings at \$12 per ton, the cattle receiving one-half wheat screenings returned the greater profit. Table XIII.

15. Heavy cattle can be successfully finished on barley as the only grain when fed with a protein supplement in a ration of sweet clover or alfalfa hay. Table XIV.

16. Sweet clover hay can be substituted for alfalfa hay with fairly satisfactory results in rations for fattening two-year-old steers. Table XIV.

17. Alfalfa hay is somewhat more palatable than sweet clover, as cattle under similar conditions consumed a larger amount of alfalfa hay and produced slightly larger gains. Tables I and XIV.