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COLORADO FATTENING RATIONS FOR CATTLE

By H. B. Osland, E. J. Maynard and George E. Morton

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COLORADO FATTENING RATIONS FOR CATTLE

By H. B. OSLAND, E. J. MAYNARD and GEORGE E. MORTON*

Colorado farmers and stockmen fatten for market annually between 75,000 and 150,000 cattle. Approximately 75 percent of these cattle are fed largely on sugar-beet by-product rations.

Alfalfa hay, sugar-beet tops, and wet beet pulp constitute the basic feeds that have regulated to a great extent the cattle-feeding operations in the beet-growing areas of the state. These sugar-beet by-products, along with a limited amount of corn silage, beet molasses, dried molasses beet pulp, and grain, have offered exceptional opportunities for Colorado stockmen to produce low-priced beef of excellent quality in successful competition with cornbelt feeders.

Table 1.—ESTIMATED NUMBERS OF CATTLE FATTENED IN COLORADO

	(Last 000 omitted)								
	1926	1927	1928	1929	1930	1931	1932	1933	1934
Northern Colorado	100	130	120	120	105	125	79	65	72
Arkansas Valley	12	12	12	13	14	9	6	5	5
Western Slope	4	4	4	3	3	3	2	3	3
Other sections	4	4	4	4	3	5	3	2	3
Total	120	150	140	140	125	142	90	75	83

Sugar-beet By-product Beef.—Beef produced on grain and alfalfa hay, supplemented with sugar-beet by-products, is of a darker color than beef produced from dry rations and does not have the same firm consistency; but many careful tests have indicated the exceptional flavor and tenderness of this beet by-product beef.

Cattle fattened in Colorado on sugar-beet by-products, grain, silage, and alfalfa are in keen demand at all the principal livestock markets of the nation. From February until the following September, they "top" the local and river markets and go in ever-increasing numbers to Ogden, Salt Lake City, and the West Coast.

Scope of the Experiments.—With a larger variety of feeds existing in Colorado than is customarily found in other cattle fattening areas, the possibility for a greater number of fattening combinations derived from home-grown feeds and some standard commercial concentrates has added interest to studies of different fattening rations. Then too, the need for developing standard fattening

*With collaboration of T. E. Leiper in 1918 and Charles I. Bray in 1918-19.

Fig. 1. A typical feed yard near a sugar factory where wet beet pulp is available.

rations for cattle of different ages and sex has been recognized. Wet cows, for instance, must have a much cheaper and bulkier ration than high-grade steers.

It is the object of this bulletin to deal principally with a study of the relative efficiency of different feeds and fattening rations for the different classes of cattle commonly fed in Colorado and to discuss economic phases of the cattle-feeding industry only insofar as they may be influenced by these factors. It covers 20 years of ration experiments. Its method is to present information classified according to feedstuffs and rations, rather than according to series completed.

Reason for the Experiments.—The fattening of livestock is a sound practice on the average irrigated farm, because it tends to develop a good market for home-grown feeds, because it affords labor during the winter, and because the manure produced is directly responsible for increased acre yields of crops.

Periodic fluctuations in livestock and feed prices make it necessary for livestock feeders to figure their net returns over long periods, while cutting production costs at every possible corner. Cattle feeding affords a real opportunity for concentrating grain, hay, other roughage, and beet by-products into marketable meat products, and at the same time securing a fertilizer which will improve the tilth of our soils as well as furnish fertilizing constituents.

The number and kind of livestock to feed is a problem for each individual feeder to determine for himself. The advisability of staying with one class when prices are in line has been demonstrated. When this point has been decided, a knowledge of the most efficient fattening ration may be directly responsible for saving many hundreds of dollars in any year, thereby increasing profits in good years and reducing losses during adverse periods.

Development of Cattle Feeding Industry in Colorado. — The establishment of the sugar-beet industry in Colorado and the enormous quantities of tops and wet beet pulp produced were responsible for the problem of logical use of these by-products. In early days, the tops were plowed under, and the beet pulp was dumped into the river. Cooke,* in a summary of cattle feeding in Colorado published in 1896, indicates that native hay or alfalfa hay alone, or alfalfa hay with a little grain and silage, were the principal fattening feeds in the state at that time. In those days alfalfa hay was abundant and very low in price. Cooke presents a few figures on methods of feeding.

"Steers were usually bought in the fall with a 3-percent shrink and sold in the spring with a 4-percent shrink. In the fall of 1895, cattle off the range of good quality sold for about $2.85 per cwt."

A good steer on hay alone could be expected to gain a pound a day in liveweight. At the end of 100 days' feeding, a 1,000-pound

*Colorado Experiment Station Bulletin 34.

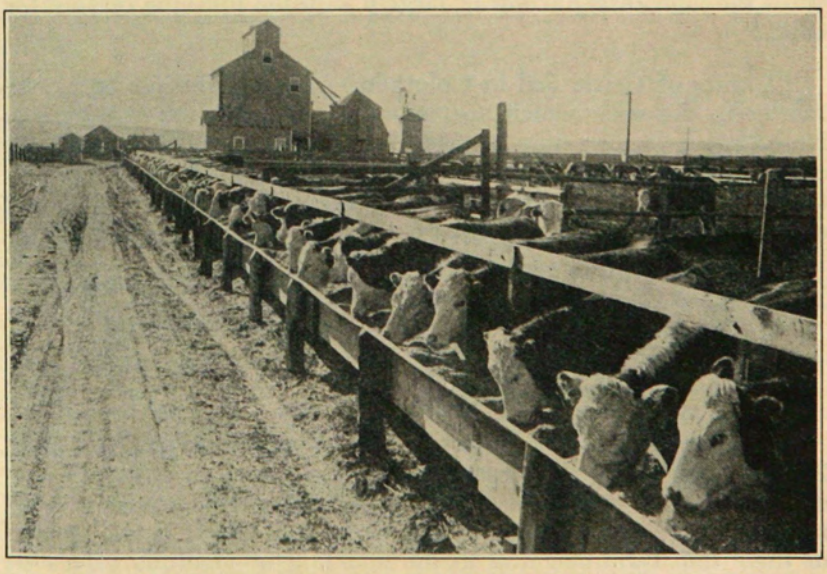


Fig. 2. Cut mixtures are fed in these troughs to 2,000 head of cattle.

steer would weigh 1,100 pounds, but would sell with a 4-percent shrink, or at 1,056 pounds. The steer would eat and waste in that time about 2 tons of alfalfa. With a half-cent spread, it would return $3.86 per ton for the hay fed. Each 10-cent increase or decrease in the selling price made a difference of 50 cents per ton in the amount realized for the hay.

When steers were grain fed to make beef, they were fed the first 60 days on hay and the next 90 on hay and grain. The grain feeding in connection with alfalfa seldom went higher than 8 pounds of grain per head daily, and this maximum amount was reached by the middle of the grain-feeding period. This required 600 pounds of grain per steer. The grain took the place of some hay, so that in the whole 5 months the steer ate and wasted about 3 tons of alfalfa. The gain averaged about 1½ pounds daily for the period when grain was fed.

After sugar factories were established in 1899 to 1905, and when it was discovered by enterprising cattle feeders that wet beet pulp was greatly relished by their cattle and was also a valuable fattening feed, pulp feeding quickly became a general practice around the factories, while pasturing of tops in the field after the beets were harvested also became a regular practice. The development of the cattle-feeding industry in the irrigated sections of the state unquestionably has been influenced by its relationship to the sugar-beet industry and the use of beet by-products. Early feeding experiments furnish data regarding the fattening of mature cattle, while the later tests have dealt largely with the finishing of younger beef.

Classes of Cattle Fed in Colorado. — Unlike sheep-feeding activities in the state which are confined closely to the fattening of lambs, cattle feeding may be classified according to the age and sex of the cattle fattened. The character of feeds used, length of fattening period, and margin needed to break even will vary with the class of cattle fed. The principal classes include:

1. Wet cows and aged bulls.
2. Aged steers.
3. Yearling steers.
4. Yearling heifers.
5. Steer and heifer calves.

Feeding Wet Cows, Using a Beet Top, Pasturage, and Pulp Ration. —Wet cows are range cows that have recently weaned calves and that usually, on account of age or conformation, have been culled from the breeding herd in the fall. These cows, because of their thin condition due to the suckling of vigorous calves on scanty feed, will generally respond well to a ration composed largely

Table 2.—STATEMENT ON 32 GOOD GRADE RANGE COWS FED NOV. 6 TO FEB. 2 —88 DAYS*

Number	Weight	Price	Amount
31 cows	29,580	$5.60	$1,656.48
1 cow	1,030	4.60	47.38
Total	30,610	$5.57 Av. cost cwt.	$1,703.86
Freight to feedlot 30,100 pounds at 11.5c (40-ft. car)			$34.62
Bedding			1.00
Commission (purchase of cattle)			15.00
Total cost cattle laid in feedlot			$1,754.48 (Per cwt. $5.73)
Feed costs in fattening cows:			
46 acres beet tops at $3			$138.00
52 acres alfalfa stubble at $1			52.00
37 tons wet beet pulp at 90c			33.30
Labor bedding, water pumping, etc.			10.00
			$233.30

Acct. sales	Number	Weight	Price	
Feb. 2	24	26,625 @	$6.25	1,664.06
	1	925 @	5.25 (bad eye)	48.56
	5	5,520 @	5.50	303.60
	1	1,080 @	5.00 (lame)	54.00
	1	1,135 @	5.00	56.75
	32	35,285	$6.03 cwt.	$2,126.97
Marketing costs:				
Freight and drayage				$55.10
Bedding				1.00
Yardage				11.55
Hay				11.20
Brand inspection				1.60
Insurance				.25
Stockman's Association				.96
Commission (sale of cattle)				24.25
				$105.91
Recapitulation:				
Cost of cattle laid in feedlot				$1,754.48
Interest at 7 percent, 88 days on feed				30.00
Feed cost				233.30
Shipping and selling expense				105.91
Total cost				$2,123.69

Weight and gain:	
Average initial weight	956.6
Average final weight	1,102.6
Average gain 88 days	146.0
Average daily gain per cow	1.66
Spread needed per cwt. to break even over purchase price	$ .48

*Record kept by E. J. Maynard on privately-owned cattle.

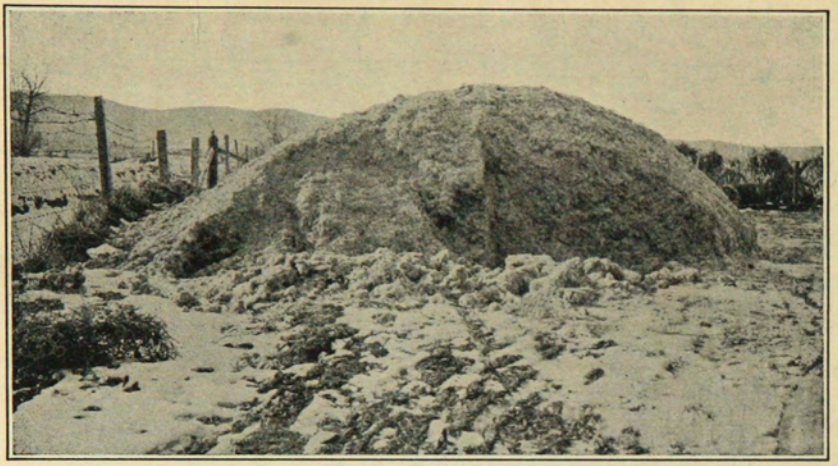


Fig. 3. This method of storing wet beet pulp results in much loss.

of pastured beet tops, alfalfa stubble, wet pulp, and straw. On account of their relatively low value per hundredweight, only cheap roughages can be used successfully in fattening them efficiently. One to 1½ acres of beet tops and 1 ton of wet beet pulp, with about 2 acres of alfalfa stubble, will usually furnish enough feed to finish a cow of this class for market. She may be expected to gain from 1 to 1½ pounds per head daily, the gain being affected by weather conditions, shelter, and feed supply.

A typical wet cow-fattening record is included. (Table 2.) It will serve to indicate not only feed requirements and gains but also accompanying costs that must be reckoned with.

In this fattening operation, 32 wet cows averaging 957 pounds in weight gained 146 pounds in an 88-day fattening period, during which time they pastured 46 acres of beet tops and 52 acres of alfalfa stubble. During the last 30 days of the fattening period, adverse weather conditions prevailed, and the tops were hauled and fed with wet beet pulp in drylot. The cows consumed 37 tons of wet beet pulp during the period. They had no alfalfa hay in drylot but consumed a small amount of straw used for bedding.

Early Colorado Feeding Experiments.—Table 3 summarizes the results of early feeding tests by Carlyle, Griffith, and Meyer*. These early tests indicated the advantage of wet pulp and alfalfa over alfalfa alone and also the advantage of a pulp and alfalfa ration over a grain and alfalfa ration. A benefit derived from the use of grain, although not evident at prices then used, is indicated with the present feed price relationship.

*Bulletins 97 and 102, Colorado Experiment Station.

Table 3.—SUMMARY OF EARLY FEEDING TESTS WITH SUGAR-BEET PULP AT COLORADO AGRICULTURAL COLLEGE*

Fattening 3-year-old steers—Heavy wet pulp rations

Lot number	1	2	3	4	5
Ration fed	Alfalfa	Wet pulp Alfalfa	Wet pulp Corn Alfalfa	Wet pulp Barley ⅔ Oats ⅓ Alfalfa	Corn Alfalfa
Number of tests	1	2	2	1	1
Average initial weight	968.0	923.3	925.1	917.6	968.0
Average daily gain (selling weights)	.94	1.24	1.94	1.69	1.20
Percent shrink to market	4.75	5.19	3.60	2.86	4.90
Average daily feed:					
Ground corn	.....	.....	6.5	.....	6.6
Ground barley and oats	.....	.....	.....	6.4	.....
Wet beet pulp	.....	110.2	96.2	95.9	.....
Alfalfa hay	41.5	17.2	15.8	10.6	31.4
Feed required per cwt. gain:					
Ground corn	.....	.....	337.3	.....	550.0
Ground barley and oats	.....	.....	.....	381.0	.....
Wet beet pulp	.....	8887.8	4984.0	5674.5	.....
Alfalfa hay	4414.9	1454.2	817.9	627.1	2616.7
Feed cost per cwt. gain:					
Alfalfa hay $5, pulp .50, grain $17	$11.04	$5.86	$6.16	$6.22	$11.22
Alfalfa hay $10, pulp $2, grain $20	$22.07	$16.16	$12.45	$12.62	$18.58

*Bulletins 97 and 102, Colorado Experiment Station.

In these tests, comparing lots 1 and 2, each ton of wet pulp saved or replaced 666 pounds of alfalfa. Even with alfalfa hay priced as low as $5 per ton, wet beet pulp showed a feed replacement value of $1.67 per ton delivered to the cattle. Wet beet pulp-alfalfa rations proved cheaper than grain-alfalfa rations in those early days, but now with the increased demand and market value of both pulp and alfalfa, the addition of home-grown or even shipped-in grain fed in limited quantities with the wet beet pulp-alfalfa ration is easily justified by the saving in pulp and alfalfa effected.

Thus it is seen that each ton of ground corn fed with wet pulp and alfalfa (lots 2 and 3) replaced or equalled 11.6 tons of wet beet pulp and 1.9 tons of alfalfa hay. In other words, with wet beet pulp costing $2 per ton and alfalfa hay at $8 per ton, ground corn would have a feed replacement value equal to $38.40 per ton when added to the ration.

With the present range of feeds and prices, gains produced on steers with alfalfa hay alone, or with wet beet pulp and alfalfa, would be very costly and impracticable. The ration problem which confronts the feeder of today is to utilize as much as possible home-grown feeds, with only a minimum amount of commercial supplements, and yet produce the greatest and cheapest gains possible on his cattle.

Fig. 4. This scheme simplifies unloading wet pulp from beet rack or truck.

I. Grain Concentrates

Grain concentrates are usually fed at the rate of 1 pound per head per day when the steers first come into the feedlot. This is increased as rapidly as possible until the steers reach a full feed. The rate of increase depends largely on the cattle themselves. A good rule to follow is to increase just fast enough to keep the steers slightly hungry, so that they are eager to come to the feed bunks at the next feeding time. At the same time the feeder should watch the droppings and prevent looseness by holding the grain back until the animal's system becomes used to it.

If the steers are thrown "off feed," either while taking them up to full feed or after they have been on full feed for some time, the quickest and surest way to get them "straightened out" is to cut the grain ration in half, giving them for a day or so the reduced amount of grain and then gradually increasing it again. In extremely bad cases, it may be necessary to withhold the grain entirely for a couple of feeds. Then start again with half the original grain ration and gradually work back.

Some middle-western feeders start their cattle on a full feed of grain, disregarding scours. They claim that after a few days of scouring the cattle come back to normal and in that way are on a full feed from the start. The practice seems rather questionable.

Corn.— Corn is generally considered the standard fattening grain for cattle and therefore will be taken as the basic grain for comparison with other carbohydrate concentrates in this discussion.

All the corn used in these tests was ground to a medium degree

of fineness. It was noticed that finely ground corn was not relished as well by the steers. Shelled corn is used quite extensively for fattening cattle, especially throughout the Corn Belt States. It is necessary, however, to have pigs following the cattle when this method of feeding is practiced, because a large percentage of the grain passes through a steer's system without being utilized at all. One pig allowed to follow two steers fed on shelled corn, and given tankage in addition, will make very satisfactory gains and convert into pork that which would otherwise be wasted.

Corn vs. Barley.—In many sections of Colorado, corn is grown primarily as a forage or silage crop; hence, much of the corn fed has to be shipped in from Eastern Colorado and Western Nebraska. Barley fits well into our system of cropping and produces very satisfactory yields. It, therefore, should be included in Colorado fattening rations. Because of the hardness of the grain, barley must be ground finely for cattle to insure complete digestion. Its comparative feeding value with corn is shown in tables 4 and 5. Fed to 3-year-old steers along with alfalfa hay, each ton of barley replaced 2,334.34 pounds of corn and 842.36 pounds of alfalfa. In this particular 1-year comparison, the barley-fed steers outgained the corn-feds and produced unit gain for considerably less. This result indicates a much greater value for barley than for corn. In this connection, the kind of barley and the age of the steers must be considered.

The barley fed in this experiment was two-row brewing barley, which has a much plumper kernel than the four-row or six-row

Fig. 5. Storage of wet pulp in a trench silo is cheap and very satisfactory.

barleys now commonly used as feed barleys. Our experience indicates that 3-year-old steers do better on barley, stay on feed better, and have less trouble with digestive disturbances when fed barley than do younger steers, particularly calves. This fact should be taken into consideration along with the superior feeding value of the two-row barley.

Another comparison of results between corn and barley when fed to 3-year-old steers (table 4) in a ration composed of cottonseed cake, sunflower silage, and alfalfa, shows a greater rate of gain for

Table 4.— BARLEY vs. CORN

	3-year-olds 1-year data 1914–15		3-year-olds 1-year data 1921–22		2-year-olds 2-year average 1916–17 1918	
Ration fed	Ground barley Alfalfa	Ground corn Alfalfa	Ground barley Cottonseed cake Sunflower silage Alfalfa	Ground corn Cottonseed cake Sunflower silage Alfalfa	Ground barley Alfalfa	Ground corn Alfalfa
Number steers per lot	10	10	10	10	9	9.5
Number days in period	70	70	140	140	133	133
Feedlot weight at start	1055.2	1057.3	1051.7	1054.5	835.5	804.2
Final feedlot weight	1243.5	1219.0	1267.7	1319.7	1078.9	1067.8
Gain	188.3	161.7	216.0	265.2	243.4	263.6
Daily gain	2.69	2.31	1.54	1.89	1.83	1.98
Daily ration fed:						
Ground barley	12.42	.....	10.40	.....	10.80	.....
Ground corn	.....	12.45	.....	10.26	.....	10.21
Cottonseed cake	.....	.....	2.36	2.34	.....	.....
Sunflower silage	.....	.....	24.50	24.32	.....	.....
Alfalfa	22.44	23.76	9.75	12.08	16.26	17.33
Maximum daily feed:						
Ground barley	15.00	.....	14.00	.....	12.90	.....
Ground corn	.....	15.00	.....	14.00	.....	12.00
Cottonseed cake	.....	.....	3.00	3.00	.....	.....
Sunflower silage	.....	.....	30.00	30.00	.....	.....
Feed required per cwt. gain at feedlot:						
Ground barley	461.8	.....	674.2	.....	590.2	.....
Ground corn	.....	539.0	.....	541.6	.....	516.0
Cottonseed cake	.....	.....	153.0	123.7	.....	.....
Sunflower silage	.....	.....	1588.4	1284.1	.....	.....
Alfalfa	834.3	1028.8	631.8	637.5	889.6	876.9
Feed cost per cwt. gain at feedlot	$7.50	$9.51	$13.90	$12.26	$8.87	$8.67
Selling price per cwt.	$7.20	$7.20	$8.25	$8.25	$14.11	$13.99
Dressing percentage (warm)	.....	.....	62.4	61.5	59.9	60 4
Carcass grade (rank)	.....	.....	4	5	.....	.....

the steers fed corn. Each ton of barley fed replaced 1,606.65 pounds of corn and 16.91 pounds of alfalfa hay, but required 86.92 pounds more cottonseed cake and 902.70 pounds more sunflower silage; or with feed prices used was worth only $13.74 per ton.

A 2-year average when barley was fed along with alfalfa to 2-year-old steers (table 4) again shows a somewhat slower rate of gain for steers fed barley. The feed replacement value for each ton of barley was 1,748.56 pounds of corn minus 43.04 pounds of alfalfa, or, in other words, barley showed 86.60 percent the feeding value of corn.

Table 5.—CORN vs. BARLEY—CALVES

	1-year data 1924–25		2-year average 1925–26	1926–27
Ration fed	Barley Corn silage Linseed-oil cake Alfalfa	Corn Corn silage Linseed-oil cake Alfalfa	Barley Dried pulp Corn silage Linseed-oil cake Alfalfa	Corn Dried pulp Corn silage Linseed-oil cake Alfalfa
Number calves per lot	10	10	10	10
Number days in period	208	208	195	195
Feedlot weight at start	347.8	348.5	351.3	350.1
Final feedlot weight	785.0	781.5	744.7	754.8
Gain	437.2	433.0	393.4	404.8
Daily gain	2.10	2.08	2.02	2.08
Daily ration fed:				
Ground barley	6.88	.....	3.56	.....
Ground corn	.....	6.83	.....	3.56
Dried beet pulp	.....	.....	3.38	3.39
Corn silage	9.16	9.15	9.78	9.78
Linseed-oil cake	1.03	1.04	.99	.99
Alfalfa	4.90	5.67	4.28	4.46
Maximum daily feed:				
Ground barley	9.4	.....	5.3	.....
Ground corn	.....	9.4	.....	5.3
Dried beet pulp	.....	.....	5.3	5.3
Corn silage	12.0	12.0	13.0	13.0
Linseed-oil cake	1.5	1.5	1.5	1.5
Feed required per cwt. gain at feedlot:				
Ground barley	331.5	.....	176.7	.....
Ground corn	.....	332.3	.....	171.7
Dried beet pulp	.....	.....	167.7	163.3
Corn silage	437.5	441.1	485.6	470.3
Linseed-oil cake	49.2	49.8	48.8	47.9
Alfalfa	233.1	272.4	212.6	215.0
Feed cost per cwt. gain at feedlot	$5.87	$6.40	$5.68	$5.74
Selling price per cwt.	$10.81	$10.64	$9.88	$9.79
Dressing percentage (cold)	59.7	59.9	63.6	62.6
Carcass grade	92	91	94	92

It should be noticed that selling price, dressing percentage, and carcass grade indicate beef of just as high quality from barley as from corn.

Table 5 gives comparative results of corn and barley when fed to calves. Using No. 3 mixed Nebraska corn in 1924-25 and comparing it with a good grade of California feed barley, barley showed 105.60 percent the feeding value of corn. The rate of gain was approximately the same in the two lots, but the feed cost was 53 cents greater per each 100 pounds gain in the lot fed corn.

Each ton of barley fed replaced 2,004.83 pounds of corn, 21.72 pounds of silage, 3.62 pounds of linseed oil cake, and 237.10 pounds of alfalfa.

Dressing percentage and carcass grade again indicated that there was little difference in quality of beef between the two lots.

A 2-year average when barley and corn were fed along with dried beet pulp, linseed oil cake, corn silage, and alfalfa (table 5) shows slightly greater gains from corn and also a somewhat smaller amount of feed required per unit of gain, making feed costs per hundredweight gain almost the same in both lots.

Each ton of barley fed replaced 1,943.41 pounds of corn and 27.16 pounds of alfalfa, but required 49.80 pounds more dried beet pulp, 173.17 pounds more corn silage, and 10.19 pounds more linseed oil cake.

Dressing percentage and carcass grade were slightly higher with the barley-fed steers.

Several years' work has shown that barley, when fed alone in a grain, cottonseed cake, and hay ration, is not a safe feed for

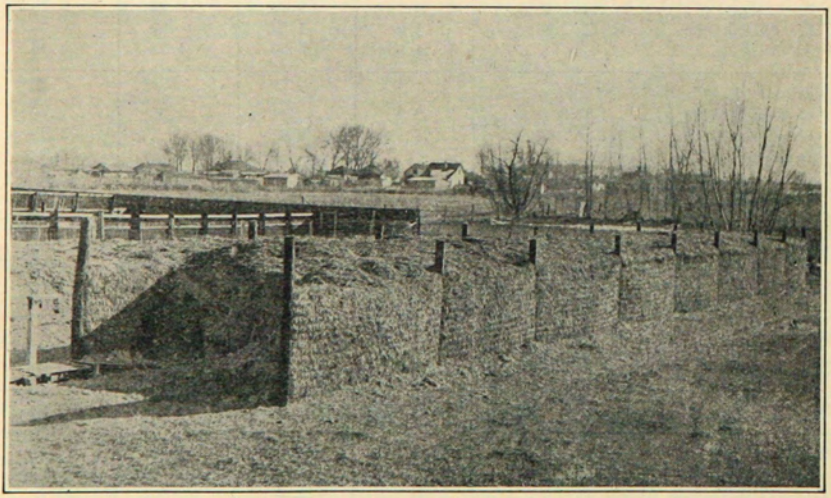


Fig. 6. Wet pulp stored in a straw silo can be held for a long time with minimum loss.

Fig. 7. A beet top trench silo.

calves because of its tendency to cause bloat, even though it is fed at the rate of only 1 percent of their live weight or less. The addition of cheap, bulky carbonaceous feeds such as wet beet pulp, silage, or potatoes has proved effective in checking digestive troubles but has failed to prevent bloats entirely. Wet, cold weather seemed to increase bloating. Labor required for constant treatment of affected individuals and occasional death losses all mark barley as undesirable and unsafe as the sole grain for calves. With older cattle, barley bloats occur much less frequently, and these objections to barley do not apply to such cattle. Barley has good fattening qualities and can well be utilized in the fattening ration. Barley mixed with corn has been proved in these experiments to be a good safe fattening feed for calves.

Table 6.—SHOWING DIGESTIVE TROUBLE WITH BARLEY-FED CALVES

(2-year average—10 steers per lot)

Ration	Pulp Barley Cottonseed cake Alfalfa	Pulp Potatoes Barley Cottonseed cake Alfalfa	Potatoes Barley Cottonseed cake Alfalfa	Potato-cornfodder silage Barley Cottonseed cake Alfalfa	Corn silage Barley Cottonseed cake Alfalfa	Barley Cottonseed cake Alfalfa
Number bloats	2	5	3	2	3	16
Number deaths	0	0	0	0	0	1.5

Corn and Barley vs. Barley.—A comparison of corn and barley, made when a carbohydrate concentrate makes up only a relatively small proportion of the total ration, cannot be expected to show such clearly defined differences as are brought out when grain and hay alone are fed. In a standard beet by-product ration composed of grain, cake, wet beet pulp, and alfalfa hay, barley must be considered at least equal to corn when fed in a barley-corn grain mixture.

As shown in table 7, replacing one half of the barley with corn made no difference in rate of gain nor any appreciable difference in feed required per unit of gain. The increase in cost of gain is almost entirely due to the higher cost of corn.

Each ton of corn added to the barley replaced 1,827.09 pounds of barley but required 5.35 pounds more wet beet pulp and 208.56

Table 7.—CORN AND BARLEY vs. BARLEY—CALVES
(2-year average 1931-32, 1932-33)

Ration fed	Ground corn Ground barley Cottonseed cake Wet beet pulp Alfalfa	Ground barley Cottonseed cake Wet beet pulp Alfalfa
Number calves per lot	9.5	9
Number days in period	192	192
Feedlot weight at start	395.7	402.3
Final feedlot weight	808.1	815.3
Gain	412.4	413.0
Daily gain	2.15	2.15
Daily ration fed:		
Ground corn	2.41	.....
Ground barley	2.41	4.61
Cottonseed cake	.97	.98
Wet beet pulp	22.99	23.14
Alfalfa	6.62	6.31
Maximum daily feed:		
Ground corn	3.6	.....
Ground barley	3.6	7.3
Cottonseed cake	1.0	1.0
Wet beet pulp	30.0	30.0
Feed required per cwt. gain at feedlot:		
Ground corn	112.2	.....
Ground barley	112.2	214.7
Cottonseed cake	45.4	45.4
Wet beet pulp	1062.3	1062.0
Alfalfa	308.8	297.1
Feed cost per cwt. gain at feedlot	$4.78	$4.53
Selling price per cwt.	$5.89	$5.89
Dressing percentage (cold)	59.9	58.1
Carcass grade	86	83

pounds more alfalfa; or with feed prices used was worth only $15.60 per ton.

Dressing percentages and carcass grades had a tendency to be higher when a half-and-half mixture of corn and barley, rather than barley alone, was fed. The selling price on the two lots was the same.

In this connection it should be remembered that the addition of corn to a barley grain ration for calves has a decidedly beneficial effect in checking trouble from bloating which in a percentage of instances means death loss.

Barley and Dried Pulp vs. Corn and Dried Pulp.—Even though barley, in a ration of dried beet pulp, linseed oil cake, corn silage,

Table 8.—BARLEY AND DRIED PULP vs. CORN AND DRIED PULP—CALVES
(2-year average 1925-26, 1926-27)

Ration fed	Ground barley Dried pulp Linseed-oil cake Corn silage Alfalfa	Ground corn Dried pulp Linseed-oil cake Corn silage Alfalfa
Number calves per lot	10	10
Number days in period	195	195
Feedlot weight at start	351.3	350.1
Final feedlot weight	744.7	754.8
Gain	393.4	404.8
Daily gain	2.02	2.08
Daily ration fed:		
Ground barley	3.56	.....
Ground corn	.....	3.56
Dried beet pulp	3.38	3.39
Linseed-oil cake	.99	.99
Corn silage	9.78	9.78
Alfalfa	4.28	4.46
Maximum daily feed:		
Ground barley	5.3	.....
Ground corn	.....	5.3
Dried beet pulp	5.3	5.3
Linseed-oil cake	1.5	1.5
Corn silage	13.0	13.0
Feed required per cwt. gain at feedlot:		
Ground barley	176.7	.....
Ground corn	.....	171.7
Dried beet pulp	167.7	163.3
Linseed-oil cake	48.8	47.9
Corn silage	485.6	470.3
Alfalfa	212.6	215.0
Feed cost per cwt. gain at feedlot	$5.68	$5.74
Selling price per cwt.	$9.88	$9.79
Dressing percentage (cold)	63.6	62.6
Carcass grade	94	92

and alfalfa (table 8), did not produce quite as high gains as corn, it produced gains that were slightly cheaper. Selling price per hundredweight, dressing percentage, and carcass grade favored the barley and dried pulp-fed group.

Each ton of barley fed replaced 1,943.41 pounds of corn and 27.16 pounds of alfalfa hay but required 49.80 pounds more dried beet pulp, 10.19 pounds more linseed oil cake, and 173.17 pounds more corn silage; or showed 93.00 percent the feeding value of corn.

Wheat.—Wheat has usually been worth too much for milling to be considered a feed for livestock, and consequently experimental work with wheat has been meager until recent years. General conclusions based on tests with wheat at other stations are:

1. Low-grade wheat is a good cattle feed.

Table 9.—CORN AND WHEAT vs. WHEAT—CALVES
(1-year data 1931-32)

Ration fed	Ground corn Cracked wheat Cottonseed cake Wet beet pulp Alfalfa	Cracked wheat Cottonseed cake Wet beet pulp Alfalfa
Number calves per lot	9	10
Number days in period	194	194
Feedlot weight at start	422.4	423.8
Final feedlot weight	887.8	840.0
Gain	465.4	416.2
Daily gain	2.40	2.15
Daily ration fed:		
Ground corn	2.47	.....
Cracked wheat	2.47	4.93
Cottonseed cake	.98	.98
Wet beet pulp	25.19	24.31
Alfalfa	7.43	6.20
Maximum daily feed:		
Ground corn	4.0	.....
Cracked wheat	4.0	8.0
Cottonseed cake	1.0	1.0
Wet beet pulp	30.0	30.0
Feed required per cwt. gain at feedlot:		
Ground corn	102.8	.....
Cracked wheat	102.8	229.7
Cottonseed cake	41.0	45.8
Wet beet pulp	1050.0	1133.3
Alfalfa	309.9	288.8
Feed cost per cwt gain at feedlot	$4.64	$4.93
Selling price per cwt.	$5.70	$5.55
Dressing percentage (cold)	59.9	59.5
Carcass grade	82	83

2. Wheat, even though comparatively high in protein, must be supplemented with a protein-rich feed.

3. Wheat should be ground coarsely, or rolled, to overcome its tendency to form pasty masses when chewed, which in turn cause digestive disturbances.

4. A grain mixture with wheat is better than feeding wheat alone.

5. Wheat alone is unpalatable.

Corn and Wheat vs. Wheat.—The calves (table 9) were fed cracked or coarsely ground wheat with cottonseed cake, wet beet pulp, and alfalfa hay. They were somewhat slow to go on feed, and even after reaching 8 pounds of wheat per head per day they were much slower in cleaning up that amount of grain than the calves fed wheat and corn. Aside from this, no difficulties were experienced. Wet beet pulp furnished bulk and water which may have been helpful in overcoming some of the objections noticed at other stations when wheat was the only grain fed. It was noticeable at the end of the test that the steers fed wheat alone were a little more growthy and somewhat thinner than the calves fed a half-and-half mixture of wheat and corn, yet they were fat enough that the carcass grade was equal.

The addition of corn to the wheat ration also increased gain .25 pound per head per day and decreased feed costs per unit of gain. It had, however, no noticeable effect on dressing percentage

Fig. 8. Trench silo for wet beet pulp.

or carcass grade, although it did enhance the selling price per hundredweight. In other words, indications are that even though wheat can be fed as the only grain in a beet by-product ration, the addition of corn is profitable and desirable.

Wheat vs. Barley.— Feeding wheat or barley alone showed (table 10) that ground barley produced the same rate of gain, cheaper gains, and more condition as indicated by selling price, and gave a 10-percent greater feed replacement value than wheat. Each ton of wheat was equal to 1,853.72 pounds of barley and 449.28 pounds of wet beet pulp but required 1.74 pounds more cottonseed cake and 154.11 pounds more alfalfa. In other words, barley seems slightly superior to wheat, according to this one-season test, when each is fed as the sole grain with wet beet pulp, cottonseed cake, and alfalfa hay.

Table 10.—WHEAT vs. BARLEY—CALVES
(1-year data, 1931-32)

Ration fed	Cracked wheat Cottonseed cake Wet beet pulp Alfalfa	Ground barley Cottonseed cake Wet beet pulp Alfalfa
Number calves per lot	10	10
Number days in period	194	194
Feedlot weight at start	423.8	421.5
Final feedlot weight	840.0	839.0
Gain	416.2	417.5
Daily gain	2.15	2.15
Daily ration fed:		
Cracked wheat	4.93	.....
Gound barley	.....	4.58
Cottonseed cake	.98	.98
Wet beet pulp	24.31	25.50
Alfalfa	6.20	5.84
Maximum daily feed:		
Cracked wheat	8.0	.....
Ground barley	.....	7.0
Cottonseed cake	1.0	1.0
Wet beet pulp	30.0	30.0
Feed required per cwt. gain at feedlot:		
Cracked wheat	229.7	.....
Ground barley	.....	212.9
Cottonseed cake	45.8	45.6
Wet beet pulp	1133.3	1184.9
Alfalfa	288.8	271.1
Feed cost per cwt. gain at feedlot	$4.93	$4.49
Selling price per cwt.	$5.55	$5.70
Dressing percentage (cold)	59.5	58.1
Carcass grade	83	83

Corn and Wheat vs. Corn and Barley.— A half-and-half mixture of ground corn and ground wheat is a more desirable combination than corn and barley (table 11), since it produces greater gains and cheaper gains.

Every ton of wheat fed replaced 2,125.00 pounds of barley, 125.00 pounds of corn, 49.24 pounds of cottonseed cake, 1,467.80 pounds of wet pulp, and 45.45 pounds of alfalfa. Using feed prices as indicated, wheat, in a wheat-and-corn mixture, showed 123.83 percent the feeding value of barley in a barley-and-corn mixture.

This test again emphasizes the advisability of feeding wheat mixed with corn rather than feeding it as the sole grain concentrate in the fattening ration.

Table 11.—CORN AND WHEAT vs. CORN AND BARLEY—CALVES

(2-year average 1931-32, 1932-33)

Ration fed	Ground corn Cracked wheat Cottonseed cake Wet beet pulp Alfalfa	Ground corn Ground barley Cottonseed cake Wet beet pulp Alfalfa
Number calves per lot	9.5	9.5
Number days in period	192	192
Feedlot weight at start	392.7	395.7
Final feedlot weight	830.1	808.1
Gain	437.4	412.4
Daily gain	2.28	2.15
Daily ration fed:		
Ground corn	2.40	2.41
Cracked wheat	2.40	.....
Ground barley	.....	2.41
Cottonseed cake	.97	.97
Wet beet pulp	22.46	22.99
Alfalfa	6.98	6.62
Maximum daily feed:		
Ground corn	3.6	3.6
Cracked wheat	3.6	.....
Ground barley	.....	3.6
Cottonseed cake	1.0	1.0
Wet beet pulp	30.0	30.0
Feed required per cwt. gain at feedlot:		
Ground corn	105.6	112.2
Cracked wheat	105.6	.....
Ground barley	.....	112.2
Cottonseed cake	42.8	45.4
Wet beet pulp	984.8	1062.3
Alfalfa	306.4	308.8
Feed cost per cwt. gain at feedlot	$4.68	$4.78
Selling price per cwt.	$5.82	$5.89
Dressing percentage (cold)	59.9	59.9
Carcass grade*	82	86

*1-year data

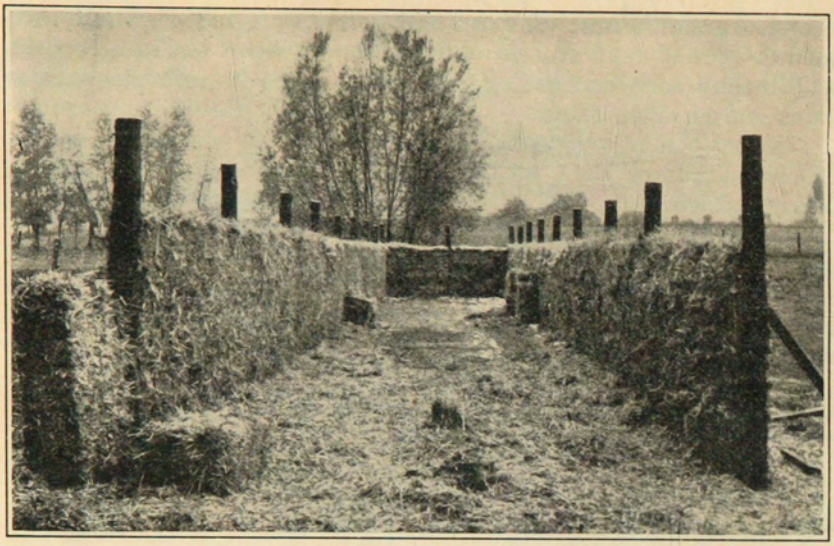


Fig. 9. A straw silo for wet beet pulp.

II. Beet By-products

Sugar-beet by-products—beet tops, wet beet pulp, pressed beet pulp, molasses, dried beet pulp, and dried molasses beet pulp—have proved to be an important factor in cattle-fattening rations in Colorado. Rations containing beet by-products usually produce heavier and cheaper gains than the same ration without those by-products.

The average annual harvest of sugar beets in Colorado beet-producing areas is over 2,190,750 tons.* This crop furnishes for livestock feed over 1½ million tons of green tops, approximately 550,000 tons of wet beet pulp or its equivalent in dried pulp, and over 15,000 tons of discard molasses.

Sugar-beet by-products are in a large measure responsible for the existence of concentrated cattle-feeding areas in Colorado and the success of producing beef in competition with cornbelt feeders. These by-products, in addition to home-grown feeds, give Colorado feeders a greater variety of feeds from which to select their fattening ration. Variety in a ration generally means safety, economy, and maximum gains.

The principal need for development in use of supplements came through an increasing demand by feeders for the wet beet pulp supply. It became necessary to sell wet beet pulp to beet growers on an allotment plan, and while pulp prices have remained at an attractive level compared with home-grown feeds, the necessarily limited allowance of from 15 to 45 percent of the beet tonnage deliv-

*C. V. Maddux, Agricultural Department, Great Western Sugar Company.

ered has made it necessary for the average Colorado feeder to apportion from 75 to 225 tons of pulp over his entire season's feeding operation.

Sugar-beet By-product Concentrates.—Molasses, dried pulp, or dried molasses pulp should be considered as concentrates in any fattening ration and should therefore be fed in much the same manner as corn and barley.

Dried Beet Pulp and Dried Molasses Beet Pulp.—Dried beet pulp is merely wet beet pulp with the moisture extracted by drying the pulp with waste steam. During late years, very little dried pulp has been on the market. Almost all dried pulp is mixed with dried molasses and sold as dried molasses beet pulp. A ton of sugar beets will produce 95 pounds of plain, dry pulp.

Table 12.—CORN vs. DRIED MOLASSES BEET PULP—3-YEAR-OLDS
(1-year data 1921-22)

Ration fed	Corn Cottonseed cake Sunflower silage Alfalfa	Dried molasses beet pulp Cottonseed cake Sunflower silage Alfalfa
Number steers per lot	10	10
Number days in period	140	140
Feedlot weight at start	1054.5	1051.8
Final feedlot weight	1319.7	1344.8
Gain	265.2	293.0
Daily gain	1.89	2.09
Daily ration fed:		
Ground corn	10.26	.....
Dried molasses beet pulp	.....	11.35
Cottonseed cake	2.34	2.57
Sunflower silage	24.32	24.50
Alfalfa	12.08	9.60
Maximum daily feed:		
Ground corn	14.00	.....
Dried molasses beet pulp	.....	14.00
Cottonseed cake	3.00	3.00
Sunflower silage	30.00	30.00
Feed required per cwt. gain at feedlot:		
Ground corn	541.6	.....
Dried molasses beet pulp	.....	542.3
Cottonseed cake	123.7	122.6
Sunflower silage	1284.1	1170.4
Alfalfa	637.5	458.8
Feed cost per cwt. gain at feedlot	.....	.....
Selling price per cwt.	$8.25	$8.25
Dressing percentage	61.5	63.0
Carcass grade (rank)	5	1

In the production of dried molasses beet pulp, 500 pounds of molasses is dried with 1,500 pounds of dried pulp. This gives approximately 1,600 pounds of dried pulp and 400 pounds of dried molasses in each ton of dried molasses pulp. Although it is not used as extensively for fattening cattle as for lambs, dried molasses beet pulp has a place in cattle-fattening rations, especially if wet pulp is not available. However, dried molasses pulp should be considered a grain concentrate and not a carbonaceous roughage such as wet beet pulp.

Dried pulp, or dried molasses pulp, is a bulky concentrate that can always be used to advantage in guarding against too heavy a concentrate feed. On account of its bulk and palatability, it has proved very effective in checking digestive troubles and has also helped in keeping steers on a heavy concentrated ration over a long period of time.

Steers gone "off feed" may be brought back more quickly by substituting dried molasses beet pulp for part of the grain concentrate allowance.

Dried Molasses Beet Pulp vs. Corn.—When compared with corn, dried molasses beet pulp fed in a ration of cottonseed cake, sunflower silage, and alfalfa hay (table 12) produced quite noticeably larger gains, and much cheaper gains, due to the decidedly lower alfalfa hay consumption per unit of gain. The steers fed dried molasses beet pulp instead of corn dressed more and graded higher than the corn-fed steers, even though their selling price was the same.

Each ton of dried molasses beet pulp fed replaced 1,997.42 pounds of corn, 4.06 pounds of cottonseed cake, 419.33 pounds of

Fig. 10. Cutting hay and fodder and mixing it with beet molasses makes a very palatable feed for all classes of stock.

sunflower silage, and 659.05 pounds of alfalfa hay in producing equal gains; or with feed prices used was worth $23.41.

Dried Molasses Beet Pulp vs. Barley.— Comparing barley and dried molasses beet pulp fed to 3-year-old steers (table 13), the rate of gain when dried molasses beet pulp is used is even greater than with corn, as shown in the previous table. Feed cost per hundredweight gain is approximately one third greater where barley is used. Apparently dried molasses beet pulp cut down necessary amounts of all feeds used per unit of gain. Selling price per hundredweight was $8.25 for both lots, but dressing percentage and carcass grade favored the steers fed dried molasses beet pulp.

Each ton of dried molasses beet pulp replaced 2,486.45 pounds of barley, 112.12 pounds of cottonseed cake, 1,541.58 pounds of

Table 13.—BARLEY vs. DRIED MOLASSES BEET PULP—3-YEAR-OLDS
(1-year data 1921-22)

Ration fed	Barley Cottonseed cake Sunflower silage Alfalfa	Dried molasses beet pulp Cottonseed cake Sunflower silage Alfalfa
Number steers per lot	10	10
Number days in period	140	140
Feedlot weight at start	1051.7	1051.8
Final feedlot weight	1267.7	1344.8
Gain	216.0	293.0
Daily gain	1.54	2.09
Daily ration fed:		
Ground barley	10.40	.....
Dried molasses beet pulp	.....	11.35
Cottonseed cake	2.36	2.57
Sunflower silage	24.50	24.50
Alfalfa	9.75	9.60
Maximum daily feed:		
Ground barley	14.00	.....
Dried molasses beet pulp	.....	14.00
Cottonseed cake	3.00	3.00
Sunflower silage	30.00	30.00
Feed required per cwt. gain at feedlot:		
Ground barley	674.2	.....
Dried molasses beet pulp	.....	542.3
Cottonseed cake	153.0	122.6
Sunflower silage	1588.4	1170.4
Alfalfa	631.8	458.8
Feed cost per cwt. gain at feedlot	.....	.....
Selling price per cwt.	$8.25	$8.25
Dressing percentage	62.4	63.0
Carcass grade (rank)	4	1

sunflower silage, and 638.02 pounds of alfalfa hay; or was worth $29.48.

Yearlings are apparently not able to handle bulky dried molasses beet pulp as efficiently as 3-year-old steers. Barley fed in a ration of cottonseed cake, sunflower silage, and alfalfa hay made somewhat larger gains than steers fed dried molasses beet pulp in a similar ration (table 14). Feed cost per unit of gain was, however, cheaper with the pulp-fed steers. They also showed a higher selling price. There was little difference in dressing percentage and carcass grade.

Each ton of dried molasses beet pulp replaced 1,924.93 pounds of barley but required 10.31 pounds more cottonseed cake, 55.27 pounds more sunflower silage, and 114.25 pounds more alfalfa to produce equal gains; or was worth $16.59, using afore-quoted feed prices.

Table 14.—DRIED MOLASSES BEET PULP vs. BARLEY—YEARLINGS
(1-year data 1922-23)

Ration fed	Ground barley Cottonseed cake Sunflower silage Alfalfa	Dried molasses beet pulp Cottonseed cake Sunflower silage Alfalfa
Number steers per lot	10	10
Number days in period	180	180
Feedlot weight at start	712.8	722.7
Final feedlot weight	1119.8	1119.0
Gain	407.0	396.3
Daily gain	2.26	2.20
Daily ration fed:		
Ground barley	10.6	.....
Dried molasses beet pulp	.....	10.7
Cottonseed cake	2.1	2.1
Sunflower silage	15.7	15.6
Alfalfa	7.3	7.7
Maximum daily feed:		
Ground barley	14.00	.....
Dried molasses beet pulp	.....	14.00
Cottonseed cake	3.00	3.00
Sunflower silage	25.00	23.00
Feed required per cwt. gain at feedlot:		
Ground barley	466.7	.....
Dried molasses beet pulp	.....	484.9
Cottonseed cake	93.3	95.8
Sunflower silage	694.7	708.1
Alfalfa	323.3	351.0
Feed cost per cwt. gain at feedlot	$8.25	$7.61
Selling price per cwt.	$10.14	$10.35
Dressing percentage (warm)	63.0	63.8
Carcass grade	88	87

Dried Beet Pulp vs. Dried Molasses Beet Pulp.—A 2-year average showing the comparative value of dried pulp and dried molasses pulp in a ration of barley, cottonseed cake, corn silage, and alfalfa hay for calves (table 15), shows the two feeds to be approximately equal in feeding value. Rate of gain, cost of gain, selling price, and dressing percentage give no decided advantage to either of these two feeds.

Each ton of dried beet pulp replaced 2,026.72 pounds of dried molasses beet pulp, 7.29 pounds of barley, 2.43 pounds of cottonseed cake, and 9.71 pounds of alfalfa, but required 1.21 pounds more corn silage. With feed prices used, each ton of dried pulp was worth $14.33, or 102.36 percent the value of dried molasses beet pulp.

Table 15.—DRIED PULP vs. DRIED MOLASSES PULP—CALVES
(2-year average 1925-26, 1926-27)

Ration fed	Ground barley Dried pulp Cottonseed cake Corn silage Alfalfa	Ground barley Dried molasses pulp Cottonseed cake Corn silage Alfalfa
Number calves per lot	10	10
Number days in period	195	195
Feedlot weight at start	348.0	349.3
Final feedlot weight	745.8	746.1
Gain	397.8	396.8
Daily gain	2.04	2.03
Daily ration fed:		
Ground barley	3.57	3.57
Dried beet pulp	3.36	.....
Dried molasses beet pulp	.....	3.39
Cottonseed cake	.99	.99
Corn silage	9.20	9.17
Alfalfa	4.20	4.20
Maximum daily feed:		
Ground barley	5.3	5.3
Dried beet pulp	5.3	.....
Dried molasses beet pulp	.....	5.3
Cottonseed cake	1.5	1.5
Corn silage	12.0	12.0
Feed required per cwt. gain at feedlot:		
Ground barley	174.8	175.4
Dried beet pulp	164.7	.....
Dried molasses beet pulp	.....	166.9
Cottonseed cake	48.7	48.9
Corn silage	451.4	451.3
Alfalfa	206.1	206.9
Feed cost per cwt. gain at feedlot	$5.36	$5.41
Selling price per cwt.	$9.86	$9.84
Dressing percentage (cold)	62.5	62.5
Carcass grade	90	88

Beet Molasses.—There is considerable interest in the comparative feeding values of different kinds of molasses for livestock.

In the production of beet sugar, the original discard molasses is known as "foreign" molasses. This is steffenized, a process consisting of the addition of lime under proper conditions. The molasses discarded after this operation is known as Steffens or "discard" molasses. A newer recovery process in use in Northern Colorado makes use of barium on the Steffens molasses for further recovery of sugar, leaving a final molasses residue which, although much smaller in total volume than the original amount, may contain as much or even more feed nutrients per pound than the original. The product from this process is known as "final discard or Johnstown molasses." Sweetwater is a synthetic by-product of molasses desugarization.

According to chemists, the character of the feeding value of all molasses from whatever source varies within rather narrow limits. They state that when sugar is first crystallized from the syrup and the crystals are separated, a mother liquor remains which contains all the impurities originally in the juice, together with an amount of sugar of rather fixed proportions. The impurities present in the syrups are always associated with a definite ratio of sugar which is non-crystallizable in the final molasses. This ratio is approximately 60 parts sugar for each 40 parts of impurities.

When a part of the sugar in the "foreign" beet molasses is precipitated with lime in the Steffens process, a part of the impurities also is precipitated and carried into the syrups. These impurities associate themselves with sugar in the 60-40 ratio, and the final molasses is very similar to the original except that it is much reduced in volume. The same procedure again takes place when the barium process is used on the Steffens discard molasses, but in this

Fig. 11. Turning steers into beet fields without piling tops often proves wasteful and expensive.

case the final discard molasses, in addition to its quota of sugar, contains about 15 percent of raffinose, which is a carbohydrate, and which should enhance its value over the other discard molasses.

Molasses adds palatability to a fattening ration and consequently often shows a higher feeding value than the actual feed nutrients in the molasses might seem to justify. Manufacturers of prepared feeds recognize this beneficial quality and frequently use molasses in their feed mixtures. In beet-growing districts, beet molasses, if available, can be used to advantage in any fattening ration.

Beet molasses may be hand-fed or self-fed to cattle. It is always wise to start feeding a small amount, not over 0.5 pound per head daily, and then to increase it gradually. Although it is customary to feed a maximum of only 4 to 6 pounds daily, aged steers will

Table 16.—BEET MOLASSES—2-YEAR-OLDS

	3-year-olds 1-year data 1914-15		2-year-olds 2-year average 1916-17, 1918	
Ration fed	Ground barley Molasses Corn silage Alfalfa	Ground barley Corn silage Alfalfa	Ground barley Molasses Corn silage Alfalfa	Ground barley Corn silage Alfalfa
Number steers per lot	10	10	9.5	9.5
Number days in period	70	70	133	133
Feedlot weight at start	1041.3	1062.8	810.9	800.1
Final feedlot weight	1255.0	1247.0	1063.5	1037.3
Gain	213.7	184.2	252.6	237.2
Daily gain	3.05	2.63	1.90	1.78
Daily ration fed:				
Ground barley	8.01	9.91	6.72	8.34
Beet molasses	4.87	.....	2.71	.....
Corn silage	36.68	36.64	22.97	23.01
Alfalfa	8.03	9.31	9.21	9.18
Maximum daily feed*				
Ground barley	.....	.....	.....	.....
Beet molasses	.....	.....	.....	.....
Corn silage	.....	.....	.....	.....
Feed required per cwt. gain at feedlot:				
Ground barley	262.3	376.6	349.9	471.6
Beet molasses	159.6	.....	146.3	.....
Corn silage	1201.5	1392.5	1204.1	1284.1
Alfalfa	263.0	353.7	483.3	513.4
Feed cost per cwt. gain at feedlot	$6.75	$7.93	$8.38	$9.18
Selling price per cwt.	$7.20	$7.20	$14.54	$14.43
Dressing percentage (warm)	.....	.....	61.2	62.7

*Not available.

consume 8 to 10 pounds daily without apparent injury. There is a point, however, beyond which molasses may not be fed safely. Too heavy feeding results in sickness, with symptoms popularly called "blind staggers," and post mortem shows greatly enlarged kidneys. If it is desired to self-feed molasses, it should be thoroughly cooled in a tank before the cattle are given access to it, and enough other feed should be included in the ration to produce proper balance. Beet molasses is sometimes mixed with wet beet pulp at the factory and the mixture hauled and fed in drylot.

Beet molasses added to a ration of barley, corn silage, and alfalfa hay for 3-year-old steers (table 16) increased rate of gain considerably and also cheapened the cost of producing unit gains.

Table 17.—VALUE OF MOLASSES—YEARLINGS

Ration fed	1-year data 1922–23		1-year data 1923–24	
	Ground barley Molasses Sunflower silage Alfalfa	Ground barley Sunflower silage Alfalfa	Ground barley Molasses Corn silage Alfalfa	Ground barley Corn silage Alfalfa
Number steers per lot	.....	.....	10	10
Number days in period	.....	.....	186	186
Feedlot weight at start	715.7	716.5	758.2	756.8
Final feedlot weight	1127.8	1094.0	1180.0	1178.0
Gain	412.2	377.5	421.8	421.2
Daily gain	2.29	2.10	2.27	2.26
Daily ration fed:				
Ground barley	10.2	10.8	11.57	11.81
Molasses	3.7	.....	3.86	.....
Sunflower silage	15.2	18.3	.....	.....
Corn silage	.....	.....	18.29	18.17
Alfalfa	8.0	8.8	7.22	8.09
Maximum daily feed:				
Ground barley	14.00	16.00	15.00	17.00
Molasses	6.00	.....	5.00	.....
Sunflower silage	23.00	25.00	.....	.....
Corn silage	.....	.....	25.00	25.00
Feed required per cwt. gain at feedlot:				
Ground barley	445.1	517.0	510.1	521.6
Molasses	163.2	.....	170.2	.....
Sunflower silage	663.9	871.7	.....	.....
Corn silage	.....	.....	806.7	802.2
Alfalfa	348.2	420.9	318.3	357.3
Feed cost per cwt. gain at feedlot	$7.21	$7.86	$8.36	$7.92
Selling price per cwt.	$9.99	$9.86	$9.62	$9.61
Dressing percentage (warm)	63.1	63.3	63.6	62.5
Carcass grade	89	87	91	94

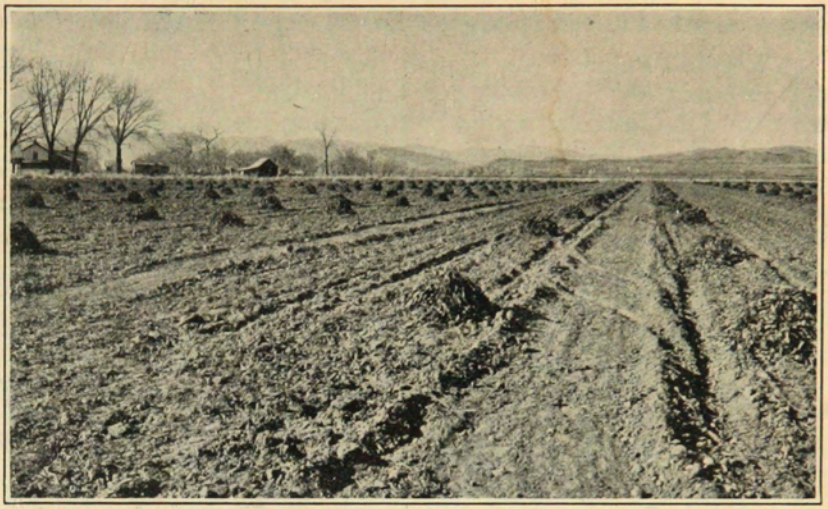


Fig. 12. Piling tops in the field is profitable.

Each ton of molasses replaced 1,432.33 pounds of barley, 2,393.48 pounds of corn silage, and 1,136.59 pounds of alfalfa; or was worth $22.83 per ton.

The same ration of barley, corn silage, and alfalfa hay (2-year average) fed to 2-year-old steers again was improved through the addition of beet molasses. Molasses increased rate of gain and cheapened cost of gain. Dressing percentage, however, was a little lower with the cattle fed molasses.

Each ton of beet molasses fed replaced 1,663.70 pounds of barley, 1,093.64 pounds of corn silage, and 411.48 pounds of alfalfa; or was worth $19.08 per ton with feed prices used.

Using yearling steers and adding molasses to their ration of barley, sunflower silage, and alfalfa (table 17), increased gains, and cheaper gains were secured. Selling price was greater and carcass grade slightly higher. Dressing percentage was just a fraction lower with molasses-fed steers.

Each ton of molasses fed replaced 881.13 pounds of barley, 2,546.57 pounds of sunflower silage, and 890.93 pounds of alfalfa; or was worth $15.95 per ton.

Again using yearling steers the following year, and adding molasses to a ration of barley, corn silage, and alfalfa hay, gave disappointing results. Rate of gain was not increased, cost per unit of gain was higher where beet molasses was fed, and carcass grades were lower.

Molasses seems particularly suitable for adding to a ration containing sunflower silage, because the latter lacks palatability in comparison with corn silage, while beet molasses is very palatable.

SUGAR-BEET BY-PRODUCT ROUGHAGES

Wet Beet Pulp.—Even though wet beet pulp is very high in moisture and low in protein and lime content, it seems to fit perfectly into the fattening ration by furnishing succulence and apparently a high-quality carbohydrate, and consequently inducing high, yet cheap, gains in an otherwise balanced ration. A cheaper and more efficient roughage than wet beet pulp is yet to be found for Colorado beet-producing areas. For 30 years it has been the foundation upon which cattle feeding in Northern Colorado has been built. In the Arkansas Valley and the Uncompahgre and Grand Valleys, farmers have not called for all the pulp produced, so that in those districts considerable pulp is fed in factory-owned feedyards close to the sugar factory and leased to the feeder. Such location saves some cost of hauling, but does not put the fertilizer out on each farm growing beets.

A farmer-feeder, of course, needs no profit beyond market

Table 18.—WET PULP ADDED TO GRAIN-CAKE-HAY RATION—CALVES

(4-year average 1927-28, 1928-29, 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Wet beet pulp Alfalfa	Ground barley Cottonseed cake Alfalfa
Number of calves per lot	9.5	8.75
Number of days in period	192.75	192.75
Feedlot weight at start	393.2	391.8
Final feedlot weight	801.2	780.1
Gain	408.0	388.3
Daily gain	2.12	2.01
Daily ration fed:		
Ground barley	4.69	6.35
Cottonseed cake	1.00	1.00
Wet beet pulp	26.73	.....
Alfalfa	5.61	9.66
Maximum daily feed:		
Ground barley	6.5	8.2
Cottonseed cake	1.0	1.0
Wet beet pulp	34.8	.....
Feed required per cwt. gain at feedlot:		
Ground barley	222.7	312.4
Cottonseed cake	47.6	49.3
Wet beet pulp	1259.8	.....
Alfalfa	267.3	483.0
Feed cost per cwt. gain at feedlot	$4.65	$5.55
Selling price per cwt.	$11.14	$11.05
Dressing percentage (cold)	59.4	58.8
Carcass grade	92	91

return for feed and the fertilizer to enable him to maintain feeding operations year after year.

In a 4-year average when wet pulp was added to a ration of grain, cake, and hay (table 18), gains were increased and feed cost was lowered; selling price, dressing percentage, and carcass grade increased.

Each ton of wet beet pulp replaced 142.40 pounds of barley, 2.70 pounds of cottonseed cake, and 342.43 pounds of alfalfa; or with feed prices used was worth $2.69 per ton.

Wet Beet Pulp vs. Dried Beet Pulp.—Wet beet pulp and dried beet pulp are really two entirely different feeds, despite the fact that one is the other with moisture extracted. Wet beet pulp is a

Table 19.—WET BEET PULP vs. DRIED BEET PULP—CALVES
(2-year average 1925-26, 1926-27)

Ration fed	Ground barley Cottonseed cake Corn silage Wet pulp Alfalfa	Ground barley Cottonseed cake Corn silage Dried pulp Alfalfa
Number calves per lot	10	10
Number days in period	195	195
Feedlot weight at start	348.1	348.0
Final feedlot weight	752.2	745.8
Gain	404.1	397.8
Daily gain	2.07	2.04
Daily ration fed:		
Ground barley	4.86	3.57
Dried beet pulp		3.36
Cottonseed cake	.99	.99
Wet beet pulp	16.47	
Corn silage	8.22	9.20
Alfalfa	4.05	4.20
Maximum daily feed:		
Ground barley	8.0	5.3
Dried beet pulp		5.3
Cottonseed cake	1.5	1.5
Wet beet pulp	20.0	
Corn silage	9.5	12.0
Feed required per cwt. gain at feedlot:		
Ground barley	235.5	174.8
Dried beet pulp		164.7
Cottonseed cake	47.9	48.7
Wet beet pulp	791.5	
Corn silage	396.8	451.4
Alfalfa	196.1	206.1
Feed cost per cwt. gain at feedlot	$5.07	$5.36
Selling price per cwt.	$9.91	$9.86
Dressing percentage (cold)	62.3	62.5
Carcass grade	91	90

carbohydrate roughage or silage, whereas dried beet pulp is a carbohydrate concentrate. The frequent question of the relative value of dry matter contained in these two feeds has led to this discussion.

A 2-year average comparison is shown in table 19. Wet beet pulp fed along with barley, cottonseed cake, corn silage, and alfalfa hay produced slightly greater and cheaper gains than dried beet pulp.

Each ton of dried beet pulp replaced 9,611.41 pounds of wet pulp and 737.10 pounds of barley but required 9.71 pounds more cottonseed cake, 663.02 pounds more corn silage, and 121.43 pounds more alfalfa. With feed prices used, each ton of dried beet pulp was worth $10.50; or showed 8.40 times the feeding value of wet beet pulp.

The moisture content of dried beet pulp fed during these 2 years was 10.06 percent; that of the wet pulp was 87.86 percent. In other words, dried beet pulp contained only 7.41 times more dry matter than wet beet pulp but showed 8.40 times the feeding value, bearing out the fact that the relative feed value of these two beet by-products is largely in the same ratio as their dry-matter content.

The type of ration fed should determine which of the two by-products to feed. If succulence is needed to add palatability, the wet pulp is to be preferred; if silage is included in the ration, dried pulp is probably just as satisfactory as wet pulp.

Wet Beet Pulp vs. Corn Silage.—The results shown in table 20 give rather conclusive evidence that wet beet pulp is a more desir-

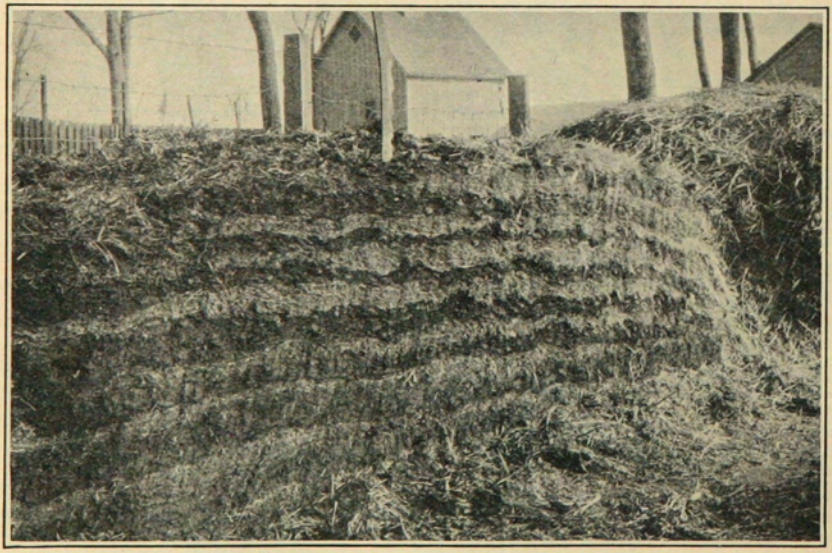


Fig. 13. Beet top stack showing alternate layers of straw and tops.

able supplement for a molasses, cake, and hay ration than corn silage. The steers fed wet beet pulp (table 20) made greater gains and produced gains for considerably less than those fed corn silage. Then also, the selling price per hundredweight and the dressing percentage were greater for the pulp-fed cattle.

When fed to 3-year-old steers, each ton of corn silage replaced 3,162.40 pounds of wet beet pulp and 6.46 pounds of alfalfa but required 74.34 pounds more beet molasses and 40.14 pounds more cottonseed cake.

With 2-year-old steers, each ton of corn silage replaced 3,983.24 pounds of wet beet pulp but required 43.18 pounds more beet molasses, 32.80 pounds more cottonseed cake, and 73.73 pounds of alfalfa.

Table 20.—WET BEET PULP vs. CORN SILAGE—2-YEAR-OLDS

	3-year-olds 1-year data 1914-15		2-year-olds 2-year average 1916-17 1918	
Ration fed	Molasses Cottonseed cake Wet pulp Alfalfa	Molasses Cottonseed cake Corn silage Alfalfa	Molasses Cottonseed cake Wet pulp Alfalfa	Molasses Cottonseed cake Corn silage Alfalfa
Number steers per lot	10	9	9.5	9.5
Number days in period	70	70	133	133
Feedlot weight at start	1047.5	1050.5	825.5	811.3
Final feedlot weight	1273.5	1226.1	1106.3	1050.4
Gain	226.0	175.6	280.8	239.1
Daily gain	3.23	2.51	2.11	1.80
Daily ration fed:				
Beet molasses	4.88	5.26	3.87	3.96
Cottonseed cake	2.64	2.85	2.75	2.84
Wet beet pulp	80.62	.....	71.10	.....
Corn silage	.....	39.62	.....	30.72
Alfalfa	13.69	10.51	9.46	9.17
Maximum daily feed:*				
Beet molasses	.....	.....	.....	.....
Cottonseed cake	.....	.....	.....	.....
Wet beet pulp	.....	.....	.....	.....
Corn silage	.....	.....	.....	.....
Feed required per cwt. gain at feedlot:				
Beet molasses	151.0	209.7	183.7	220.3
Cottonseed cake	81.9	113.6	130.7	158.5
Wet beet pulp	2497.2	.....	3376.4	.....
Corn silage	.....	1579.3	.....	1695.3
Alfalfa	424.1	419.0	448.0	510.5
Feed cost per cwt. gain at feedlot	$5.21	$7.94	$6.79	$9.35
Selling price per cwt.	$7.20	$7.20	$14.84	$14.21
Dressing percentage (warm)	.....	.....	61.4	59.9

*Not available.

Corn Silage as a Supplement to Wet Beet Pulp.—Although the fattening qualities of wet pulp are well recognized, the allotment to the average beet grower in Northern Colorado (75 to 125 tons) is too small to allow feeding all the animals will take; for in that case pulp will give out before the animals are finished, and experience has shown that cattle carried for a considerable time on pulp will not do well in the final stages of fattening upon dry feeds, especially with cottonseed cake or molasses in the ration. However, a specified wet-pulp allotment does not necessarily have to be the limiting factor in the number of cattle the feeder can put into the feedlot. Where other cheap carbonaceous roughages such as corn silage, corn fodder, and potatoes are available, they offer a means of stretching a given tonnage of wet pulp over a feeding period.

According to the 3-year average reported in table 21, the

Table 21.—CORN SILAGE AS A SUPPLEMENT TO WET BEET PULP—CALVES
(3-year average 1926-27, 1927-28, 1928-29)

Ration fed	Ground barley Cottonseed cake Wet pulp Corn silage Alfalfa	Ground barley Cottonseed cake Wet pulp Alfalfa
Number calves per lot	10	9.33
Number days in period	190.67	190.67
Feedlot weight at start	358.9	360.3
Final feedlot weight	744.9	754.0
Gain	386.0	393.7
Daily gain	2.02	2.06
Daily ration fed:		
Ground barley	4.69	4.59
Cottonseed cake	1.04	1.03
Wet beet pulp	15.79	25.04
Corn silage	7.08	.....
Alfalfa	4.05	5.62
Maximum daily feed:		
Ground barley	7.5	7.3
Cottonseed cake	1.2	1.2
Wet beet pulp	22.3	33.0
Corn silage	7.7	.....
Feed required per cwt. gain at feedlot:		
Ground barley	232.9	222.9
Cottonseed cake	51.2	50.0
Wet beet pulp	774.2	1210.0
Corn silage	347.7	.....
Alfalfa	201.7	271.2
Feed cost per cwt. gain at feedlot	$5.01	$4.68
Selling price per cwt.	$12.44	$12.38
Dressing percentage (cold)	61.2	60.0
Carcass grade	94	91

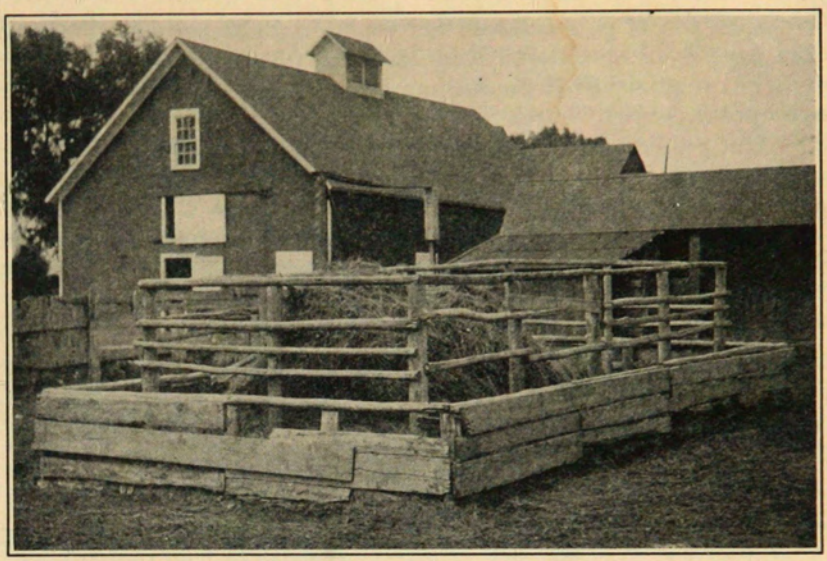


Fig. 14. A satisfactory hayrack where only a small bunch of cattle is fed.

addition of corn silage to a standard beet by-product ration somewhat decreased gains and increased cost of gain, but enhanced dressing percentage and carcass grade; also slightly increased selling price.

Each ton of corn silage fed replaced 2,506.76 pounds of wet beet pulp and 399.77 pounds of alfalfa hay but required 57.52 pounds more barley and 6.90 pounds more cottonseed cake; or was worth only $2.54 per ton. In other words, a combination of corn silage and wet beet pulp was not as efficient as pulp alone, but, nevertheless, offers a means of stretching an allotted amount of wet beet pulp. A 75-ton allotment of wet beet pulp fed in a standard beet by-product ration with grain, cottonseed cake, and alfalfa hay, will finish out 32 calves. The same amount of wet pulp, with the addition of 33.69 tons of corn silage plus grain, cake, and alfalfa hay, will finish 50 calves but at a cost of 33 cents per hundredweight more for gains.

Cull Potatoes as a Supplement to Wet Beet Pulp.—Cull potatoes, which often have little or no market value, can be used to stretch a limited amount of wet beet pulp (table 22). The addition of potatoes to a grain, cake, wet beet pulp, and hay ration produced about the same rate of gain as the standard beet by-product ration, but the cost of gain was 49 cents greater for each hundred pounds produced. Selling price per hundredweight was lower for the steers fed potatoes, but dressing percentage and carcass grade showed no material difference between the two lots.

Each ton of cull potatoes fed replaced 13.22 pounds of barley, 2.45 pounds of cottonseed cake, and 1,776.31 pounds of wet beet pulp but required 36.22 pounds more alfalfa hay; or with feed prices used potatoes were worth $1.13 per ton.

Wet vs. Pressed Pulp.—A few years ago there existed a considerable demand for wet pulp from feeders located too far away from the factories to permit economical hauling. Presses were installed at several factories to widen the pulp-feeding territory. These presses removed some of the free moisture of wet pulp and increased dry-matter content to 15 percent. Ordinary wet pulp generally contains only about 10 percent dry matter. In other words, one half more dry matter is found in pressed pulp than the wet pulp, or two thirds of a ton of pressed pulp (85 percent moisture) contains as much dry matter as a ton of wet pulp (90 percent moisture).

Table 22.—CULL POTATOES AS A SUPPLEMENT TO WET BEET PULP—CALVES
(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Wet pulp Cull potatoes Alfalfa	Ground barley Cottonseed cake Wet pulp Alfalfa
Number of calves per lot	10	10
Number of days in period	194.5	194.5
Feedlot weight at start	415.3	418.3
Final feedlot weight	838.0	836.3
Gain	422.7	418.0
Daily gain	2.17	2.15
Daily ration fed:		
Ground barley	4.51	4.51
Cottonseed cake	.98	.98
Wet beet pulp	21.43	28.84
Cull potatoes	8.66	.....
Alfalfa	6.04	5.83
Maximum daily feed:		
Ground barley	6.0	6.0
Cottonseed cake	1.0	1.0
Wet beet pulp	27.5	37.5
Cull potatoes	10.0	.....
Feed required per cwt. gain at feedlot:		
Ground barley	206.8	209.5
Cottonseed cake	45.5	46.0
Wet beet pulp	984.6	1347.5
Cull potatoes	408.6	.....
Alfalfa	284.2	276.8
Feed cost per cwt. gain at feedlot	$5.09	$4.60
Selling price per cwt.	$9.07	$9.26
Dressing percentage (cold)	59.7	59.5
Carcass grade	89	90

A 3-year summary (table 23) comparing wet and pressed pulp in a ration composed of barley, cottonseed cake, and alfalfa hay, showed no material advantage in favor of pressed pulp. Pressed beet pulp slightly increased gains but also increased cost of gain. There was practically no difference in selling price, but dressing percentage and carcass grade were higher for the cattle fed pressed beet pulp.

Each ton of pressed beet pulp replaced 2,221.61 pounds of wet pulp, 10.28 pounds of barley, and 1.29 pounds of cottonseed cake but required 83.91 pounds more alfalfa; or showed 92.80 percent the feeding value of wet beet pulp at given prices.

Storage Studies with Pressed Beet Pulp.—The greater percentage of the feeders haul pulp daily to their cattle; however, there are some who prefer to lay in their pulp supply during the fall. In order

Table 23.—WET vs. PRESSED PULP—CALVES
(3-year average 1926-27, 1927-28, 1928-29)

Ration fed	Ground barley Cottonseed cake Wet pulp Alfalfa	Ground barley Cottonseed cake Pressed pulp Alfalfa
Number of calves per lot	9.33	9.67
Number of days in period	190.67	190.67
Feedlot weight at start	360.3	360.2
Final feedlot weight	754.0	760.7
Gain	393.7	400.5
Daily gain	2.06	2.10
Daily ration fed:		
Ground barley	4.59	4.55
Cottonseed cake	1.03	1.03
Wet beet pulp	25.04	.....
Pressed beet pulp	.....	22.89
Alfalfa	5.62	6.27
Maximum daily feed:		
Ground barley	7.3	7.5
Cottonseed cake	1.2	1.2
Wet beet pulp	33.0	.....
Pressed beet pulp	.....	30.3
Feed required per cwt. gain at feedlot:		
Ground barley	222.9	217.3
Cottonseed cake	50.0	49.3
Wet beet pulp	1210.0	.....
Pressed beet pulp	.....	1089.3
Alfalfa	271.2	316.9
Feed cost per cwt. gain at feedlot	$4.68	$4.99
Selling price per cwt.	$12.38	$12.41
Dressing percentage (cold)	60.0	61.4
Carcass grade	91	93

to determine the percentage loss in storage, the following data was compiled.

A test was made, using two types of silos for storing beet pulp. The experiment was conducted with pressed beet pulp, but the results probably are applicable to wet beet pulp in the same comparative way. At least, this is the best measure available, pending definite data on wet pulp. Wet pulp varies from 5.5 to 6 percent in moisture between first and final dates of its use, so that there is almost as great a difference in its moisture content at different periods as there is between wet pulp and pressed pulp at the beginning of the season.

A trench silo was constructed with ordinary scrapers and was 100 feet long, 5 feet deep, with sloping sides, having an average width of 12 feet. A straw silo was constructed with 6-inch posts, 12 feet in length and with 60-inch woven wire stretched on both sides of the posts, and with straw packed between the two layers of wire. The straw silo also was 100 feet long, 5 feet deep, and 12 feet wide. Each silo was estimated to hold 150 tons of pressed pulp at 50 pounds per cubic foot.

In this test 304.5 tons of pressed pulp were shipped from the Loveland factory. One half of each carload was stored in the trench silo and the other half in the straw silo. The results were as follows:

	Trench silo	Straw silo
Amount stored, tons	153.44	151.05
Amount fed, tons	108.61	110.43
Percentage loss	29.21	26.89
Moisture at time of storing, percentage	83.33	83.33
Average moisture content throughout period, percent.	84.44	83.88
Acidity, percentage	1.713	1.726

Although the losses were not quite as high in the straw silo, the much lower cost of construction makes the trench silo more desirable.

Without a doubt, the loss when pulp is merely dumped on the ground is greater than in either of the previously mentioned methods of storage. The greater surface exposed to weather causes a higher percentage of drying and rotting which always occurs when air and moisture come in contact with pulp.

Beet Tops.—Sugar beet tops, a protein or growth-producing feed, are available in the fall as soon as the beets are harvested. From the limited information available, indications are that the green weight of tops usually equals from one half to two thirds the weight of beets produced. The dry matter in tops per acre is equal to 10 to 15 per cent of the net weight of the beets. Because of the possibility for wide variation in moisture content, tops are generally considered in terms of tops per ton of beets produced.

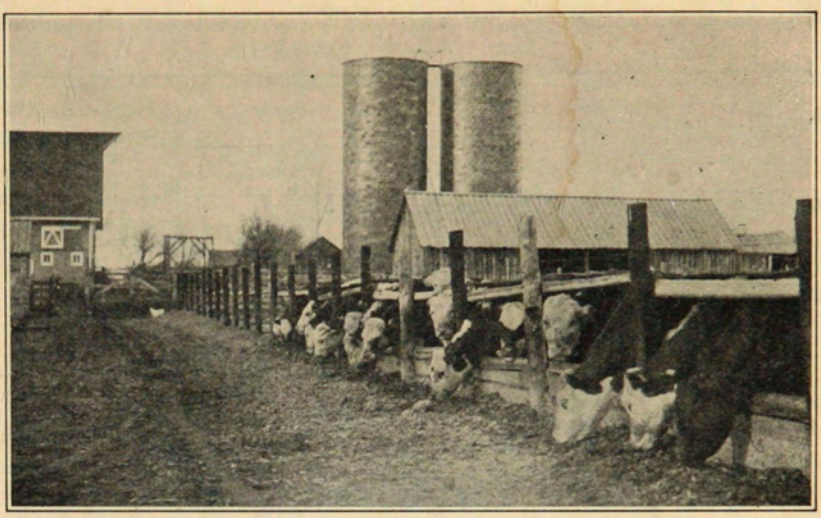


Fig. 15. A simple, yet efficient roughage feed rack for cattle.

According to feeding value under ideal conditions, tops would be worth from 50 cents to $1 per ton of beets, depending on the value of alfalfa hay. The feeder who purchases tops to be pastured must consider a possible substantial loss of value in case of bad weather conditions; consequently, tops usually sell for 25 to 50 cents per ton of beets produced.

One of the common methods of using tops is to turn cattle into the field where the tops are still in the windrows made by the beet toppers at harvest time. Fortunately, this method of utilizing tops is fast disappearing because of the waste and loss of tops through trampling, drying, shattering, and blowing during the fall days. This loss of feed and feed value is even greater during a stormy, wet fall. Snow makes it hard for stock to locate the tops. Rain softens the ground so that cattle trample a great percentage of the tops into the ground.

Experience has shown that it pays to pile tops in the field by gathering them from the windrows into small piles. As a general rule, the tops cure better if the piles are about the size of an inverted washtub. Handling tops in this manner insures against great loss through drying and shattering, cuts trampling to a minimum, and also makes it easier to find the tops when snow covers the ground, whether they are to be pastured, or hauled and fed in drylot.

During the fall and early winter, beet tops usually are fed before cattle are put on a heavy finishing ration. In many instances no grain is fed during this preliminary feeding period, alfalfa being

Table 24.—COMPARISON OF GOOD AND BAD WEATHER CONDITIONS IN PASTURING BEET TOPS WITH CATTLE

Year of test and weather condition	1919 Stormy	1920 Dry and fair
Ration fed	Tops pastured Alfalfa hay	Tops pastured Alfalfa hay
Number of steers per lot	10	10
Total gain per steer (40 days)	24.3	74.3
Average daily gain, pounds	.61	1.86
Average daily feed:		
Beet tops (acres)	.012	.01
Alfalfa, pounds	13.0	5.9
Feed required for 100 pounds gain:		
Beet tops (acres)	2.06	.54
Alfalfa, pounds	2137.3	316.5
Feed cost per cwt. gain	$14.73	$2.89

the only supplementary feed used. When grain prices are low compared with the price of alfalfa, the addition of some carbohydrate feed during this period seems justified. Either wet beet pulp or a light grain ration, fed with tops and alfalfa, tends to balance the ration and give more economical gains.

A 2-year comparison (table 24) of different methods of handling tops shows that, with good weather conditions, cheapest gains are secured where tops are pastured.

A study of the effect of weather conditions on gains indicates, however, that they represent a factor which may seriously affect the feeding value of pastured beet tops. Wet weather results in considerable loss of feed nutrients, and many tops are lost because of being trampled in the mud, where they decay. During such weather, the cattle puddle the soil badly through trampling. Average results actually show most economical returns where tops are piled in small piles in the field and hauled and fed in drylot, rather than pastured. Yet a season of bad weather increases the difficulty of getting beets harvested and delivered, and so makes it more difficult for a farmer to apply labor to the hauling of tops.

Table 25 shows average results of different methods for feeding beet tops to cattle. One season of bad weather in three lowered the gain and increased the cost on the pastured lot enough to make it less economical than the lot where tops were hauled and fed in drylot.

A 2-year comparison, using beet tops as a roughage in a basal ration of barley, cottonseed cake, and alfalfa hay, indicated that the ration was too narrow for optimum gains, even though it did

Table 25.—COMPARISON OF DIFFERENT METHODS FOR FEEDING BEET TOPS TO CATTLE

(3-year average)

Ration fed Weather good 2 years and bad 1 year.	Tops pastured in field Alfalfa	Tops dried and fed in lot Alfalfa	Beet-top silage Alfalfa
Number of steers in lot	10	10	10
Total gain per steer (40 days) pounds	50.2	56.1	57.3
Average daily gain, pounds	1.25	1.40	1.43
Average daily feed:			
Beet tops pastured (acres)	.01		
Beet tops (dried), pounds		23.5	
Beet-top silage, pounds			28.9
Alfalfa, pounds	8.6	17.9	18.4
Feed required for 100 pounds gain:			
Beet tops pastured (acres)	1.12		
Beet tops (dried), pounds		1820.0	
Beet-top silage, pounds			2195.7
Alfalfa, pounds	996.1	1281.2	1330.4
Feed cost per 100 pounds gain	$7.34	$6.71	$8.06

lower cost per unit gain. The tops showed a high feed replacement value. Selling price, dressing percentage, and carcass grade were lower for the steers fed beet tops in addition to barley, cake, and hay.

Each ton of beet tops fed replaced 364.08 pounds of barley and 302.99 pounds of alfalfa but required 24.68 pounds more cottonseed cake; or with feed prices used was worth $4.90 per ton.

Beet Tops Hauled from Field vs. Wet Beet Pulp.—Replacing wet beet pulp with beet tops in a ration of barley, cottonseed cake, and alfalfa, reduced rate of gain, increased feed cost per hundredweight gain, lowered selling price, dressing percentage, and carcass grade.

Each ton of beet tops replaced 7,232.95 pounds of wet beet pulp but required 212.90 pounds more barley, 33.94 pounds more cottonseed cake, and 748.53 pounds more alfalfa; or with feed prices used was worth only 95 cents. In other words, beet tops will not take the place of wet beet pulp in a grain, cake, and hay ration.

Beet-top Silage.—Beet tops were ensiled in an effort to conserve them and to furnish a succulent feed during the whole feeding period. Although this silage gave fairly good results for the short preliminary feed, it proved impractical for the entire feeding period. Beet-top silage, like most protein silages, spoiled quickly when exposed to the air and caused digestive disturbances and scouring, especially when the weather became milder. In wet seasons much dirt is apt to be mixed with the tops, which may cause some digestive trouble when large amounts are fed.

It might be well to mention here that during these last 2 years several feeders have put tops into the silo, and they claim very satisfactory results. They report no spoilage or trouble from scouring. More work is needed to reach final conclusions on the feeding value of tops and the most satisfactory and economical way of handling them.

Piling tops in small piles in the field and hauling and feeding them in drylot proved the most economical method for handling them in the long run, according to the limited work conducted by this station.

Beet Tops Stacked.—During the last few years the practice of stacking beet tops with straw has given satisfactory results. The tops handled in this manner provide a good supplement to a limited pulp allotment, and they are well adapted for wintering steers and cows.

Table 26.—BEET TOPS—CALVES
(2-year average 1927-28, 1928-29)

Ration fed	Ground barley Cottonseed cake Beet tops Alfalfa	Ground barley Cottonseed cake Alfalfa
Number calves per lot	10	9.5
Number days in period	191	191
Feedlot weight at start	364.9	365.4
Final feedlot weight	725.4	747.8
Gain	360.5	382.4
Daily gain	1.89	2.00
Daily ration fed:		
Ground barley	5.08	6.58
Cottonseed cake	1.03	1.01
Beet tops	6.04	.....
Alfalfa	7.12	8.53
Maximum daily feed:		
Ground barley	8.0	9.0
Cottonseed cake	1.2	1.1
Beet tops	10.5	.....
Feed required per cwt. gain at feedlot:		
Ground barley	270.5	329.5
Cottonseed cake	54.8	50.8
Beet tops	324.1	.....
Alfalfa	379.0	428.1
Feed cost per cwt. gain at feedlot	$5.34	$5.52
Selling price per cwt.	$13.17	$13.22
Dressing percentage (cold)	58.1	59.0
Carcass grade	93	94

A 6-inch layer of straw is put on the ground as a foundation of the stack to prevent unnecessary spoilage of the stack bottom. On top of this is piled a 6-inch layer of tops followed by a 2-inch layer of straw; then another 6-inch layer of tops and again a 2-inch layer of straw. This is repeated until the stack reaches the desired height. Experience has been that more than 2 inches of straw is unsatisfactory because it tends to absorb too much of the moisture of the tops and causes them to char.

Furthermore, it was found that it is better to stack green tops than dry ones, because of their better keeping qualities in the stack. Dry tops are hard to pack, and hold much air, which later aids in the growth of molds. It is true that this ordinary white mold is harmless to stock, but stacked tops free from mold are much more palatable.

Table 27.—WET BEET PULP vs. BEET TOPS—CALVES
(2-year average 1927-28, 1928-29)

Ration fed	Ground barley Cottonseed cake Wet pulp Alfalfa	Ground barley Cottonseed cake Beet tops Alfalfa
Number calves per lot	9	10
Number days in period	191	191
Feedlot weight at start	365.4	364.9
Final feedlot weight	762.2	725.4
Gain	396.8	360.5
Daily gain	2.08	1.89
Daily ration fed:		
Ground barley	4.90	5.08
Cottonseed cake	1.02	1.03
Wet beet pulp	24.36	.....
Beet tops	.....	6.04
Alfalfa	5.35	7.12
Maximum daily feed:		
Ground barley	6.9	8.0
Cottonseed cake	1.1	1.2
Wet beet pulp	32.0	.....
Beet tops	.....	10.5
Feed required per cwt. gain at feedlot:		
Ground barley	236.0	270.5
Cottonseed cake	49.3	54.8
Wet beet pulp	1172.1	.....
Beet tops	.....	324.1
Alfalfa	257.7	379.0
Feed cost per cwt. gain at feedlot	$4.69	$5.34
Selling price per cwt.	$13.22	$13.17
Dressing percentage (cold)	59.4	58.1
Carcass grade	94	93

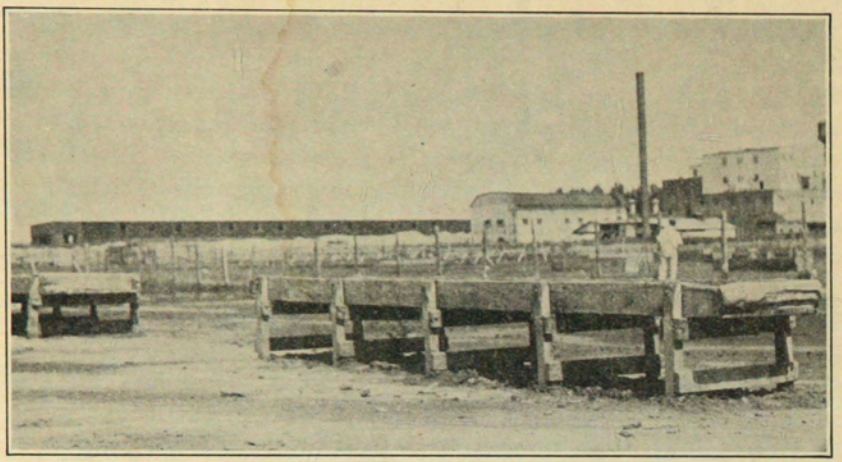


Fig. 16. A combination grain and pulp trough.

A 3-year comparison of beet tops from the stack, and of corn silage used in a wintering ration, shows that beet tops produced a lower rate of gain than silage and also a little more costly gains.

Table 28.—BEET-TOP STACK vs. CORN SILAGE

(3-year average 1928-29, 1929-30, 1930-31)

Ration fed A simple mineral mixture and salt was self-fed in both lots	Beet tops Ground barley Wet pulp Cottonseed cake Alfalfa	Corn silage Ground barley Wet pulp Cottonseed cake Alfalfa
Number steers per lot	18	18
Number days in period	120.3	120.3
Feedlot weight at start	377.2	377.4
Final feedlot weight	565.3	600.8
Gain	188.1	223.4
Daily gain	1.58	1.87
Daily ration fed:		
Ground barley	1.87	1.87
Beet pulp (wet or pressed)	15.17	15.77
Beet tops	12.93	.....
Corn silage	.....	11.43
Cottonseed cake	.50	.50
Alfalfa	5.20	4.23
Feed required per cwt. gain at feedlot:		
Ground barley	118.1	100.2
Beet pulp (wet or pressed)	964.4	846.7
Beet tops	805.9	.....
Corn silage	.....	606.1
Cottonseed cake	31.6	26.7
Alfalfa	328.8	226.5
Feed cost per cwt. gain at feedlot	$4.51	$4.14
Selling price per cwt.	$10.43	$10.55

There also was a 10-cent lower appraisal on the steers fed beet tops from the stack.

Each ton of beet tops replaced only 1,504.16 pounds of corn silage and required 44.42 pounds more barley, 12.16 pounds more cottonseed cake, 292.10 pounds more wet beet pulp, and 253.88 pounds more alfalfa hay; or had 35.11 percent the feeding value of corn silage, and its cost was 55.56 percent that of corn silage.

III. Carbonaceous Roughages

Rotations on the average farm call for considerable roughage production. This roughage is generally of a comparatively low market value and, therefore, must be used in the fattening ration. Some of it can be used as dry fodder, and some can be converted into silage which adds succulence and palatability to an ordinary ration of grain and hay. Especially is this type of feed valuable where wet beet pulp is not available. Then, too, these roughages are needed to "stretch" a limited pulp allotment.

They are generally fed as heavily as the cattle will consume them. Older cattle are much better adapted to handle rough feeds,

Table 29.—CORN SILAGE—2-YEAR-OLDS

Ration fed	3-year-olds		2-year-olds	
	1-year data	1914-15	2-year av'ge	1916-17, 1918
	Ground barley Corn silage Alfalfa	Ground barley Alfalfa	Ground barley Corn silage Alfalfa	Ground barley Alfalfa
Number of steers per lot	10	10	9.5	9
Number of days in period	70	70	133	133
Feedlot weight at start	1062.8	1055.2	800.1	835.5
Final feedlot weight	1247.0	1243.5	1037.3	1078.9
Gain	184.2	188.3	237.2	243.4
Daily gain	2.63	2.69	1.78	1.83
Daily ration fed:				
Ground barley	9.91	12.42	8.34	10.77
Corn silage	36.64	.....	23.01	.....
Alfalfa	9.31	22.44	9.18	16.26
Maximum daily feed*:				
Ground barley	.....	.....	.....	.....
Corn silage	.....	.....	.....	.....
Feed required per cwt. gain at feedlot:				
Ground barley	376.6	461.8	471.6	590.2
Corn silage	1392.5	.....	1284.1	.....
Alfalfa	353.7	834.3	513.4	889.6
Feed cost per cwt. gain at feedlot	$7.93	$7.50	$9.18	$8.87
Selling price per cwt.	$7.20	$7.20	$14.43	$14.11

*Not available.

but even calves consume considerable of these roughages in their fattening ration with apparent relish.

Corn Silage.—Wherever corn would grow, silage, cut when well matured, has been a favorite among feeders. The silo was a means of preserving a part of the corn crop conveniently for feeding. Cattle liked silage, and it added succulence to a grain and hay ration, giving cattle an added amount of sleek finish. Now that trench silos can be constructed so cheaply, and the fact has been established that trench silos will preserve the crop as fully and as well as the more expensive upright silos, more silage is being made every year for use in fattening and dairy rations.

When fed to 2- and 3-year-old steers (table 29), silage added to a ration of barley and alfalfa did not increase gains, but it saved a considerable amount of grain and hay to produce unit gains. Each ton of silage fed to 3-year-olds in a ration of barley and alfalfa saved or replaced 122.37 pounds of barley and 690.27 pounds of alfalfa. In the same ration fed to 2-year-olds, each ton of silage replaced 185.10 pounds of barley and 585.94 pounds of alfalfa hay.

Furthermore, the addition of silage to this ration enhanced selling price and increased dressing percentage rather substantially.

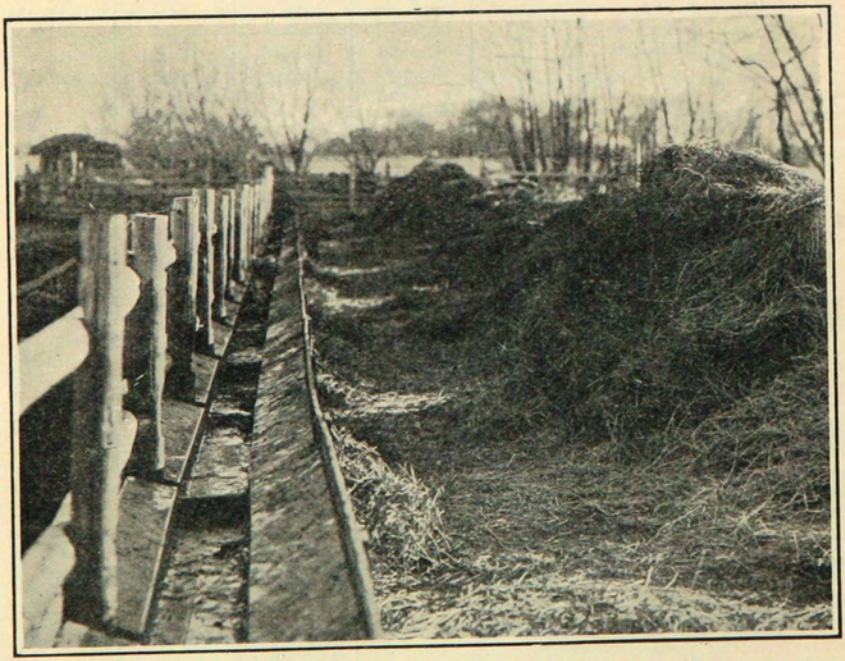


Fig. 17. A practical hay bunk for molasses feeding. Beet molasses spread over hay in this bunk eliminates the wasting of hay.

Corn silage added to a grain, cake, and hay ration for calves (table 30) had no beneficial effects on rate of gain, but it again saved considerable amounts of grain and hay, increased selling price, slightly cheapened cost of gain, and increased dressing percentage of the calves.

Each ton of silage fed replaced 176.74 pounds of barley and 799.85 pounds of alfalfa hay but required 4.78 pounds more cottonseed cake; or with feed prices used was worth $4.71 per ton.

Cut Corn Fodder vs. Corn Silage.—On farms without silos, the corn crop is fed in the form of corn fodder. The fodder is usually fed directly from the shocks in the field. It is unwise to attempt to put through a cutter and store more than one load of fodder at a time, because only a small amount of moisture either within the plant or on the outside will cause it to heat and develop an undesirable taste and odor, making it unfit for the fattening ration.

Table 30.—CORN SILAGE ADDED TO GRAIN-CAKE-HAY RATION—CALVES
(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Corn silage Alfalfa	Ground barley Cottonseed cake Alfalfa
Number of calves per lot	10	8
Number of days in period	194.5	194.5
Feedlot weight at start	417.12	423.2
Final feedlot weight	802.5	818.5
Gain	385.3	395.3
Daily gain	1.98	2.03
Daily ration fed:		
Ground barley	4.51	6.09
Cottonseed cake	.98	.98
Corn silage	15.59	.....
Alfalfa	4.25	10.98
Maximum daily feed:		
Ground barley	6.01	7.5
Cottonseed cake	1.0	1.0
Corn silage	18.0	.....
Feed required per cwt. gain at feedlot:		
Ground barley	225.1	295.3
Cottonseed cake	49.8	47.9
Corn silage	794.4	.....
Alfalfa	220.2	537.9
Feed cost per cwt. gain at feedlot	$5.52	$5.60
Selling price per cwt.	$9.11	$9.06
Dressing percentage (cold)	59.8	58.6
Carcass grade	88	89

It is best to cut whole fodder through a silage cutter or some other type of mill to prevent excessive waste which occurs when attempts are made to feed it whole.

In a 1-year comparison, corn fodder vs. corn silage when fed along with barley, linseed oil cake, and alfalfa hay (table 31), corn silage produced a slightly greater rate of gain and also much cheaper gains than did cut corn fodder. The silage-fed steers also sold for slightly more per hundredweight and dressed higher than the fodder-fed steers. The carcass grade in the coolers, however, was decidedly in favor of the steers fed corn fodder.

Each ton of fodder replaced 4,370.63 pounds of corn silage and 30.97 pounds of alfalfa but required 55.94 pounds more barley and 10.99 pounds more cottonseed cake; or had a value of $9.27 per ton. With corn silage at $4.50 per ton, corn fodder showed a fraction over two times the feed value of corn silage.

Figuring returns on an average basis, each acre of corn returned $35.41 in the form of dried fodder and $52.65 in the form of silage. The yield of the dry fodder was 3.82 tons per acre and that of green fodder 11.7 tons per acre. In other words, it was by far more economical to use this corn crop as silage than as corn fodder.

A 2-year comparison also shown in table 31, when wet beet pulp was included in the ration, again shows silage to produce a somewhat higher rate of gain, cheaper gains, and a higher dressing percentage but a lower carcass grade.

Each ton of corn fodder fed in these tests replaced 4,568.79 pounds of corn silage and 50.66 pounds of barley but required 13.82

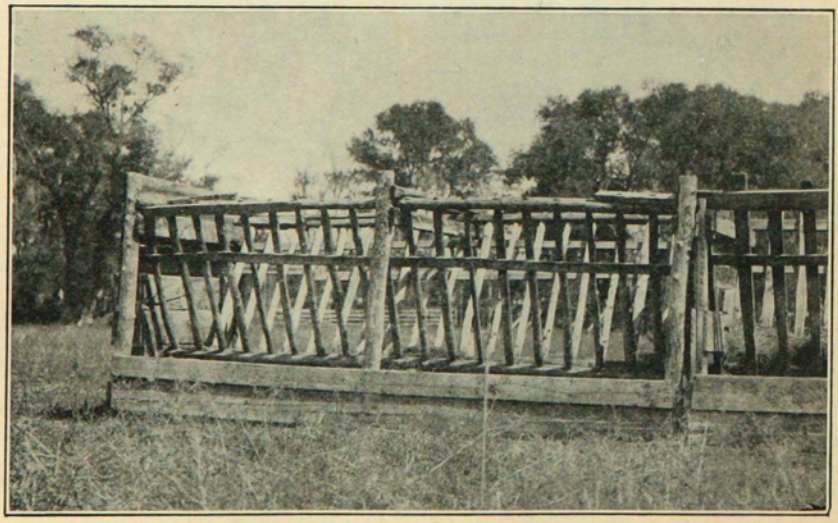


Fig. 18. This type of hay feeder is cheap, yet satisfactory for winter use.

pounds more cottonseed cake, 283.25 pounds more wet beet pulp, and 75.99 pounds more alfalfa hay; or with feed prices used was worth $10.03 per ton. With corn silage costing $4.50 per ton, cut corn fodder was worth 2.23 times as much per ton. Figures showing actual yields for these 2 years were destroyed by fire, but taking those for the year 1924-25 of 3.82 tons per acre of dry fodder and 11.7 tons per acre of green fodder, each acre of corn returned $38.31 in the form of dry fodder and $52.65 as silage, again a decided advantage in favor of corn silage.

Table 31.—CORN FODDER vs. CORN SILAGE—CALVES

	1-year data 1924-25		2-year average 1925-26	1926-27
Ration fed	Ground barley Linseed-oil cake Corn fodder Alfalfa	Ground barley Linseed-oil cake Corn silage Alfalfa	Ground barley Cottonseed cake Corn fodder Wet pulp Alfalfa	Ground barley Cottonseed cake Corn silage Wet pulp Alfalfa
Number calves per lot	10	10	10	10
Number days in period	208	208	195	195
Feedlot weight at start	344.7	347.8	350.3	348.1
Final feedlot weight	774.0	785.0	745.7	752.2
Gain	429.3	437.2	395.3	404.1
Daily gain	2.06	2.10	2.03	2.07
Daily ration fed:				
Ground barley	6.88	6.88	4.70	4.86
Protein supplement	1.04	1.03	.99	.99
Corn fodder	4.14	.....	3.53	.....
Corn silage	.....	9.16	.....	8.22
Wet beet pulp	.....	.....	16.46	16.47
Alfalfa	4.75	4.90	4.12	4.05
Maximum daily feed:				
Ground barley	9.4	9.4	8.0	8.0
Protein supplement	1.5	1.5	1.5	1.5
Corn fodder	6.0	.....	4.2	.....
Corn silage	.....	12.0	.....	9.5
Wet beet pulp	.....	.....	20.0	20.0
Feed required per cwt. gain at feedlot:				
Ground barley	337.1	331.5	231.1	235.5
Protein supplement	50.3	49.2	49.1	47.9
Corn fodder	200.2	.....	173.7	.....
Corn silage	.....	437.5	.....	396.8
Wet beet pulp	.....	.....	816.1	791.5
Alfalfa	230.0	233.1	202.7	196.1
Feed cost per cwt. gain at feedlot	$6.16	$5.87	$5.25	$5.07
Selling price per cwt.	$10.78	$10.81	$9.76	$9.91
Dressing percentage (cold)	58.4	59.7	61.8	62.3
Carcass grade	96	92	92	91

Corn and Soybean Silage vs. Corn Silage.—The forage production per acre of corn and soybeans planted together was 11.55 tons, and the forage production per acre for corn planted alone was 11.7 tons. The acre production of ear corn from the corn and soybean field was 4,120 pounds, while that of the corn field was 4,593 pounds.

In this test (table 32), corn and soybean silage showed a slightly greater rate of gain than corn silage but also a slightly higher feed cost per unit of gain. Dressing percentage and carcass grade were a shade better with the corn silage-fed steers, but selling price favored those fed corn and soybean silage.

Each ton of corn and soybean silage replaced 2,058.82 pounds of corn silage, 44.24 pounds of barley, and 5.65 pounds of linseed oil cake but required 177.88 pounds more alfalfa. With feed prices used, each ton was worth $4.41.

Table 32.—CORN AND SOYBEAN SILAGE vs. CORN SILAGE—CALVES
(1-year data 1924-25)

Ration fed	Ground barley Linseed-oil cake Corn silage Alfalfa	Ground barley Linseed oil-cake Corn and soybean silage Alfalfa
Number calves per lot	10	10
Number days in period	208	208
Feedlot weight at start	347.8	345.5
Final feedlot weight	785.0	795.5
Gain	437.2	450.0
Daily gain	2.10	2.16
Daily ration fed:		
Ground barley	6.88	6.89
Linseed-oil cake	1.03	1.04
Corn silage	9.16	.....
Corn and soybean silage	.....	9.16
Alfalfa	4.90	5.86
Maximum daily feed:		
Ground barley	9.4	9.4
Linseed-oil cake	1.5	1.5
Corn silage	12.0	.....
Corn and soybean silage	.....	12.0
Feed required per cwt. gain at feedlot:		
Ground barley	331.5	322.1
Linseed-oil cake	49.2	48.0
Corn silage	437.5	.....
Corn and soybean silage	.....	425.0
Alfalfa	233.1	270.9
Feed cost per cwt. gain at feedlot	$5.87	$5.90
Selling price per cwt.	$10.81	$10.89
Dressing percentage (cold)	59.7	59.3
Carcass grade	92	91

Fig. 19. Cutting sunflowers for silage.

Sunflower Silage vs. Corn Silage.—Sunflowers grown at the station here averaged about twice the yield per acre secured with corn. It has been impossible to harvest them with a cornbinder. The sunflowers were cut in the field, using a sled with knife attachment (see fig. 20, p. 54, showing construction) which worked very satisfactorily.

Sunflowers must be cut at the early bloom stage for the production of the most palatable silage. Silage made from sunflowers which are more than one third in bloom is unpalatable, woody, and resinous. The latter is the type of sunflower silage used in feeding 3-year-old steers in 1921-22 as reported in table 33. In that particular year, the corn silage used was bright but contained very little corn. A better quality of corn silage would undoubtedly have shown a greater difference between this mature type of sunflower silage and corn silage.

Sunflower silage, in this test, produced a lower rate of gain than corn silage, and also more expensive gains. Selling price was the same for the two lots of steers, although dressing percentage and carcass grade were in favor of the steers fed sunflower silage.

Each ton of sunflower silage replaced only 1,768.12 pounds of corn silage and required 108.68 pounds more dried molasses beet pulp, 23.75 pounds more cottonseed cake, and 290.33 pounds more alfalfa; or with feed prices used was worth only 37.11 percent as much as corn silage.

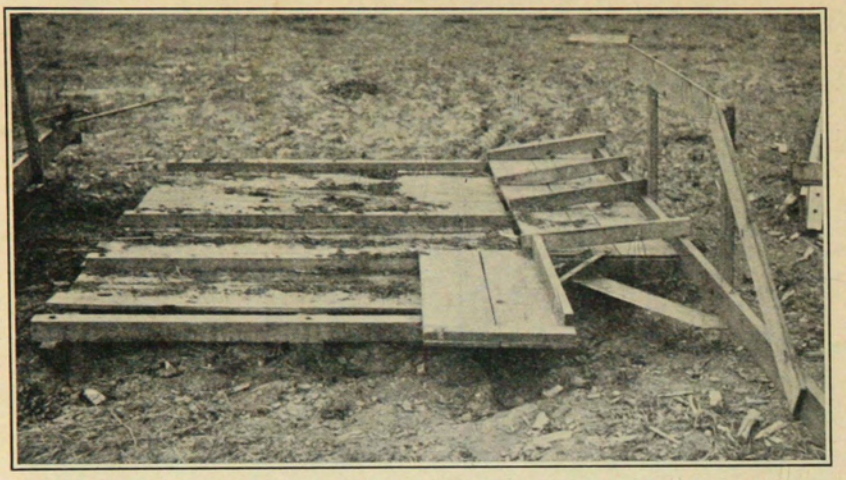


Fig. 20. Sled for cutting sunflowers.

Each acre of corn yielding 10.3 tons of green fodder returned $46.35 in the form of silage, whereas each acre of sunflowers yielding 20.3 tons of green flowers returned only $33.90 in the form of sunflower silage.

Feeding sunflower silage to yearlings in a ration of dried molasses beet pulp, cottonseed cake, and alfalfa hay again produced a slower rate of gain and costlier gains than corn silage (table 33). Also, dressing percentage and carcass grade were in favor of the steers fed corn silage.

Each ton of sunflower silage replaced only 1,585.37 pounds of corn silage and required 134.16 pounds more dried molasses beet pulp, 14.12 pounds more cottonseed cake, and 89.82 pounds more alfalfa hay. In other words, sunflower silage showed 45.33 percent the feeding value of corn silage, ton for ton.

Another comparison between sunflower and corn silage used in a ration of barley and alfalfa hay gives much the same results: lower rate of gain and higher cost of gain, with no advantage in selling price, dressing percentage, and carcass grade in the lot fed sunflower silage.

Each ton of sunflower silage replaced 1,971.74 pounds of corn silage and required 69.31 pounds more barley and 332.31 pounds more alfalfa; or showed 55.33 percent the feeding value of corn silage. This higher replacement percentage in this particular comparison is to be expected, since sunflower silage contains half again as much protein as corn silage, and the ration used contained no protein supplement.

In conclusion, it can be said that sunflowers, when yield in this locality is considered, present a means of adding a succulent feed

to the fattening ration which is quite comparable to corn silage if cut in the early bloom stage. They are, however, difficult to handle in harvesting and cutting, and use of corn seems advisable where yields of corn are half as great as the yields of sunflowers.

Corn yields lessen rapidly with increase in altitude, and sunflowers are grown successfully at altitudes where corn is a poor

Table 33.—SUNFLOWER SILAGE vs. CORN SILAGE

	3-year-olds 1-year data 1921–22		Yearlings 1-year data 1922-23		Yearlings 1-year data 1923–24	
Ration fed	Dried molasses beet pulp Cottonseed cake Sunflower silage Alfalfa	Dried molasses beet pulp Cottonseed cake Corn silage Alfalfa	Dried molasses beet pulp Cottonseed cake Sunflower silage Alfalfa	Dried molasses beet pulp Cottonseed cake Corn silage Alfalfa	Barley Sunflower silage Alfalfa	Barley Corn silage Alfalfa
Number steers per lot	10	10	10	10	10	10
Number days in period	140	140	180	180	186	186
Feedlot weight at start	1051.8	1053.7	722.7	708.7	759.8	756.8
Final feedlot weight	1344.8	1385.3	1119.0	1126.8	1157.5	1178.0
Gain	293.0	331.6	396.3	418.2	397.7	421.2
Daily gain	2.09	2.37	2.20	2.32	2.21	2.26
Daily ration fed:						
Ground barley	.....	.....	.....	.....	12.12	11.81
Dried molasses beet pulp	11.35	11.34	10.7	10.2	.....	.....
Cottonseed cake	2.57	2.58	2.1	2.1	.....	.....
Sunflower silage	24.50	.....	15.6	.....	17.94	.....
Corn silage	.....	24.51	.....	13.0	.....	18.17
Alfalfa	9.60	6.84	7.7	7.4	10.86	8.09
Maximum daily feed:						
Ground barley	.....	.....	.....	.....	17.0	17.0
Dried molasses beet pulp	14.0	14.0	14.0	13.0	.....	.....
Cottonseed cake	3.0	3.0	3.0	3.0	.....	.....
Sunflower silage	30.0	.....	23.0	.....	25.0	.....
Corn silage	.....	30.0	.....	23.0	.....	25.0
Feed required per cwt. gain at feedlot:						
Ground barley	.....	.....	.....	.....	549.8	521.6
Dried molasses beet pulp	542.3	478.7	484.9	437.4	.....	.....
Cottonseed cake	122.6	108.7	95.8	90.8	.....	.....
Sunflower silage	1170.4	.....	708.1	.....	813.7	.....
Corn silage	.....	1034.7	.....	561.3	.....	802.2
Alfalfa	458.8	288.9	351.0	319.2	492.5	357.3
Feed cost per cwt. gain at feedlot	$9.71	$8.63	$7.61	$7.10	$8.34	$7.92
Selling price per cwt.	$8.25	$8.25	$10.35	$10.33	$9.53	$9.61
Dressing percentage	63.0	62.5	63.8	65.5	61.3	62.5
Carcass grade	1	3	87	93	94	94

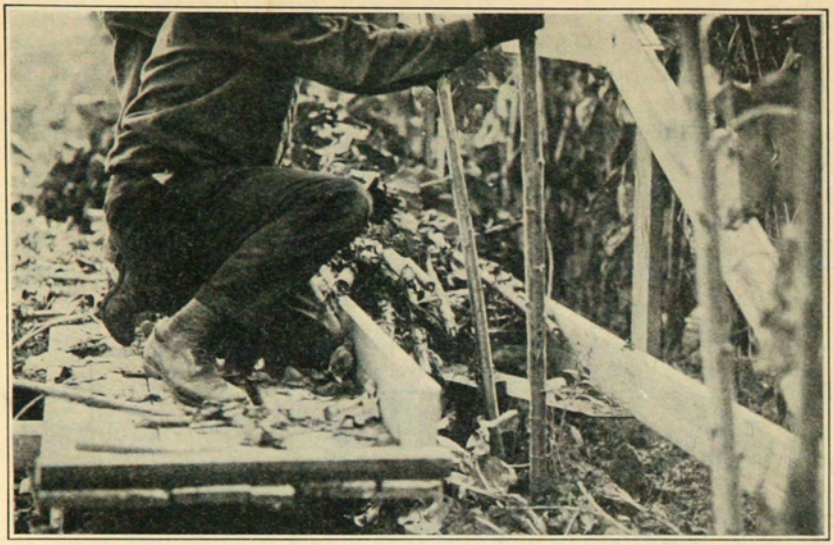


Fig. 21. The sunflower-cutting sled in operation.

crop and even where corn runs the risk of being frozen any month in the year. It is at these higher altitudes that sunflower silage may be considered a valuable feed in view of the comparisons given above.

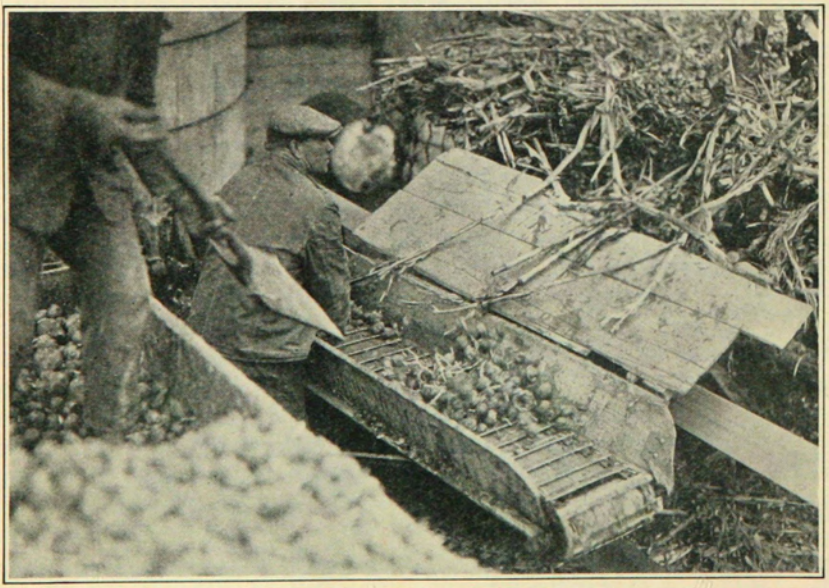


Fig. 22. Making potato-corn fodder silage.

Potatoes. —Potatoes are often of low market value, with little or no sale for culls. At such times they can well be utilized in a cattle-fattening ration. All spoiled potatoes should be thrown out, of course. For safety's sake, all potatoes fed should be sliced. This may be done with a cheap hand root-cutter, or they may be cut up with a sharp spade. Feeding potatoes whole has frequently caused choking in cattle, which may result in death loss. During cold weather, potatoes should be stored in a frost-proof cellar, since frozen potatoes may cause digestive disorders. Cooking potatoes is not to be recommended, because it makes them less digestible for cattle.

A 2-year comparison, using cull potatoes as a supplement in a barley, cake, and hay ration, shows (table 34) that the addition of potatoes somewhat retarded rate of gain; that it decreased the amount of grain and hay required, but increased cake requirements so that total feed cost per unit of gain was also increased. The potato-fed cattle sold for practically the same as the checklot; they

Table 34.—POTATOES ADDED TO GRAIN-CAKE-HAY RATION—CALVES
(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Cull potatoes Alfalfa	Ground barley Cottonseed cake Alfalfa
Number calves per lot	10	8
Number days in period	194.5	194.5
Feedlot weight at start	419.6	423.2
Final feedlot weight	801.8	818.5
Gain	382.2	395.3
Daily gain	1.97	2.03
Daily ration fed:		
Ground barley	4.51	6.09
Cottonseed cake	.98	.98
Cull potatoes	16.39	.....
Alfalfa	7.57	10.98
Maximum daily feed:		
Ground barley	6.0	7.5
Cottonseed cake	1.0	1.0
Cull potatoes	20.0	.....
Feed required per cwt. gain at feedlot:		
Ground barley	229.6	295.3
Cottonseed cake	50.7	47.9
Cull potatoes	846.3	.....
Alfalfa	389.9	537.9
Feed cost per cwt. gain at feedlot	$5.95	$5.60
Selling price per cwt.	$9.07	$9.06
Dressing percentage (cold)	59.6	58.6
Carcass grade	85	89

showed, however, a greater dressing percentage, even though carcass grades were lower than those of the cattle fed barley, cake, and hay.

Each ton of cull potatoes replaced 155.26 pounds of barley and 349.76 pounds of alfalfa but required 6.62 pounds more cottonseed cake; or with feed prices used was worth $2.69 per ton.

Potatoes vs. Corn Silage.—Comparing cull potatoes with corn silage when used as a supplement in a barley, cake, and hay ration (table 35), the test shows potatoes produce about the same rate of gain as silage but increase the cost per unit of gain.

Each ton of potatoes fed in a ration of barley, linseed oil cake,

Table 35.—POTATOES vs. CORN SILAGE—CALVES

	1-year data 1924–25		2-year average 1929–30, 1930–31	
Ration fed	Ground barley Linseed-oil cake Corn silage Alfalfa	Ground barley Linseed-oil cake Potatoes Alfalfa	Ground barley Cottonseed cake Corn silage Alfalfa	Ground barley Cottonseed cake Potatoes Alfalfa
Number calves per lot	10	10	10	10
Number days in period	208	208	194.5	194.5
Feedlot weight at start	347.8	348.5	417.2	419.6
Final feedlot weight	785.0	782.5	802.5	801.8
Gain	437.2	434.0	385.3	382.2
Daily gain	2.10	2.09	1.98	1.97
Daily ration fed:				
Ground barley	6.88	6.88	4.51	4.51
Protein supplement	1.03	1.04	.98	.98
Corn silage	9.16	.....	15.59	.....
Cull potatoes	.....	9.05	.....	16.39
Alfalfa	4.90	6.70	4.25	7.57
Maximum daily feed:				
Ground barley	9.4	9.4	6.0	6.0
Protein supplement	1.5	1.5	1.0	1.0
Corn silage	12.0	.....	18.0	.....
Cull potatoes	.....	12.0	.....	20.0
Feed required per cwt. gain at feedlot:				
Ground barley	331.5	333.5	225.1	229.6
Protein supplement	49.2	49.7	49.8	50.7
Corn silage	437.5	.....	794.4	.....
Cull potatoes	.....	417.3	.....	846.3
Alfalfa	233.1	321.2	220.2	389.9
Feed cost per cwt. gain at feedlot	$5.87	$6.00	$5.52	$5.95
Selling price per cwt.	$10.81	$10.73	$9.11	$9.07
Dressing percentage (cold)	59.7	60.1	59.8	59.6
Carcass grade	92	93	88	85

and alfalfa hay replaced 2,096.82 pounds of silage but required 9.59 pounds more barley, 2.40 pounds more linseed oil cake and 422.24 pounds more alfalfa hay. With feed prices used it was worth $2.89, or 64.22 percent the value of silage.

In a ration of barley, cottonseed cake and alfalfa, each ton of potatoes replaced only 1,877.35 pounds of corn silage and required 10.63 pounds more barley, 2.13 pounds more cottonseed cake, and 401.04 pounds more alfalfa. Each ton of potatoes, therefore, was worth $2.48, or 55.11 percent the value of corn silage.

Potatoes vs. Potato Silage.—Comparing cull potatoes with potato silage in a ration of barley, linseed oil cake, and alfalfa hay (table 36), potato silage produced a greater rate of gain and also a cheaper gain than cull potatoes. Dressing percentage and carcass grade favored the steers fed cull potatoes.

Table 36.—POTATOES vs. POTATO SILAGE—CALVES
(1-year data 1924-25)

Ration fed	Ground barley Linseed-oil cake Cull potatoes Alfalfa	Ground barley Linseed-oil cake Potato silage Alfalfa
Number calves per lot	10	9
Number days in period	208	208
Feedlot weight at start	348.5	358.0
Final feedlot weight	782.5	807.2
Gain	434.0	449.2
Daily gain	2.09	2.16
Daily ration fed:		
Ground barley	6.88	6.89
Linseed-oil cake	1.04	1.04
Cull potatoes	9.05	.....
Potato silage	.....	7.44
Alfalfa	6.70	6.71
Maximum daily feed:		
Ground barley	9.4	9.0
Linseed-oil cake	1.5	1.5
Cull potatoes	12.0	.....
Potato silage	.....	12.0
Feed required per cwt. gain at feedlot:		
Ground barley	333.5	324.6
Linseed-oil cake	49.7	48.0
Cull potatoes	417.3	.....
Potato silage	.....	331.2
Alfalfa	321.2	311.9
Feed cost per cwt. gain at feedlot	$6.00	$5.88
Selling price per cwt.	$10.73	$10.72
Dressing percentage (cold)	60.1	58.7
Carcass grade	93	91

Table 37.—POTATO SILAGE vs. CORN SILAGE—CALVES
(1-year data 1924-25)

Ration fed	Ground barley Linseed-oil cake Corn silage Alfalfa	Ground barley Linseed-oil cake Potato silage Alfalfa
Number calves per lot	10	9
Number days in period	208	208
Feedlot weight at start	347.8	358.0
Final feedlot weight	785.0	807.2
Gain	437.2	449.2
Daily gain	2.10	2.16
Daily ration fed:		
Ground barley	6.88	6.89
Linseed-oil cake	1.03	1.04
Corn silage	9.16	.....
Potato silage	.....	7.44
Alfalfa	4.90	6.71
Maximum daily feed:		
Ground barley	9.4	9.0
Linseed-oil cake	1.5	1.5
Corn silage	12.0	.....
Potato silage	.....	12.0
Feed required per cwt. gain at feedlot:		
Ground barley	331.5	324.6
Linseed-oil cake	49.2	48.0
Corn silage	437.5	.....
Potato silage	.....	331.2
Alfalfa	233.1	311.9
Feed cost per cwt. gain at feedlot	$5.87	$5.88
Selling price per cwt.	$10.81	$10.72
Dressing percentage (cold)	59.7	58.7
Carcass grade	92	91

Each ton of potato silage replaced 2,519.93 pounds of potatoes, 53.74 pounds of barley, 10.27 pounds of linseed oil cake, and 56.16 pounds of alfalfa hay; or was worth $5.32 per ton.

Quite a bit of difficulty was experienced in removing potato silage from the silo because of its high moisture content. If potatoes are put up in a silo, it should be remembered to provide good drainage to allow a large part of the moisture to drain off.

Potato Silage vs. Corn Silage.—Potato silage compares very favorably with corn silage in a ration of barley, linseed oil cake, and alfalfa hay (table 37). There is a tendency toward a greater rate of gain when potato silage furnishes the succulence. Feed costs per hundredweight gain and selling price per hundredweight are approximately equal. Dressing percentage and carcass grade are, however, higher with the steers fed corn silage.

Each ton of potato silage replaced 2,641.91 pounds of corn silage, 41.67 pounds of barley, and 7.25 pounds of linseed oil cake but required 475.85 pounds more alfalfa hay; or with feed prices used was worth $4.57 per ton.

Table 38.—POTATO-CORN FODDER SILAGE ADDED TO GRAIN-CAKE-HAY RATION —CALVES

(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Potato-corn fodder silage Alfalfa	Ground barley Cottonseed cake Alfalfa
Number calves per lot	10	8
Number days in period	194.5	194.5
Feedlot weight at start	418.1	423.2
Final feedlot weight	804.3	818.5
Gain	386.2	395.3
Daily gain	1.99	2.03
Daily ration fed:		
Ground barley	4.51	6.09
Cottonseed cake	.98	.98
Potato-corn fodder silage	15.55	.....
Alfalfa	5.35	10.98
Maximum daily feed:		
Ground barley	6.0	7.5
Cottonseed cake	1.0	1.0
Potato-corn fodder silage	18.0	.....
Feed required per cwt. gain at feedlot:		
Ground barley	221.5	295.3
Cottonseed cake	48.9	47.9
Potato-corn fodder silage	776.7	.....
Alfalfa	270.4	537.9
Feed cost per cwt. gain at feedlot	$5.63	$5.60
Selling price per cwt.	$9.06	$9.06
Dressing percentage (cold)	59.5	58.6
Carcass grade	88	89

Potato-Corn Fodder Silage.—In order to avoid the high moisture content of potato silage, 18 percent of dry corn fodder by weight and 82 percent cull potatoes were cut into a silo during the spring, and the silo was sealed after fermentation was completed. This silage was partly fed the following fall and the rest sealed up again and fed a year later. The silage proved to be a palatable feed both years and furnished a satisfactory means of saving potatoes which were on the verge of spoiling.

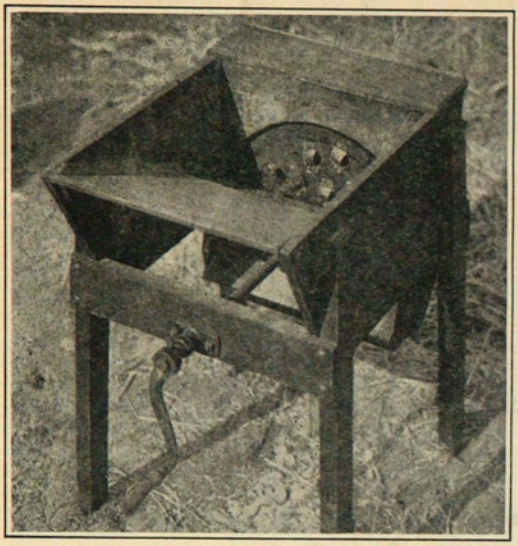


Fig. 23. A low-priced root cutter with good capacity.

Potato-corn fodder silage, added to a ration of barley, cottonseek cake, and alfalfa hay, produced a slightly lower rate of gain but produced unit gains almost as cheaply as the checklot (table 38). Each ton of potato-corn fodder silage fed showed a replacement value of $4.43. Each ton replaced 190.04 pounds of barley and 688.81 pounds of alfalfa but required 2.58 pounds more cottonseed cake.

Potatoes vs. Potato-Corn Fodder Silage.—There is little choice between potatoes and potato-corn fodder silage as far as rate of gain is concerned (table 39). But potato-corn fodder silage cheapened cost per unit of gain, sold for the same per hundredweight, and produced carcasses of a higher grade than did cull potatoes.

Each ton of potato-corn fodder silage replaced 2,179.22 pounds of cull potatoes, 20.86 pounds of barley, 4.64 pounds of cottonseed cake, and 307.71 pounds of alfalfa hay; or was worth $5.31 per ton. With feed prices used, potato-corn fodder silage showed 118 percent the feeding value of cull potatoes.

Table 39.—CULL POTATOES vs. POTATO-CORN FODDER SILAGE—CALVES
(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Cull potatoes Alfalfa	Ground barley Cottonseed cake Potato-corn fodder silage Alfalfa
Number calves per lot	10	10
Number days in period	194.5	194.5
Feedlot weight at start	419.6	418.1
Final feedlot weight	801.8	804.3
Gain	382.2	386.2
Daily gain	1.97	1.99
Daily ration fed:		
Ground barley	4.51	4.51
Cottonseed cake	.98	.98
Cull potatoes	16.39	.....
Potato-corn fodder silage	.....	15.55
Alfalfa	7.57	5.35
Maximum daily feed:		
Ground barley	6.0	6.0
Cottonseed cake	1.0	1.0
Cull potatoes	20.0	.....
Potato-corn fodder silage	.....	18.0
Feed required per cwt. gain at feedlot:		
Ground barley	229.6	221.5
Cottonseed cake	50.7	48.9
Cull potatoes	846.3	.....
Potato-corn fodder silage	.....	776.7
Alfalfa	389.9	270.4
Feed cost per cwt. gain at feedlot	$5.95	$5.63
Selling price per cwt	$9.07	$9.06
Dressing percentage (cold)	59.6	59.5
Carcass grade	85	88

Potato-Corn Fodder Silage vs. Corn Silage.—In a ration of barley, cottonseed cake, and alfalfa hay (table 40), potato-corn fodder silage produced the same rate of gain as corn silage but at a slightly greater cost for each hundred pounds of gain. The steers sold for 5 cents per hundredweight less, but dressing percentage and carcass grade were approximately equal in the two lots.

Each ton of potato-corn fodder silage replaced 2,045.58 pounds of corn silage, 9.27 pounds of barley, and 2.32 pounds of cottonseed cake but required 129.27 pounds more alfalfa. With feed prices used, potato corn-fodder silage was worth $4.20 per ton, or showed 93.33 percent the feeding value of corn silage.

Fig. 24. Cutting corn directly into the trench and using a team to distribute and pack the silage.

Fig. 25. Cutting potatoes through an ordinary ensilage cutter to make potato silage. Two per cent of corn chop added through the hopper insures the proper fermentation.

Table 40.—POTATO-CORN FODDER SILAGE vs. CORN SILAGE—CALVES
(2-year average 1929-30, 1930-31)

Ration fed	Ground barley Cottonseed cake Potato-corn fodder silage Alfalfa	Ground barley Cottonseed cake Corn silage Alfalfa
Number calves per lot	10	10
Number days in period	194.5	194.5
Feedlot weight at start	418.1	417.2
Final feedlot weight	804.3	802.5
Gain	386.2	385.3
Daily gain	1.99	1.98
Daily ration fed:		
Ground barley	4.51	4.51
Cottonseed cake	.98	.98
Potato-corn fodder silage	15.55	.....
Corn silage	.....	15.59
Alfalfa	5.35	4.25
Maximum daily feed:		
Ground barley	6.0	6.0
Cottonseed cake	1.0	1.0
Potato-corn fodder silage	18.0	.....
Corn silage	.....	18.0
Feed required per cwt. gain at feedlot:		
Ground barley	221.5	225.1
Cottonseed cake	48.9	49.8
Potato-corn fodder silage	776.7	.....
Corn silage	.....	794.4
Alfalfa	270.4	220.2
Feed cost per cwt. gain at feedlot	$5.63	$5.52
Selling price per cwt.	$9.06	$9.11
Dressing percentage (cold)	59.5	59.8
Carcass grade	SS	SS

IV. Protein Concentrates

The great majority of feeds available to Colorado feeders are low in protein. Alfalfa hay, a home-grown protein carrier, generally constitutes only a small percentage of the entire ration fed, due to the use of so many other bulky feeds. The protein content of the average ration, therefore, is low unless some standard commercial supplement is added.

In a cooperative test carried out with the Haley-Harris Company, commercial feeders of Sterling, Colo., a comparison of supplemental feed values was made in a simple test in 1917 (table 41). The results from this test served to substantiate earlier findings with regard to the beneficial value of cottonseed cake when fed with the beet by-product combination.

Three pounds of cottonseed cake fed daily with a wet beet pulp, beet molasses, and alfalfa hay ration to 3-year-old steers increased the daily gain from 1.54 pounds per head to 2.48 pounds per head daily and reduced unit cost of gain.

Each ton of cottonseed cake replaced, or was equal to, 31,397.06 pounds of wet beet pulp, 1,919.72 pounds of beet molasses, and 5,632.79 pounds of alfalfa.

This early cooperative feeding test very forcefully demonstrates the necessity of adding some high-quality commercial supplement to beet by-product fattening rations if maximum and most economical gains are expected.

Table 41.—COOPERATIVE FEEDING EXPERIMENT WITH HALEY-HARRIS FEEDING COMPANY, STERLING, COLORADO

(1-year data, 1917)

Ration fed	Wet beet pulp Beet molasses Alfalfa	Wet beet pulp Beet molasses Cottonseed cake Alfalfa
Number steers per lot	17	17
Number days in period	117	117
Feedlot weight at start	1059.0	1086.0
Final feedlot weight	1255.0	1401.0
Gain	196.0	315.0
Daily gain	1.54	2.48
Daily ration fed:		
Wet beet pulp	95.0	106.9
Beet molasses	4.7	4.6
Cottonseed cake	.....	2.9
Alfalfa	9.8	7.6
Feed required per cwt. gain at feedlot:		
Wet beet pulp	6143.5	4305.2
Beet molasses	299.3	186.9
Cottonseed cake	.....	117.1
Alfalfa	634.0	304.2
Feed cost per cwt. gain at feedlot	$7.58	$6.59

The Value of Cottonseed Cake.—Although cottonseed cake has been shown beneficial when fed in beet by-product rations, results in this particular test (table 42) seem to show that 2 pounds per head per day of cottonseed cake for yearlings is too great an amount to be economical. It is true that the addition of cake to a ration of barley, sunflower silage, and alfalfa hay increased the rate of gain considerably. It also decreased the amount of barley, sunflower silage, and alfalfa per unit of gain, but the feed cost was increased so that 2 pounds of cake proved uneconomical. Furthermore, it had no desirable effect on dressing percentage or carcass grade, even though it did increase selling price.

Experimental work at other stations has demonstrated quite definitely the economy of adding 1 pound of protein supplement to a grain, silage, and hay ration.

Table 42.—VALUE OF COTTONSEED CAKE—YEARLINGS
(2-year average 1922-23, 1923-24)

Ration fed	Ground barley Sunflower silage Alfalfa	Ground barley Cottonseed cake Sunflower silage Alfalfa
Number steers per lot	10	10
Number days in period	183	183
Feedlot weight at start	738.2	735.1
Final feedlot weight	1125.8	1139.2
Gain	387.6	404.1
Daily gain	2.12	2.21
Daily ration fed:		
Ground barley	11.31	11.14
Cottonseed cake		1.85
Sunflower silage	17.83	16.83
Alfalfa	9.69	7.84
Maximum daily feed:		
Ground barley	16.5	15.5
Cottonseed cake		2.8
Sunflower silage	25.0	25.0
Feed required per cwt. gain at feedlot:		
Ground barley	533.4	504.7
Cottonseed cake		83.6
Sunflower silage	842.7	762.9
Alfalfa	456.7	355.1
Feed cost per cwt. gain at feedlot	$8.10	$8.68
Selling price per cwt.	$9.69	$9.76
Dressing percentage	62.3	62.2
Carcass grade	90.5	90.5

Amount of Cottonseed Cake.—Because of its relatively high market cost, it is very essential that only the minimum required amount of protein supplement be added to the ration.

In table 43 standard beet by-product rations are shown with varying amounts of cottonseed cake. Results show only a small tendency toward greater gain as the cottonseed cake is increased from ½ to 1 to 1½ pounds per calf per day. The additional amount of cake over ½ pound per head per day saved only small amounts in feed required per hundredweight gain and at the same time increased cost per unit of gain. Considering ½ pound of cottonseed

Table 43.—AMOUNT OF COTTONSEED CAKE NECESSARY—CALVES
(2-year average 1931-32, 1932-33)

Ration fed	Ground corn Ground barley .5 pound cottonseed cake Wet pulp Alfalfa	Ground corn Ground barley 1 pound cottonseed cake Wet pulp Alfalfa	Ground corn Ground barley 1.5 pounds cottonseed cake Wet pulp Alfalfa
Number calves per lot	9.5	9.5	9.5
Number days in period	192	192	192
Feedlot weight at start	394.4	395.7	396.8
Final feedlot weight	803.2	808.1	808.1
Gain	408.8	412.4	411.3
Daily gain	2.13	2.15	2.14
Daily ration fed:			
Ground corn	2.41	2.41	2.38
Ground barley	2.41	2.41	2.38
Cottonseed cake	.49	.97	1.40
Wet beet pulp	23.08	22.99	22.97
Alfalfa	7.11	6.62	6.39
Maximum daily feed:			
Ground corn	3.6	3.6	3.6
Ground barley	3.6	3.6	3.6
Cottonseed cake	.5	1.0	1.5
Wet beet pulp	30.0	30.0	30.0
Feed required per cwt. gain at feedlot:			
Ground corn	113.2	112.2	110.9
Ground barley	113.2	112.2	110.9
Cottonseed cake	23.2	45.4	65.6
Wet beet pulp	1075.3	1062.3	1064.2
Alfalfa	335.2	308.8	299.0
Feed cost per cwt. gain at feedlot	$4.54	$4.78	$5.06
Selling price per cwt.	$5.84	$5.89	$5.87
Dressing percentage (cold)*	59.3	59.9	60.5
Carcass grade*	83	86	83

*1-year data.

cake daily as 100 percent efficient, an average of 2 years' work shows that an extra ½ pound of cake is only 36.21 percent as efficient, and each additional pound above ½ pound daily is only 27.94 percent as valuable. In other words, this experiment indicates that ½ pound of cottonseed cake is sufficient for most economical gains and balances a standard beet by-product ration for fattening calves.

There is a tendency toward a higher dressing percentage as the cake is increased; however, selling price remains practically the same for all three lots. The increased amount of cake did not show better condition on the cattle in the feedlot.

Cottonseed Cake vs. Linseed Oil Cake.—Linseed oil cake and cottonseed cake are generally considered the two standard protein supplements for cattle-fattening rations.

In a 2-year comparison using cottonseed cake and linseed oil cake in a ration of barley, dried pulp, corn silage, and alfalfa (table 44), cottonseed cake produced slightly greater and cheaper gains. The same conditions were true when cottonseed cake and linseed oil cake were used in a standard beet by-product ration of corn, barley, wet beet pulp, and alfalfa hay.

Each ton of linseed oil cake used in the silage ration replaced 1,995.90 pounds of cottonseed cake but required 77.87 pounds more barley, 122.95 pounds more dried beet pulp, 1,401.64 pounds more silage, and 266.39 pounds more alfalfa hay; or with feed prices used was worth $27.15 per ton.

In the wet beet pulp ration, each ton of linseed oil cake replaced 1,986.87 pounds of cottonseed cake and 258.21 pounds of alfalfa but required 35.01 pounds more corn, 35.01 pounds more barley, and 166.30 pounds more wet beet pulp; or was worth $33.04 per ton.

It is true that linseed oil cake enhanced both dressing percentage and carcass grade in the silage ration, but there was no difference in the selling price. In the beet by-product ration, the 1-year data available shows cottonseed cake to be more desirable from the standpoint of carcass grade and dressing percentage.

Cottonseed Cake vs. Linseed Oil Cake vs. Flaxseed.—Flax is not generally used for livestock feeding because of its high commercial value in the linseed oil industry; its comparative low yield per acre, which averages 5 to 6 bushels in Colorado; and the suspected danger of poisoning, which suspicion is so prevalent among livestock men. It is thought that in some instances flaxseed may contain a compound which, when acted upon by an enzyme in the seeds, yields a poison—prussic acid. Colorado feeders who have used flaxseed as a protein supplement, however, have not experienced any difficulties in their feedlots. Work conducted by this station in feeding

Table 44.—COTTONSEED CAKE vs. LINSEED-OIL CAKE—CALVES

	2-year average		2-year average	
	1925–26	1926–27	1931–32	1932–33
Ration fed	Ground barley Dried pulp Cottonseed cake Corn silage Alfalfa	Ground barley Dried pulp Linseed-oil cake Corn silage Alfalfa	Ground corn Ground barley Cottonseed cake Wet pulp Alfalfa	Ground corn Ground barley Linseed-oil cake Wet pulp Alfalfa
Number calves per lot	10	10	9.5	9.5
Number days in period	195	195	192	192
Feedlot weight at start	348.0	351.3	395.7	390.4
Final feedlot weight	745.8	744.7	808.1	798.9
Gain	397.8	393.4	412.4	408.5
Daily gain	2.04	2.02	2.15	2.13
Daily ration fed:				
Ground corn	.....	.....	2.41	2.40
Ground barley	3.57	3.56	2.41	2.40
Dried beet pulp	3.36	3.38	.....	.....
Cottonseed cake	.99	.....	.97	.....
Linseed-oil cake	.....	.99	.....	.97
Corn silage	9.20	9.78	.....	.....
Wet beet pulp	.....	.....	22.99	22.62
Alfalfa	4.20	4.28	6.62	6.46
Maximum daily feed:				
Ground corn	.....	.....	3.6	3.6
Ground barley	5.3	5.3	3.6	3.6
Dried beet pulp	5.3	5.3	.....	.....
Cottonseed cake	1.5	.....	1.0	.....
Linseed-oil cake	.....	1.5	.....	1.0
Corn silage	12.0	13.0	.....	.....
Wet beet pulp	.....	.....	30.0	30.0
Feed required per cwt. gain at feedlot:				
Ground corn	.....	.....	112.2	113.0
Ground barley	174.8	176.7	112.2	113.0
Dried beet pulp	164.7	167.7	.....	.....
Cottonseed cake	48.7	.....	45.4	.....
Linseed-oil cake	.....	48.8	.....	45.7
Corn silage	451.4	485.6	.....	.....
Wet beet pulp	.....	.....	1062.3	1066.1
Alfalfa	206.1	212.6	308.8	302.9
Feed cost per cwt. gain at feedlot	$5.36	$5.68	$4.78	$4.94
Selling price per cwt.	$9.86	$9.88	$5.89	$5.85
Dressing percentage (cold)	62.5	63.6	59.9	59.6*
Carcass grade	90	94	86	82 *

*1-year data.

flaxseed to hogs and sheep has never shown ill results. Feeding flaxseed in these tests (table 45) was no different than feeding cottonseed cake or linseed oil cake. The calves took to flax just as readily as to the other protein supplements and were on full feed at the same time as the others. At no time during the tests were any abnormal digestive disturbances noticed among the flax-fed calves.

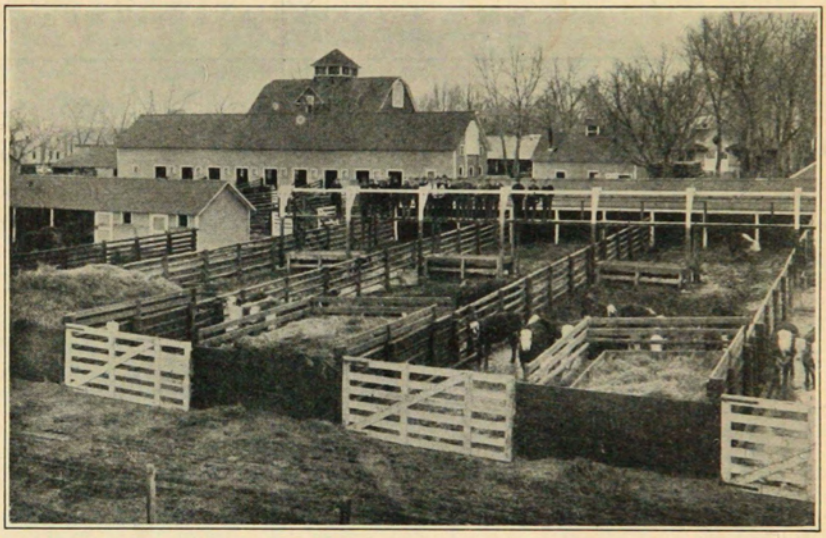


Fig. 26. Early experimental pens at the Colorado Experiment Station.

Although no definite information is available, it is thought that flaxseed must be ground for cattle in order to get maximum utilization of the feed and to prevent waste.

Feeding flaxseed instead of cottonseed cake or linseed oil cake increased gains considerably. The cost of this gain was also materially cheaper where flaxseed was used.

Comparing flaxseed with cottonseed cake, each ton of flax replaced 2,111.63 pounds of cake, 344.19 pounds of corn, 344.19 pounds of barley, 3,506.98 pounds of wet beet pulp, and 1,790.70 pounds of alfalfa; or each ton of flaxseed was worth $50.73.

When compared with linseed oil cake, each ton of flaxseed replaced 2,125.58 pounds of linseed oil cake, 381.40 pounds of corn, 381.40 pounds of barley, 3,683.72 pounds of wet beet pulp, and 1,516.28 pounds of alfalfa hay; or with feed prices used was worth $58.12 per ton.

Slaughter data show dressing percentage and carcass grade on an equal plane with cottonseed and linseed oil cake.

Judging from these tests, indications are that ground flaxseed is not dangerous for fattening cattle; that it can be used to good advantage as a protein supplement in a beet by-product ration; and that it does give the feeder a home-grown feed which can replace cottonseed cake and linseed oil cake when the commercial value of flax in the linseed oil industry permits.

Table 45.—COTTONSEED CAKE vs. LINSEED-OIL CAKE vs. FLAXSEED—CALVES
(2-year average 1931-32, 1932-33)

Ration fed	Ground corn Ground barley Cottonseed cake Wet pulp Alfalfa	Ground corn Ground barley Linseed-oil cake Wet pulp Alfalfa	Ground corn Ground barley Flaxseed Wet pulp Alfalfa
Number calves per lot	9.5	9.5	10
Number days in period	192	192	192
Feedlot weight at start	395.7	390.4	392.5
Final feedlot weight	808.1	798.9	828.1
Gain	412.4	408.5	435.6
Daily gain	2.15	2.13	2.27
Daily ration fed:			
Ground corn	2.41	2.40	2.37
Ground barley	2.41	2.40	2.37
Cottonseed cake	.97	.....	.....
Linseed-oil cake	.....	.97	.....
Ground flaxseed	.....	.....	.97
Wet beet pulp	22.99	22.62	22.47
Alfalfa	6.62	6.46	6.13
Maximum daily feed:			
Ground corn	3.6	3.6	3.6
Ground barley	3.6	3.6	3.6
Cottonseed cake	1.0	.....	.....
Linseed-oil cake	.....	1.0	.....
Ground flaxseed	.....	.....	1.0
Wet beet pulp	30.0	30.0	30.0
Feed required per cwt. gain at feedlot:			
Ground corn	112.2	113.0	104.8
Ground barley	112.2	113.0	104.8
Cottonseed cake	45.4	.....	.....
Linseed-oil cake	.....	45.7	.....
Ground flaxseed	.....	.....	43.0
Wet beet pulp	1062.3	1066.1	986.9
Alfalfa	308.8	302.9	270.3
Feed cost per cwt. gain at feedlot	$4.78	$4.94	$4.34
Selling price per cwt.	$5.89	$5.85	$5.76
Dressing percentage (cold)*	59.9	59.6	60.9
Carcass grade*	86	82	85

*1-year data.

V. Miscellaneous Comparisons

Sex and Its Effect on Rate of Gain.—Quite a number of open heifers are fed annually in Colorado feedlots. Tables 46 and 47 show comparisons of gains made, feed required, and feed costs between steer and heifer calves. A 2-year comparison of steer and heifer calves (table 46) indicates that steers make a greater rate of gain and produce unit gains more cheaply than heifers, but that heifer calves have a higher dressing percentage and yield higher grade carcasses. It was noticed throughout this work that steers showed a greater growth tendency, whereas heifers put on a quicker finish and were ready to ship much sooner than steers.

Table 46.—STEERS vs. OPEN HEIFERS—CALVES
(2-year average 1927-28, 1928-29)

Ration fed	Steers Ground barley Cottonseed cake Wet pulp Alfalfa	Heifers Ground barley Cottonseed cake Wet pulp Alfalfa
Number calves per lot	9	10
Number days in period	191	191
Feedlot weight at start	365.4	343.7
Final feedlot weight	762.2	682.8
Gain	396.8	339.1
Daily gain	2.08	1.78
Daily ration fed:		
Ground barley	4.90	4.70
Cottonseed cake	1.02	1.00
Wet beet pulp	24.36	19.75
Alfalfa	5.35	4.88
Maximum daily feed:		
Ground barley	6.9	7.0
Cottonseed cake	1.1	1.2
Wet beet pulp	32.0	29.0
Feed required per cwt. gain at feedlot:		
Ground barley	236.0	264.9
Cottonseed cake	49.3	56.5
Wet beet pulp	1172.1	1110.3
Alfalfa	257.7	274.4
Feed cost per cwt. gain at feedlot	$4.69	$5.10
Dressing percentage (cold)	59.4	61.1
Carcass grade	94	98

Table 47.—SEX AND ITS EFFECT ON RATE OF GAIN
(5-year average 1924-25, 1925-26, 1926-27, 1927-28, 1928-29)

Cattle fed	Steers	Heifers
Number of cattle per lot	118	120
Number of days in period	180	180
Average feedlot weight at start	351.30	350.23
Average final feedlot weight	739.62	693.93
Gain	388.32	343.70
Daily gain	2.16	1.91
Feed required per cwt. gain at feedlot*:		
Ground barley	295.0	290.7
Cottonseed cake	52.2	60.4
Wet pulp	1116.8	1106.7
Alfalfa	272.8	278.2
Feed cost per cwt. gain at feedlot*	$5.31	$5.42
Gain—At 30-day periods (in pounds):		
30-day	41.69	38.91
60-day	105.46	100.82
90-day	172.18	158.18
120-day	248.52	221.37
150-day	316.29	284.41
180-day	388.32	343.70
Daily gain—At 30-day periods (in pounds):		
30-day	1.39	1.30
60-day	1.76	1.68
90-day	1.91	1.76
120-day	2.07	1.84
150-day	2.11	1.90
180-day	2.16	1.91

*Based on 2-year average.

Effect of Age on Economy of Gains.—Table 48 shows the difference in rate of gain and feed required per hundredweight gain between calves, yearlings, and 2-year-old cattle. This summary indicates that an increase in age of cattle of equal quality causes, in fairly definite proportions, an increase in the amount of feed needed to produce a pound of gain. Taking the feed required per hundredweight with a 2-year-old steer as 100 percent, a yearling requires only 84.80 percent that amount of feed and a calf only 63.69 percent. It takes, however, longer to fatten younger cattle. A 2-year-old steer is ready for market in at least 5 months, a yearling in about 6 months, and a calf in 7 months.

Relationship Between Initial and Final Weights of Steer Calves.—Table 49, an average of several years' work, is presented to show whether initial weight of calves is any criterion of rate of gain in the feedlot. It will be seen that there existed a steady increase in gain as the initial weight of the calves increased, until 500-550 pounds were reached. Calves weighing more than that had a ten-

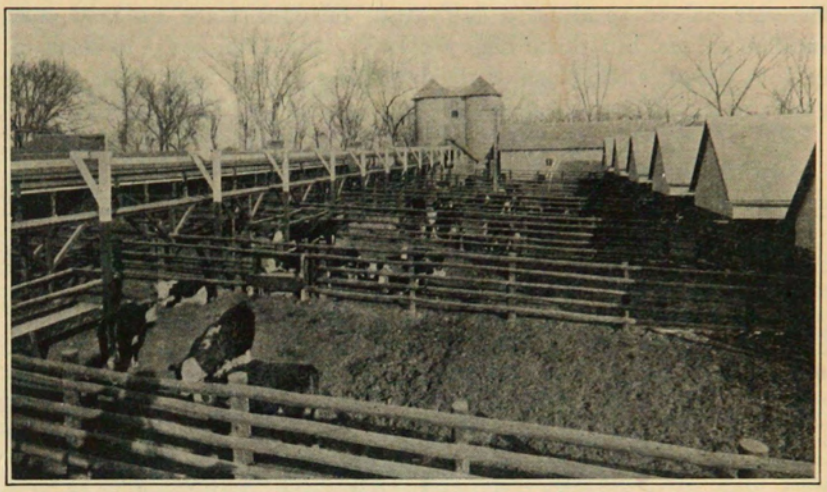


Fig. 27. Experimental feeding pens at the Colorado Experiment Station.

Table 48.—AGE AND ECONOMY OF GAIN

Cattle fed	Calves	Yearlings	2-year-olds or over
Number of trials	1	2	7
Number of days to fatten cattle	200	188	145
Average daily gain per steer at market, pounds	1.9	2.1	1.8
Feed required per cwt. gain, pounds:			
Wet beet pulp	1542	4103	5159
Beet molasses	121	174	216
Cottonseed cake	70	148	132
Alfalfa	725	402	590
Feed cost per cwt. gain	$5.49	$7.31	$8.62
Percentage feed required per unit of gain:			
Wet beet pulp	29.89	79.53	100.00
Beet molasses	56.02	80.56	100.00
Cottonseed cake	53.03	112.12	100.00
Alfalfa	122.88	71.19	100.00
Percentage cost per unit of gain	63.69	84.80	100.00

dency to produce a somewhat lower rate of gain. Unfortunately, only a small number of these heavy calves were available, so the information presented on this particular class may not be conclusive.

Considering gain by 30-day periods, indications are that lighter calves produce heavier gains as the feeding period progresses.

Heavier calves produce a high rate of gain more quickly than smaller calves, but these heavy calves have a tendency to drop off in gain towards the close of the fattening period, below the rate of gain produced by light calves.

Table 49.—RELATIONSHIP BETWEEN INITIAL AND FINAL FEEDLOT WEIGHTS OF STEER CALVES

Groups by weight	All groups	250–300 pounds	300–350 pounds	350–400 pounds	400–450 pounds	450–500 pounds	500–550 pounds	550–600 pounds
Number of animals	450	27	108	148	111	38	10	8
Initial weight	422.45	285.22	326.05	375.77	419.93	469.73	515.00	565.42
Final weight (180-day)	798.58	636.66	686.80	748.26	801.39	859.68	918.50	938.75
Gain	376.13	351.44	360.75	372.49	381.46	389.95	403.50	373.33
Daily gain	2.09	1.95	2.00	2.07	2.12	2.17	2.24	2.07
Gain any 30-day period	62.69	58.58	60.13	62.08	63.58	64.99	67.25	62.22
Percent of initial weight gained	89.04	123.21	110.06	99.13	90.84	83.02	78.35	66.03
Gain:								
First 30 days	42.53	38.30	38.07	41.42	42.68	45.48	49.00	42.73
Second 30 days	65.43	61.11	60.73	63.26	65.07	64.21	73.00	70.60
Third 30 days	63.63	52.96	56.68	62.25	63.60	70.66	73.00	66.25
Fourth 30 days	67.67	66.83	67.58	70.33	72.22	67.87	63.00	65.88
Fifth 30 days	72.10	65.42	68.97	65.69	71.18	72.44	87.80	73.12
Sixth 30 days	64.68	66.62	68.72	69.54	66.71	69.29	57.70	53.75
Daily gain during:								
First 30 days	1.42	1.28	1.27	1.38	1.42	1.52	1.63	1.42
Second 30 days	2.18	2.04	2.02	2.11	2.17	2.14	2.43	2.35
Third 30 days	2.12	1.77	1.89	2.08	2.12	2.36	2.43	2.21
Fourth 30 days	2.26	2.23	2.25	2.34	2.41	2.26	2.10	2.20
Fifth 30 days	2.40	2.18	2.30	2.19	2.37	2.41	2.93	2.44
Sixth 30 days	2.16	2.22	2.29	2.32	2.22	2.31	1.92	1.79
Percent of total gain:								
First 30 days	11.31	10.90	10.55	11.12	11.19	11.66	12.14	11.45
Second 30 days	17.40	17.39	16.83	16.98	17.06	16.47	18.09	18.91
Third 30 days	16.92	15.07	15.71	16.71	16.67	18.12	18.09	17.75
Fourth 30 days	17.99	19.02	18.73	18.88	18.93	17.40	15.61	17.65
Fifth 30 days	19.17	18.61	19.12	17.64	18.66	18.58	21.76	19.59
Sixth 30 days	17.20	18.96	19.05	18.67	17.49	17.77	14.30	14.40

Rate of Gain Between Various Market Grades of Steer Calves.—During later years, steers used in these experiments were classified according to market grades at the beginning of the test. A study of rate of gain of these different grades of steer calves is presented in table 50. It will be noticed that there exists almost a uniform increase in total gain produced as market grade of steer calves decreases. The greater condition generally carried by calves of a higher market grade is largely responsible for this difference in gain. Work conducted elsewhere supports this evidence that market grade and rate of gain are generally inversely proportional. In this connection, buying and selling price per hundredweight should be taken into consideration.

Table 50.—RATE OF GAIN BETWEEN VARIOUS MARKET GRADES OF STEER CALVES

	Select	Choice	Good	Medium
Number of steers	18	228	155	29
Number days in period	180	180	180	180
Average initial weight	430.5	381.4	336.0	301.3
Average final weight	795.7	746.3	708.2	702.6
Total gain	365.2	364.9	372.2	401.3
Daily gain	2.03	2.03	2.07	2.23

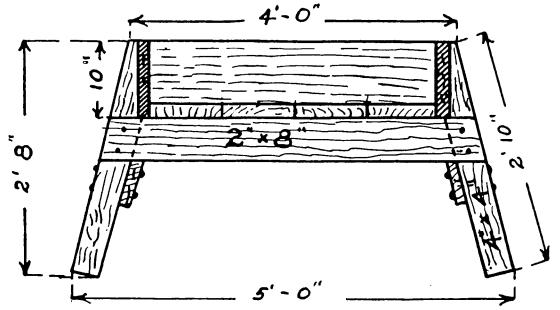
Rail vs. Truck Shipment.—There is much discussion on the comparative merits of rail vs. truck shipments of cattle. Data compiled on 200 steers shipped from Fort Collins to Denver is shown in table 51. The steers were divided according to weight and ration fed. All steers were weighed about 10 o'clock in the morning and separated into the two groups. The steers to be shipped by train were driven to the loading point, 3 miles away, immediately following weighing. The others were turned back into the lots and had access to hay. They were loaded about 6 o'clock in the afternoon and trucked to market.

It will be noticed that there was very little difference in shrink: 3.43 percent for the train-shipped steers and 3.64 percent for those taken to market by truck. Furthermore, dressing percentage shows only a difference of .14 of 1 percent in favor of the trucked-in cattle. Judging from the number of bruised carcasses, trucking is more likely to bruise steers than shipping by rail. In conclusion, it may be said that if cattle are trucked 70 miles to market the evening previous to selling, there is little difference in shrink or dressing percentage.

Table 51.—RESULTS OF VARIOUS METHODS OF MARKETING CATTLE
(3-year average 1930-31, 1931-32, 1932-33)

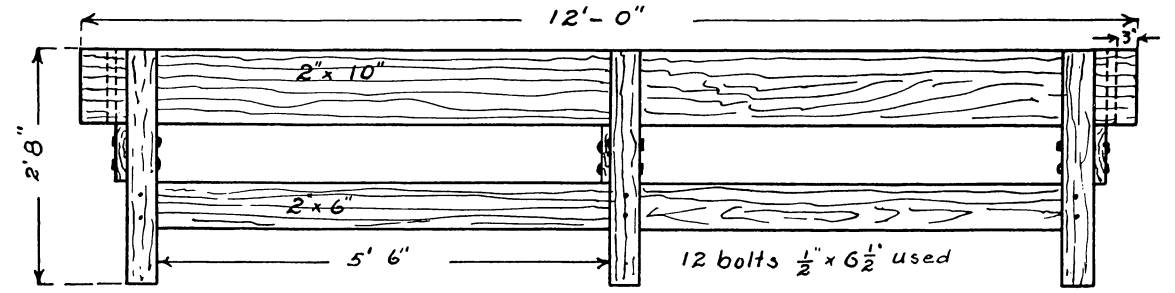
Method of transport	Train	Truck
Number of cattle	100	100
Shipping weight	832.71	835.35
Market weight	805.13	806.03
Shrink (pounds)	27.58	29.32
Shrink (percent)	3.43	3.64
Selling price	$6.46	$6.46
Warm dressed weight	488.96*	492.39*
Dressing percentage	60.80*	60.94*
Bruised carcasses	4.0*	5.5*
Freight rate	16c	17c
Hours in transit	7	3.17

*Based on 2-year average; data not available for 1932-33.



END VIEW

For further information address Animal Husbandry Department, Colorado State College, Fort Collins, Colorado.



SIDE VIEW
Scale ¾" = 1'-0"

Cattle Feed Bunks used at State College.

VI. Appendix

Information given in the discussion of the following phases of the experiments may be helpful in determining conditions as they actually existed during the years of experimental work reported in this bulletin. Furthermore, this information may be helpful as a means of clarifying results and, also, may aid those who care to analyze the tests in more detail.

EQUIPMENT

The experimental cattle feeding pens of the Colorado Experiment Station are located on the college farm. The pens are 114 by 24 feet in size, the long dimension running north and south. At the north end of the lots, 14- by 24-foot sheds provide shelter for the cattle. Water is piped into each lot. In the early years small galvanized watering troughs were used. In 1927 automatic watering troughs were installed and have been found to be very satisfactory. Feed bunks for grain and other roughage than hay are located in the middle of the feed yards below an overhead silage carrier. Hay is stored in a wooden enclosure at the south end of the lots and fed there in hay bunks running along the west and north sides of these enclosures. Originally no cover was provided for the hay. In 1926 each hay bunk was covered to keep the alfalfa dry.

In 1922 the south end of the pens around the hay bunks, and also around the grain troughs, was cemented and the rest of the yard graveled to get away from the mud and mire present during the early tests.

CATTLE USED IN EXPERIMENTS

The quality of steers and heifers used in these experiments has perhaps been somewhat above the average grade of cattle fed in most commercial feedlots. Especially is that true of individuals used during the later years of the work reported here. At times undue criticism has been given because of the high-quality cattle which were used. It should be remembered, however, that in experimental work small numbers must be used because of cost involved. Furthermore, these lots of cattle must be as uniform as possible to make conditions comparable between lots. High-grade cattle selected for experimental work are divided much more readily into uniform lots than cattle of different types, breeding and condition. All cattle used in these experiments were range cattle.

1914-15

Sixty high-grade Shorthorn steers averaging 1,050 pounds in weight were used in this test. These cattle were purchased in

Denver December 13, 1914. They weighed 59,800 pounds. They were taken to Fort Collins and pastured and were fed some alfalfa hay in addition until December 29, when started on test. On that date they weighed 63,146 pounds.

1916-17

Sixty grade Shorthorn steers were purchased on the Denver market December 8, 1916. They averaged 745 pounds in weight. From December 8 until December 28 they were fed alfalfa. On this latter date these steers averaged 794 pounds.

1918

Sixty grade Hereford steers averaging 746 pounds in weight were purchased on the Denver market January 25, 1918. They arrived at the feedlots January 28 and were fed alfalfa hay until February 8, when they were divided and started on the feeding experiment. Nine steers averaging 838 pounds were used in each lot.

1918-19

Sixty grade Hereford and Shorthorn steers averaging 800 pounds in weight were selected from the Great Western Sugar Company's steers on October 15 and put on a ration of alfalfa hay. They were medium-to-good steers. November 15 these steers were divided into six lots and started on test. The steers weighed 970 pounds at that time.

1919-20

Sixty grade Hereford steers, averaging in weight 860 pounds, were used in this test. They were secured on the Denver market and were classified as good steers.

1920-21

Sixty good grade Hereford steers were purchased on the Denver market in October and were run on pasture until November 10, when the test started. These cattle weighed at start of test 796 pounds per head.

1921-22

Sixty-two good-to-choice grade Hereford steers were purchased in April, 1921. When put on the college foothill range May 3, they weighed 685 pounds per head. On October 24 they were brought in weighing 1,015 pounds and were carried on beet tops and beet-top silage until December 3, when they were divided into six lots of 10 steers, equal in weight and conformation.

1922-23

Sixty-six good grade Hereford steers were purchased in May, 1922. They were put on the college foothill range May 19, weighing 435 pounds per head. On October 17 they were taken off the range, weighing 688 pounds. They were carried on beet tops and beet-top silage until November 25, when they were divided into six equal pens of 10 steers each and started on the present test.

1923-24

The grade Hereford steers used in this test were purchased as yearlings in May, 1923. They were put on the college foothill range weighing 447 pounds per head. On October 29 they were taken off the range weighing 687 pounds and were fed silage and alfalfa until December 12, when they were divided into six equal pens of 10 steers each and started on the fattening test. At that time they weighed an average of 759 pounds per head. They were graded good.

1924-25

Good-to-choice grade Hereford steer and heifer calves, born between March 9 and July 15 on the foothill ranges near Fort Collins, were used in this test. Six lots of 10 calves each were fed 200 days, and each lot was made up of 5 steer and 5 open heifer calves fed together. Each lot contained 2 March calves, 2 April calves, 2 May calves, 3 June calves and 1 July calf.

1925-26

Forty-five good-to-choice grade Hereford steer and open heifer calves, born between March 24 and July 30 on the foothill ranges near Fort Collins, were used in the test. These calves were supplemented with 15 calves secured on the Denver market. The average birth date for the calves was May 1. The calves were sorted into six lots of 5 steer and 5 heifer calves as nearly as possible equal in weight, condition, and quality, and were started on feed November 6.

1926-27

The good-to-choice grade Hereford steer and open heifer calves used in this test were secured from the Experiment Station range herd and from two local range herds near Fort Collins. The calves were sorted into eight lots of 10 (5 steer and 5 heifer calves) as nearly as possible equal in weight, condition and quality and were started on feed November 30. Their average initial weight was 350 pounds.

1927-28

Grade Hereford calves averaging 376 pounds in weight were used in this test. They were graded good-to-choice. These calves were sorted into five pens of 10 steers each and one pen of 10 heifers. The greatest uniformity possible was maintained between the different lots of cattle by balancing all known factors involved. The steers averaged 379 pounds in weight and the heifers only 365 pounds at the beginning of the experiment. This difference in weight between steers and heifers born at the same time in the spring may ordinarily be expected in the fall of the year.

1928-29

Grade Hereford calves grading good-to-choice and averaging 347 pounds in weight were used in this test. These calves were sorted into five pens of 10 steers each and one pen of 10 heifers. The greatest uniformity possible was maintained between the different lots of cattle by balancing all known factors involved. The steers averaged 352 pounds in weight and the heifers only 323 pounds at the beginning of the experiment. This difference in weight between steers and heifers born at the same time in the spring may ordinarily be expected in the fall of the year.

1929-30

Sixty grade Hereford feeder calves grading good-to-choice in quality were used in the test and averaged 421.8 pounds at the start. They were sorted into six uniform pens of 10 head each and were fed different rations from November 19 to June 2, a period of 195 days.

1930-31

Sixty choice-quality grade Hereford steer calves were bought in the vicinity of the station and used in the test. They averaged 415 pounds at the start. These calves were divided in six as nearly uniform lots as possible by balancing the factors of weight, origin, type, breeding, condition, and color.

1931-32

Eighty choice-quality grade Hereford steer calves were bought in the vicinity of the station and used in the test. They averaged about 420 pounds at the start. These calves were divided into eight as nearly uniform lots as possible by balancing the factors of weight, origin, type, breeding, condition, and color.

1932-33

Seventy choice-quality grade Hereford steer calves were bought locally for this experiment. They were allotted according to weight, origin, type, breeding, condition, and color.

ALLOTMENT AND WEIGH-DAYS

The cattle, whether purchased on the open market or locally, were given a rest period from 1 to 3 weeks and were fed during that time only alfalfa hay. Vaccination, dehorning, and other necessary operations were performed during this time.

When the first individual weight of the cattle was taken, they were also graded according to type, sex, condition, and in later years, color for use in allotment. Individual weights were taken on three consecutive days in order to overcome as much as possible variation in weight which might be due to shrink or fill. The experiment started at noon of the second weigh-day.

Through the consideration of all these factors, as much uniformity as possible was obtained between the various lots. Following the individual initial weights taken on 3 consecutive days, 10-day group weights and 30-day individual weights were made during the test. At the end of the feeding period, three individual weights were taken on consecutive days, with the average used as a final feedlot weight.

FEEDS USED AND METHODS OF FEEDING

This year-by-year description of feeds used and methods of feeding is rather incomplete during the earliest work. Grain was not bought on grade for feeding purposes. Notes were kept only concerning feeds of abnormal qualities; otherwise, unless specified, feeds of good quality and grade were fed. Damaged alfalfa hay was not fed, and hay of a given cutting or quality, from the same stack, was fed to all lots alike.

1914-15

Method of Feeding.—The cattle were fed twice daily, 7 a. m. and 4:30 p. m. One half of the entire ration was usually fed at each feed. Beet molasses, grain, and cottonseed cake were spread over the wet pulp or silage. Alfalfa hay was fed in racks practically constituting self-feeders. Wet beet pulp was hauled from the factory and stored in a wooden enclosure. It was weighed to the steers as fed during the winter from this silo.

1916-17

Method of Feeding.—The cattle were fed twice daily, morning and evening. Molasses, grain, and cake were spread over the wet pulp or silage. Alfalfa hay was fed in racks three times daily, so that the steers had hay before them at all times.

1918

Method of Feeding.—The cattle were fed twice daily, 7 a. m. and 4:30 p. m. One half of the entire ration was given at each feed. Alfalfa hay was fed three times daily. Wet beet pulp was hauled from the factory, siloed in a wooden enclosure, and weighed from there to the steers as fed during the winter.

1918-19

Method of Feeding.—All feeds except alfalfa were fed twice daily, morning and evening. Alfalfa was fed three times daily. Pulp was hauled from the factory and stored in a wooden silo. It was fed from this silo as the steers needed it.

1919-20

Method of Feeding.—Steers were fed twice daily, morning and evening.

Feeds Used:

Molasses was standard beet molasses from the Great Western Sugar Company.

Dried molasses beet pulp was of standard quality.

Cottonseed cake was guaranteed 43 percent protein.

Wet beet pulp was hauled from the local factory from time to time during the experiment.

Beet tops were of standard quality, but bad weather conditions existed throughout the test.

Beet top silage was from tops hauled to a trench silo near the feedlots and thrown from the wagon as it was driven through the trench. The tops were covered by about a foot of clean straw, which in turn was covered by about 8 inches of dirt. About 66 percent of the weight of fresh green tops ensiled was recovered as beet top silage.

Corn silage was of poor quality. It was made from immature corn.

Alfalfa hay was of good quality.

1920-21

Method of Feeding.—All feeds were fed twice daily.

Feeds Used:

Barley was of excellent quality. The grade of this grain is not available.

Dried molasses beet pulp was of standard quality.

Molasses was standard quality beet molasses.

Cottonseed cake was guaranteed 43 percent protein.

Wet beet pulp was hauled from the sugar factory and stored in a wooden silo at the feedlots.

Beet top silage was of good quality.

Corn silage was made from immature corn.

Beet tops were obtained under favorable weather conditions which existed throughout this test.

Alfalfa hay was of good quality.

1921-22

Method of Feeding.—All feeds were fed twice daily. Maximum feed of molasses with wet pulp was 8 pounds per head daily.

Feeds Used:

Corn was of good quality.

Barley, locally grown, was of good quality.

Beet molasses was of standard quality.

Dried molasses beet pulp was of standard quality.

Cottonseed cake contained 43 percent protein.

Wet beet pulp was hauled from the local factory and stored in the pulp silo. It had an average moisture content of 87.88 percent as against an average figure at the factory silo during the feeding season of 89.82 percent. In order to give figures comparable to those secured where pulp is hauled and fed, the wet pulp fed in the experiment has been figured on an 89.82 percent moisture basis.

Sunflower silage was made from sunflowers yielding 20.3 tons per acre. This silage was from plants too mature and lacked palatability.

Corn silage was bright but contained very little corn.

Alfalfa hay was of good quality.

1922-23

Method of Feeding.—All feeds were fed twice daily. The molasses was spread over the grain. Alfalfa hay was fed three times daily.

Feeds Used:

Barley was locally-grown, good-quality grain.

Beet molasses was of standard quality.

Dried molasses beet pulp was of standard quality.

Cottonseed cake was guaranteed 43 percent protein.

Wet beet pulp was hauled and stored at the feedlots and fed as needed.

Sunflower silage was made from sunflowers yielding 17.2 tons per acre. The plants had developed branching heads when cut for silage. This silage was from plants too mature and very unpalatable to the cattle.

Corn silage fed during the first half of the test was of poor quality. That fed during the last 75 days was very good.

Alfalfa hay was of good quality.

1923-24

Method of Feeding.—All feeds were fed twice daily, morning and evening. Alfalfa was fed so that the steers had access to it at all times.

Feeds Used:

Barley was locally-grown California feed barley.

Beet molasses was of standard quality.

Cottonseed cake was guaranteed 43 percent protein.

Wet beet pulp was hauled from the local sugar factory, ensiled, and fed from the silo at the feedlots. In this test, wet pulp has been figured on a 90 percent moisture basis to make it comparable to pulp hauled from factory direct.

Sunflower silage was made from sunflowers yielding 19.2 tons per acre. They were cut at an immature stage when only about one third of the heads were in bloom. This was much more palatable and a brighter silage than that of the previous year.

Corn silage was of good quality.

Alfalfa hay was of good quality.

1924-25

Method of Feeding.—Grain, protein concentrates, and supplementary roughages were fed twice daily. Alfalfa was fed three times daily.

Feeds Used:

Corn was a No. 3 mixed Nebraska corn.

Barley was California feed barley produced locally.

Linseed oil cake (old process) was guaranteed 34 percent protein.

Ground corn fodder was cut just before frost, shocked in the field and left until thoroughly dry; then it was hauled in and cut into a bin. The fodder was grown in the same field as the corn used for silage. The yield of the dry fodder was 3.82 tons per acre.

Corn silage was of good quality, grown on the station farm, yielding 11.7 tons per acre. The ear corn production of this field was 4,593 pounds.

Corn and soybean silage was grown on the station farm. The forage production was 11.6 tons per acre. The ear corn production of this field was 4,120 pounds.

Cull potatoes were stored in a cellar and fed raw. They were chopped before feeding.

Potato silage was made by cutting cull potatoes through an ensilage cutter into an upright concrete silo. A 2 percent mixture of corn chop was added to start fermentation. There was approximately a 20 percent loss of weight in the silo.

Alfalfa hay was of good quality.

1925-26

Method of Feeding.—The calves were hand-fed all feeds except alfalfa twice daily, starting at 7 a. m. and 4 p. m. Wet pulp was limited to 15 pounds daily. All roughages were fed during the forenoon.

Feeds Used:

Corn was shipped-in and recleaned Nebraska corn of good quality.

Barley was grown locally and of good quality.

Dried beet pulp was of standard quality.

Dried molasses beet pulp was of standard quality.

Linseed oil cake (old process) was guaranteed 34 percent protein.

Cottonseed cake was guaranteed 43 percent protein.

Wet beet pulp was hauled at periodic intervals from the local sugar factory. Each load lasted about a week.

Cut corn fodder was grown on the station farm, shocked in the field, hauled in and cut as needed.

Corn silage, grown at the station, was of good quality, with well-matured grain.

Alfalfa hay was of good quality.

1926-27

Method of Feeding.—The calves were hand-fed all feeds except alfalfa twice daily, starting at 7 a. m. and 4 p. m. Alfalfa hay was self-fed. Wet beet pulp was limited to 30 pounds daily. Siloed beet pulp was used in all lots where wet pulp was fed except lot 8, where pressed pulp was used. All roughages were fed about the middle of the forenoon.

Feeds Used:

Corn was a No. 2 recleaned corn shipped in from Nebraska.

Barley was a No. 3 locally-grown feed barley.

Dried pulp, standard quality, was bought at the Brighton factory.

Dried molasses pulp was bought at the Brighton factory. It was of standard quality.

Cottonseed cake was guaranteed 43 percent protein.

Linseed oil cake (old process) was guaranteed 34 percent protein.

Cut corn fodder was grown on the station farm, cut just before frost, shocked in the field and hauled and cut as needed for the test.

Corn silage was of good quality, with well-matured grain. It was grown on the station farm.

Wet (siloed) beet pulp was hauled from the Fort Collins factory and stored in a small wooden silo adjacent to the feedlots. Each load of from 3 to 4 tons lasted from 6 to 7 days.

Pressed beet pulp was shipped from the Loveland factory and stored in a trench and straw silo.

Alfalfa hay was of good quality. Both first and second cutting were used.

Salt was block salt.

1927-28

Method of Feeding.—Grain and protein supplement were fed in the morning and evening. Wet pulp, silage, and tops were fed shortly after the morning grain feed. Alfalfa hay and salt were self-fed.

Feeds Used:

Ground Trebi barley, 46.5 pounds per bushel, was grown locally.

Wet (siloed) beet pulp was hauled from the Fort Collins sugar factory and stored in a small wooden silo adjacent to the feedlots. Each load of from 3 to 4 tons lasted from 6 to 8 days.

Pressed beet pulp was shipped from the Loveland factory and stored in a trench and straw silo.

Sugar-beet tops were piled in small piles near the feedlots.

Corn silage was of good quality, with well-matured grain.

Cottonseed cake was guaranteed to contain 43 percent protein.

Alfalfa hay was of good quality; both first and second cuttings were used.

Salt for all lots was block salt, self-fed.

1928-29

Method of Feeding.—The grain and protein concentrate was fed twice daily, morning and evening. Pulp, tops, and silage were fed shortly after the morning grain feed. Alfalfa, minerals, and salt were self-fed.

Feeds Used:

Ground Trebi barley, 48 pounds per bushel, was grown locally. It was graded U. S. No. 2.

Wet (siloed) beet pulp was hauled from the Fort Collins sugar factory and stored in a small wooden silo adjacent to the feedlots. Each load of from 3 to 4 tons lasted from 6 to 8 days.

Pressed beet pulp was shipped from the Loveland factory and stored in a trench and straw silo.

Sugar-beet tops were piled in small piles near the feedlot.

Corn silage was of good quality with well-matured grain.

Cottonseed cake was guaranteed 43 percent protein.

Alfalfa hay was of good quality; first cutting was fed.

Mineral mixture for all lots was a simple mixture composed of 50 percent steamed bonemeal, 30 percent lime cake, and 20 percent salt, self-fed.

Salt for all lots was No. 4 salt, self-fed.

1929-30

Method of Feeding.—Concentrates were fed twice daily, morning and evening. Wet pulp, potatoes, and silage were given in one feed daily at about 10 o'clock in the morning. Fed during the warmth of the day, there was less tendency for these high-moisture feeds to freeze in the troughs before being consumed.

Feeds Used:

Ground Colcess barley was grown on the college farm. It weighed 47 pounds per bushel and was graded No. 2.

Cull potatoes tested 82.3 percent moisture and were of rather poor quality. With market potatoes high, a close sorting caused the culls to be distinctly lower in quality than in a year of moderate-priced market potatoes. The culls were sliced in a low-priced, hand-power root cutter. The potatoes were stored in a frost-proof dugout, but some of them were frozen when eaten. During the latter part of the feeding period, the potatoes sprouted very noticeably, but no ill effects were noted in feeding frozen culls and later sprouted culls.

Wet beet pulp was hauled from the silo of the local sugar factory and was stored in a small silo near the feedlots.

Corn silage, grown on the college farm, was used in the test. It was of good quality, with well-matured grain.

Potato-and-corn-fodder silage was a mixture by weight of 18 percent dry corn fodder and 82 percent cull potatoes cut into the silo during the spring of 1929. Cull potatoes on the verge of spoiling were stored in this manner for use the following feeding season. There was little waste, and the resultant silage proved to be a very palatable feed.

Alfalfa hay was grown locally and was bright, leafy, and of good quality. First and second cutting hay was used.

Mineral mixture, self-fed to all lots, was a simple mixture composed of 30 percent steamed bonemeal, 60 percent limecake, and 10 percent salt.

Salt, self-fed in all lots, was No. 4 salt.

1930-31

Method of Feeding.—Concentrates were fed twice daily, morning and evening. Wet pulp, potatoes, and silage were given in one feed daily at about 10 o'clock in the morning. Fed during the warmth of the day, there was less tendency for these high-moisture feeds to freeze in the troughs before being consumed.

Feeds Used:

Ground Trebi barley, grown locally, was used. It weighed 40 pounds per bushel and was graded No. 4.

Cull potatoes were a good quality potato. The market price of potatoes was relatively low, consequently the usual close sorting was not practiced. The potatoes were sliced in a hand-power root cutter. During the cold weather they were stored in a frost-proof cellar.

Wet beet pulp was hauled from the silo of the local sugar factory and stored in a small silo near the feedlots.

Corn silage was made from corn grown on the college farm which was a good quality Minnesota No. 13, with well-matured grain.

Potato-corn fodder silage was a mixture by weight of 18 percent dry corn fodder and 82 percent cull potatoes cut into the silo during the spring of 1929. The potatoes used were culls on the verge of spoiling and were stored in this manner for use the following season. The corn fodder was added to insure fermentation, to give the potato silage a moisture content similar to that of corn silage, and to improve the handling quality of the potato silage. There was very little waste, and the resultant silage proved to be a very palatable feed. One half of this silage was fed during the 1929-30 feeding period, and the other half was used during the 1930-31 period. No difficulty was experienced in keeping the potato-corn fodder silage during the summer of the second season.

Alfalfa hay was grown locally and was bright, leafy, and of good quality. First and second-cutting hay was used.

Mineral mixture composed of 40 percent steamed bonemeal, 40 percent limecake and 20 percent salt was self-fed in all lots.

Salt was No. 4 salt, self-fed in all lots.

1931-32

Method of Feeding.—The grain and cake ration was fed twice daily, morning and evening. Pulp was hauled into the cattle pens shortly after the morning grain feed. Alfalfa, mineral mixture, and salt were self-fed.

Feeds Used:

Corn used in this test was shipped-in Nebraska grain. It weighed 56.4 pounds per bushel and was graded No. 1 yellow, according to U. S. Standard.

Barley, grown locally, weighed 44 pounds per bushel and was graded No. 3 Trebi barley.

Wheat was secured from a local elevator and contained 60 percent hard winter wheat and 40 percent hard spring wheat. It weighed 58.8 pounds per bushel.

Cottonseed cake had a guaranteed analysis of 43 percent protein. Pea-sized cake was fed.

Linseed oil cake was old-process cake and contained a guaranteed protein content of 34 percent.

Flaxseed was grown in Northeastern Colorado. It was ground very finely through a hammer mill.

Wet beet pulp was hauled directly from the silo of the local sugar factory to the calves as needed.

Alfalfa hay was grown locally and was bright, leafy, and of good quality. First-cutting hay was used.

Mineral mixture composed of 40 parts steamed bonemeal, 40 parts high calcium carbonate lime cake, and 20 parts salt was self-fed in all lots.

Salt for all lots was No. 4 salt, self-fed.

1932-33

Method of Feeding.—The grain and cake ration was fed twice daily, morning and evening. Pulp was hauled into the pens shortly after the morning grain feed. Alfalfa, mineral mixture, and salt were self-fed.

Feeds Used:

Corn was No. 2 yellow, shipped-in Nebraska grain. It weighed 55.6 pounds per bushel.

Barley graded No. 2, weighed 46.5 pounds per bushel, and was a locally-produced grain.

Cottonseed cake (pea-size) contained 43 percent protein.

Linseed oil cake (old process) had a guaranteed protein content of 34 percent.

Flaxseed was grown in Northeastern Colorado. It was ground finely before feeding.

Wet beet pulp was hauled from the local sugar factory every day as the calves consumed it.

Alfalfa hay was grown locally and was bright, leafy, and of good quality. First-cutting hay was used.

Mineral mixture composed of 40 parts steamed bonemeal, 40 parts high calcium carbonate lime cake, and 20 parts salt was self-fed in all lots.

Salt for all lots was No. 4 salt, self-fed.

MINERAL AND SALT CONSUMPTION

In the discussion of results found, no mention is made of mineral and salt. It was purposely omitted, since during the earlier years no record was kept of the amount of salt fed. It was, however, kept before the steers at all times during the experiments.

Mineral feeding was not practiced in any test at this station before 1928. Since that time, a simple mineral mixture composed of two parts steamed bonemeal, two parts high calcium carbonate limestone, and one part salt has been available to the steers while they were on feed. No assurance existed that these minerals were needed; it was simply a step of precaution in case some mineral were lacking. The combination of minerals used furnished a source of calcium, phosphorus, sodium, and chlorine, which are mineral elements most likely to be lacking in the ordinary ration.

An average of 4 years' work, including records for 340 steer and heifer calves, shows the daily mineral consumption per head to be only 0.0223 pounds. The cost of this amount is so small for an average feeding period that it was felt it was a good insurance against any mineral deficiency which might exist.

The average salt consumption for this same period of time was 0.0272 pounds per head per day. Salt was self-fed to the cattle during all the experiments conducted.

FEED PRICES USED

In this summarization of fattening experiments, representative rather than average feed prices are used for the purpose of comparison. In order to secure cost-of-gain comparison applicable to different feeding districts where cost of feeds may vary, the amount of feed required per hundredweight should be multiplied by local feed prices.

The feed prices used in this bulletin are:

Carbohydrate concentrates	Cost per ton
Corn	$20.00
Barley	18.00
Wheat	20.00
Dried beet pulp	14.00
Dried molasses beet pulp	14.00
Beet molasses	8.00
Protein concentrates	**Cost per ton**
Cottonseed cake	$33.00
Linseed-oil cake	40.00
Flaxseed	30.00
Carbohydrate roughages	**Cost per ton**
Corn silage	$ 4.50
Cut corn fodder	12.00
Corn and soybean silage	4.50
Potato-corn fodder silage	4.50
Sunflower silage	3.50
Potato silage	4.50
Cull potatoes	3.50
Beet tops, pastured	3.00 per acre
Beet tops in the feedlot	1.75
Beet top silage	2.50
Beet tops, stacked	2.50
Wet beet pulp, siloed	1 25
Wet beet pulp pressed	1.75
Protein roughages	**Cost per ton**
Alfalfa hay	$ 8.00

CHEMICAL ANALYSES OF FEEDS USED IN EXPERIMENTS

Feeds reported in this table were analyzed by the State Dairy Commission chemists. These men, chemically trained, were recommended by the head of the chemistry department to do this work, since no provision had been made to use station chemists for analytical work during these years.

During the earlier years, no chemical analyses were made of the feeds; also, a fire in 1927 destroyed some of the chemical records. All available analyses are listed here by years.

	Water	Ash	Crude protein	Carbohydrates		Fat	No. analyses
				Fiber	N-free extract		
1914–15							
Beet molasses	19.8	10.40	9.30	.....	60.50	.....	1
Wet beet pulp	88.1	.40	1.80	2.80	6.80	.10	1
1918–19							
Corn silage	69.93	1.82	2.40	6.14	19.13	.58	1
Pastured beet tops	75.37	5.86	3.63	4.27	10.54	.35	2
1919–20							
Beet molasses	21.19	7.47	6.48	.....	64.86	.....	1
Cottonseed cake	6.61	5.35	40.00	20.00	22.13	5.91	1
Corn silage	89.23	.61	1.24	1.77	6.82	.33	1
Beet top silage	70.66	13.03	3.52	2.83	9.46	.50	1
Dried beet tops	52.90	16.71	5.03	5.65	19.08	.63	1
Pastured beet tops	83.57	4.02	2.59	1.51	8.09	.22	1
Wet beet pulp	92.73	.29	1.04	2.91	1.90	.13	1
1921–22							
Sunflower silage (mature)	83.20	2.40	2.22	3.38	8.29	1.52	1
Corn silage	76.30	2.02	3.50	7.55	9.44	1.19	1
1923–24							
Barley	11.90	3.07	8.89	5.67	68.21	2.28	2
Wet beet pulp	86.60	.50	2.04	3.55	6.56	.71	1
Corn silage	80.70	1.35	1.86	5.10	10.75	.54	1
Sunflower silage (⅓ bloom)	81.20	2.25	2.39	5.35	9.11	.70	1
Alfalfa	8.60	8.04	13.79	33.50	34.07	2.00	1

	Water	Ash	Crude protein	Carbohydrates		Fat	No. analyses
				Fiber	N-free extract		
1924–25							
Corn and soybean silage	74.80	1.65	2.80	5.78	14.62	.35	1
Potato silage	78.20	1.84	2.07	.65	17.12	.12	1
1926–27							
Corn	16.00	2.93	7.69	9.69	59.12	4.57	1
Barley	10.90	5.10	9.38	8.85	64.70	1.07	1
Dried beet pulp	9.97	3.60	8.13	23.30	54.75	.25	1
Dried molasses beet pulp	10.40	6.03	8.75	17.92	56.15	.75	1
Cottonseed cake	7.11	6.41	41.56	9.45	28.26	7.21	1
Linseed-oil cake	9.53	4.85	35.44	7.55	38.22	4.41	1
Corn fodder	13.68	5.81	6.33	20.24	52.16	1.79	4
Corn silage	73.31	2.28	1.56	7.01	14.25	1.58	3
Wet beet pulp	86.12	.47	1.55	6.43	4.91	.54	2
Pressed beet pulp	85.20	.72	1.30	4.44	7.96	.42	4
1927–28							
Barley	10.65	4.00	12.38	5.64	66.70	.65	2
Beet tops	25.14	9.74	3.68	11.18	49.90	.36	1
Wet beet pulp	86.41	.44	2.37	6.60	3.64	.54	1
Pressed beet pulp	88.11	.52	1.97	5.15	3.97	.28	1
1929–30							
Barley	10.75	2.59	11.21	6.38	67.45	1.62	2
Cottonseed cake	8.19	5.40	40.61	10.79	26.68	8.33	2
Corn silage	72.04	1.04	1.95	6.46	17.65	.85	2
Potato-corn fodder silage	61.52	2.84	2.96	5.87	26.15	.66	2
Wet beet pulp	89.01	.37	1.38	4.03	4.98	.22	2
1930–31							
Barley	10.65	2.42	11.18	5.77	67.73	2.27	2
Cottonseed cake	9.29	5.45	41.18	12.60	25.06	6.44	2
Potatoes	78.17	1.14	2.17	1.33	17.10	.10	2
Potato-corn fodder silage	57.48	1.84	2.80	16.74	20.61	.54	2
Corn silage	66.09	1.74	3.28	7.05	21.13	.71	2
Wet beet pulp	87.45	.38	1.67	4.96	5.27	.27	2
1931–32							
Corn	12.78	1.40	11.00	1.94	68.95	3.94	2
Barley	11.67	2.32	13.06	5.25	65.75	1.96	2
Wheat	11.87	1.77	14.32	2.49	67.72	1.85	2
Cottonseed cake	7.59	6.10	43.89	8.46	26.28	7.69	2
Linseed-oil cake	8.76	6.36	36.68	7.48	35.28	5.46	2
Flaxseed	8.68	4.21	22.84	5.12	22.98	36.19	2
Wet beet pulp	88.67	.31	1.58	4.45	4.69	.30	2
Alfalfa	4.54	8.85	12.15	37.47	34.73	2.27	2
1932–33							
Corn	11.81	1.30	9.98	2.28	70.47	4.18	2
Barley	10.85	2.51	11.77	7.70	65.28	1.90	2
Wheat	11.37	1.60	14.59	3.06	67.63	1.76	2
Cottonseed cake	7.85	6.13	42.53	11.11	25.93	6.47	2
Linseed-oil cake	9.10	5.68	39.20	8.44	33.05	4.54	2
Flaxseed	7.80	4.26	26.80	9.16	22.00	30.01	2
Wet beet pulp	89.16	.34	1.56	4.45	4.23	.26	2
Alfalfa	10.25	8.63	14.69	35.93	29.08	1.65	2

CHEMICAL ANALYSES OF FEEDS
Taken from Appendix Table No. 1, Henry and Morrison's "Feeds and Feeding"

	Water	Ash	Crude protein	Carbohydrates		Fat	No. analyses
				Fiber	N-free extract		
Carbohydrate concentrates:							
Corn, dent	10.5	1.5	10.1	2.0	70.9	5.0	440
Corn, dent No. 2 grade	14.8	1.4	9.6	1.9	67.6	4.8	.....
Corn, dent No. 3 grade	16.5	1.4	9.4	1.9	66.1	4.7	.....
Barley, common	9.3	2.7	11.5	4.6	69.8	2.1	298
Wheat, all analyses	10.2	1.9	12.4	2.2	71.2	2.1	858
Wheat, Rocky Mountain States	8.5	2.0	13.3	2.1	71.9	2.2	193
Wheat, winter	10.9	1.8	11.7	2.0	71.6	2.0	94
Dried beet pulp	8.2	3.5	8.9	18.9	59.6	0.9	48
Dried molasses beet pulp	7.6	5.6	9.5	15.9	60.7	0.7	21
Molasses, beet	22.0	7.0	9.0	.....	62.0	.....	.....
Carbohydrate roughages:							
Corn silages	73.7	1.7	2.1	6.3	15.4	0.8	121
Corn and soybean silage*	.....	.....	.....	.....	.....	.....	.....
Cull potatoes	78.8	1.1	2.2	0.4	17.4	0.1	465
Potato silage*	.....	.....	.....	.....	.....	.....	.....
Potato-corn fodder silage*	.....	.....	.....	.....	.....	.....	.....
Sunflower silage	78.1	2.2	2.0	6.4	10.2	1.1	33
Beet tops	88.6	2.0	2.6	1.2	5.3	0.3	4
Beet top silage	71.2	13.0	3.2	2.4	9.6	0.6	11
Wet beet pulp, siloed	90.0	0.3	1.5	3.1	4.7	0.4	1
Wet beet pulp, pressed*	.....	.....	.....	.....	.....	.....	.....
Cut corn fodder	9.0	6.5	7.8	27.2	47.3	2.2	56
Protein concentrates:							
Cottonseed meal, choice	7.5	6.2	44.1	8.1	25.0	9.1	2556
Linseed meal, new process	9.6	5.6	36.9	8.7	36.3	2.9	182
Flaxseed	9.2	4.3	22.6	7.1	23.2	33.7	50
Protein roughages:							
Alfalfa, all analyses	8.6	8.6	14.9	28.3	37.3	2.3	250
Alfalfa, first cutting	8.5	8.8	13.9	30.9	36.2	1.7	46
Alfalfa, second cutting	7.3	9.0	14.7	31.9	35.4	1.7	33

*No analyses given.

AVERAGE MOISTURE ANALYSES OF FEEDS USED IN EXPERIMENTS

Feed	Moisture	Number Analyses
1914–15		
Beet molasses	19.8	1
Wet beet pulp	88.1	1
1919–20		
Corn silage	64.83	1
Beet top silage	62.53	1
Wet beet pulp	88.93	6
1920–21		
Dried molasses beet pulp	9.94	1
Beet molasses	19.80	1
Cottonseed cake	7.01	1
Corn silage	77.37	1
Beet top silage	69.77	1
Pastured beet tops	77.87	3
Wet beet pulp	89.32	3
1921–22		
Wet beet pulp	87.88	1
1924–25		
Corn fodder	15.48	11
Corn silage	74.20	11
Corn and soybean silage	73.85	11
Cull potatoes	79.80	11
Potato silage	73.60	10
1925–26		
Corn	14.97	12
Barley	12.05	12
Dried beet pulp	9.97	12
Dried molasses beet pulp	9.50	12
Cottonseed cake	7.72	12
Linseed-oil cake	10.02	11
Corn fodder	20.09	12
Corn silage	71.02	12
Wet beet pulp	87.69	12
1926–27		
Corn	15.25	19
Barley	11.10	18
Dried beet pulp	10.15	18
Dried molasses beet pulp	8.81	18
Cottonseed cake	7.75	17
Linseed-oil cake	9.36	18
Corn fodder	14.41	19
Corn silage	65.39	19
Wet beet pulp	88.02	19
Pressed beet pulp	85.81	20
1927–28		
Barley	11.49	14
Cottonseed cake	7.22	14
Corn silage	72.51	14
Beet tops	45.36	14
Wet beet pulp	87.46	13
Pressed beet pulp	86.79	14

AVERAGE MOISTURE ANALYSES OF FEEDS USED IN EXPERIMENTS—Continued

Feed	Moisture	Number Analyses
1928–29		
Barley	9.84	19
Cottonseed cake	7.76	18
Corn silage	71.56	19
Wet beet pulp	86.52	19
Pressed beet pulp	84.17	34
1929–30		
Barley	10.75	15
Cottonseed cake	8.19	15
Corn silage	72.04	13
Potatoes	82.29	14
Potato-corn fodder silage	61.52	14
Wet beet pulp	89.01	14
1930–31		
Barley	12.45	17
Cottonseed cake	8.56	13
Potatoes	78.17	12
Potato-corn fodder silage	57.48	17
Corn silage	66.09	12
Wet beet pulp	87.45	17
1931–32		
Corn	14.10	19
Barley	10.83	19
Wheat	11.70	19
Cottonseed cake	7.39	19
Linseed-oil cake	8.94	19
Flaxseed	8.25	19
Wet beet pulp	88.67	19
1932–33		
Corn	13.05	20
Barley	11.49	20
Wheat	11.53	19
Cottonseed cake	7.76	21
Linseed oil cake	9.05	21
Flaxseed	7.51	21
Wet beet pulp	89.16	20

MOISTURE VARIATION IN WET BEET PULP BETWEEN FACTORY AND FEEDLOT

Much discussion and criticism has existed in regard to the method employed in feeding wet beet pulp to experimental cattle. During earlier years, when all the pulp was hauled in the fall and stored in a silo adjacent to the feedlots, this criticism was no doubt justified, since the loss in moisture through storage in a small silo was proportionately greater than the moisture loss in the large factory silo. This simply meant that experimental cattle receiving a definite, weighed amount of pulp were actually getting more feed

nutrients than cattle in a commercial feedlot eating the same amount of pulp by weight. Under commercial conditions, pulp is hauled daily from factory to feed trough.

Following these early years of experimental work, pulp was hauled weekly, and still later it was hauled at least every other day. A comparison by months of dry matter in pulp at the feedlot and factory is shown in the following table. The feedlot figures presented are averages of 10-day moisture samples for the last 8 years of experimental work. Factory figures were obtained through the research department of the Great Western Sugar Company and represent the averages for all Colorado factories for the year 1929-30. This, it seems, is the only year for which these figures are available. In analyzing these figures, it is surprising how closely those two sets check. It would seem that during later years, at least, we have very closely duplicated feedlot conditions as far as the feeding of wet beet pulp is concerned.

AVERAGE PERCENTAGE DRY MATTER IN WET BEET PULP

	At factory		At feedlot	
	Moisture	Dry matter	Moisture	Dry matter
October	91.06	8.94	89.27	10.73
November	90.01	9.99	90.35	9.65
December	90.08	9.92	89.52	10.48
January	89.11	10.89	88.77	11.23
February	87.35	12.65	87.95	12.05
March	86.70	13.30	87.21	12.79
April	86.27	13.73	86.69	13.31
May	86.66	13.34	86.92	13.08
Average	88.40	11.60	88.33	11.67

MARKETING AND SELLING PRICE

The general procedure of marketing these experimental cattle was to cut off succulent roughages a few days before shipping. The final weight was taken in the morning before driving to the loading point, 3 miles away from the feedlots.

During the earlier years, the steers were sorted at market into the various feedlot groups and sold by lots. Later on, all the steers were thrown together, the poor end sorted off, and the steers sold in two different groups. The number of cut-backs in the various lots determined the difference in selling price. During later years, a combination of selling price and appraisal made previous to shipping has been the determining factor in setting a value on the different lots. In other words, the market top for the day when the experimental cattle are on the market has been taken for the highest appraised lot and the others valued as much lower as the appraisal varied. Appraisals on the cattle were made by a packer-buyer and a commission-house salesman.

TABLE SHOWING AVERAGE SHRINK PER STEER TO MARKET WITH DIFFERENT TYPES OF RATIONS USED

(Cattle driven 3 miles to loading point, then shipped 67 miles by rail to Denver market.)

	Grain with or without protein supplement Alfalfa	Grain with or without protein supplement Wet beet pulp Alfalfa	Grain with or without protein supplement Succulent roughage Alfalfa	Grain with or without protein supplement Dry roughage Alfalfa	Grain protein supplement Wet beet pulp Other roughages Alfalfa	Alfalfa
1914–15	7.52	7.58	7.22			
(3-year-olds)	6.73		6.77			
			8.47			
1916–17	5.70	5.00	2.90			
(2-year-olds)	7.00		7.00			
			7.00			
1918	5.12	4.89	1.21			
(2-year-olds)	8.95		1.76			
			8.45			
1918–19	7.01	5.17	6.38			
(3-year-olds)	7.10	5.71	7.26			
1919–20	8.57	6.87	6.30			
(2-year-olds)		7.09	8.12			11.05
1920–21	4.42	5.77	5.70			
(2-year-olds)		6.01	5.67			
			6.82			
1921–22		4.50	4.20			
(3-year-olds)			4.20			
			5.80			
			6.50			
			6.30			
1922–23		6.38	4.76			
(Yearlings)			6.09			
			6.04			
			6.05			
			4.82			
1923–24	6.04	6.38	6.09			
(Yearlings)			6.04			
			4.77			
			4.82			
1924–25			3.06	1.42		
(Calves)			2.49			
			3.58			
			2.68			
			2.75			
1926–27		2.34	3.91		4.35	
(Calves)		3.39	3.47		3.67	
			2.94			
			3.45			
1927–28	3.17	2.81		3.32	3.21	
(Calves)		3.43				
		4.05				
1928–29	4.77	5.15		4.99	4.83	
(Calves)		6.30				
		6.66				
1929–30	2.98	3.64	3.46		4.57	
(Calves)			4.88			
			3.77			
1930–31	4.51	3.90	3.01		3.55	
(Calves)			2.99			
			2.80			

TABLE SHOWING AVERAGE SHRINK PER STEER TO MARKET WITH DIFFERENT TYPES OF RATIONS USED—Continued

(Cattle driven 3 miles to loading point, then shipped 67 miles by rail to Denver market.)

	Grain with or without protein supplement Alfalfa	Grain with or without protein supplement Wet beet pulp Alfalfa	Grain with or without protein supplement Succulent roughage Alfalfa	Grain with or without protein supplement Dry roughage Alfalfa	Grain protein supplement Wet beet pulp Other roughages Alfalfa	Alfalfa
1931–32	.....	3.58	.....	.....	.....	.....
(Calves)	.....	4.39	.....	.....	.....	.....
	.....	3.90	.....	.....	.....	.....
	.....	4.56	.....	.....	.....	.....
	.....	4.17	.....	.....	.....	.....
	.....	4.22	.....	.....	.....	.....
	.....	3.87	.....	.....	.....	.....
	.....	3.19	.....	.....	.....	.....
1932–33	.....	2.82	.....	.....	.....	.....
(Calves)	.....	3.67	.....	.....	.....	.....
	.....	3.17	.....	.....	.....	.....
	.....	2.63	.....	.....	.....	.....
	.....	3.70	.....	.....	.....	.....
	.....	1.70	.....	.....	.....	.....
	.....	1.99	.....	.....	.....	.....
No. trials	15	37	45	3	6	1
Average shrink:						
3-year-olds	7.07	5.74	6.31	.....	.....	.....
2-year-olds	6.63	5.94	5.54	.....	.....	11.05
Yearlings	6.04	6.38	5.50	.....	.....	.....
Calves	3.86	3.73	3.08	3.24	4.03	.....

CARCASS GRADES

The cattle, numerically branded, were identified on the slaughtering floor, and the carcasses were tagged with corresponding numbers. A warm-dressed weight was obtained on each steer, and the customary packer's shrink was figured to get cold-dressed weight. The carcass grade determined by packers has been given the following numerical values to facilitate comparisons: Choice, 100; good, 90; medium, 80; and common, 70.

In these ration experiments, an attempt has been made to ascertain as nearly as possible the true relative fattening values of feeds tested. A detailed study of the shrinkage of steers enroute to market has not revealed any significant difference based on character of ration fed. This lack of difference is probably due to the method of

handling these steers just previous to shipping. All succulent roughages were taken away from the cattle several days before marketing, so that the shrinkage of cattle on succulent rations was cut down to a minimum.

Feedlot gains based on averages of a series of initial and final weights of steers are obviously most reliable for comparison, since shrink to market varies so greatly between different shipping points. The practical feeder can very readily apply his shrink to figures presented in this bulletin.

TABLES SHOWING FEEDING TESTS BY YEARS
1914–15
George E. Morton in charge
3-year-old steers—fed Dec. 29 to March 9—70 days
(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed Salt self-fed.	Molasses Cottonseed cake Wet pulp Alfalfa	Molasses Cottonseed cake Corn silage Alfalfa	Ground barley Molasses Corn silage Alfalfa	Ground barley Corn silage Alfalfa	Ground barley Alfalfa	Ground corn Alfalfa
Number steers per lot	10	9	10	10	10	10
Feedlot weight at start	1047.5	1050.5	1041.3	1062.8	1055.2	1057.3
Final feedlot weight	1273.5	1226.1	1255.0	1247.0	1243.5	1219.0
Gain	226.0	175.6	213.7	184.2	188.3	161.7
Daily gain	3.23	2.51	3.05	2.63	2.69	2.31
Daily ration fed:						
Ground corn	.....	.....	.....	.....	.....	12.45
Ground barley	.....	.....	8.01	9.91	12.42	.....
Beet molasses	4.88	5.26	4.87	.....	.....	.....
Cottonseed cake	2.64	2.85	.....	.....	.....	.....
Corn silage	.....	39.62	36.68	36.64	.....	.....
Wet beet pulp	80.62	.....	.....	.....	.....	.....
Alfalfa	13.69	10.51	8.03	9.31	22.44	23.76
Feed required per cwt. gain at feedlot:						
Ground corn	.....	.....	.....	.....	.....	539.0
Ground barley	.....	.....	262.3	376.6	461.8	.....
Beet molasses	151.0	209.7	159.6	.....	.....	.....
Cottonseed cake	81.9	113.6	.....	.....	.....	.....
Corn silage	.....	1579.3	1201.5	1392.5	.....	.....
Wet beet pulp	2497.2	.....	.....	.....	.....	.....
Alfalfa	424.1	419.0	263.0	353.7	834.3	1028.8
Feed cost per cwt. gain at feedlot	$5.21	$7.94	$6.75	$7.93	$7.50	$9.51
Selling price per cwt.	$7.20	$7.20	$7.20	$7.20	$7.20	$7.20

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1916–17

George E. Morton in charge

2-year-old steers—fed Dec. 28 to May 17—140-day feeding period

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed	Molasses Cottonseed cake Wet pulp	Molasses Cottonseed cake Corn silage	Ground barley Molasses Corn silage	Ground barley Corn silage	Ground barley	Ground corn
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	9	10
Feedlot weight at start	800.0	786.2	795.7	779.5	828.0	773.2
Final feedlot weight	1069.5	1021.5	1065.8	1034.5	1085.2	1033.9
Gain	269.5	235.3	270.1	255.0	257.2	260.7
Daily gain	1.93	1.68	1.93	1.82	1.84	1.86
Daily ration fed:						
Ground corn						9.89
Ground barley			7.48	8.23	10.25	
Beet molasses	3.87	4.02	2.31			
Cottonseed cake	2.58	2.72				
Corn silage		37.01	24.55	24.73		
Wet beet pulp	66.31					
Alfalfa	10.91	9.03	9.78	9.72	15.87	16.33
Feed required per cwt. gain at feedlot:						
Ground corn						531.3
Ground barley			387.6	452.0	558.1	
Beet molasses	201.1	239.2	119.6			
Cottonseed cake	133.9	161.8				
Corn silage		2201.8	1272.3	1358.0		
Wet beet pulp	3444.5					
Alfalfa	566.8	536.9	506.7	533.5	863.5	877.0
Feed cost per cwt. gain at feedlot	$7.43	$10.73	$8.86	$9.26	$8.47	$8.82
Selling price per cwt.	$12.25	$11.25	$12.10	$12.10	$12.00	$11.85
Dressing percentage (warm)	61.7	60.3	62.5	63.0	60.4	60.3

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1918

T. E. Leiper in charge

2-year-old steers—fed March 6 to July 10—126-day feeding period

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed	Molasses Cottonseed cake Wet pulp	Molasses Cottonseed cake Corn silage	Ground barley Molasses Corn silage	Ground barley Corn silage	Ground barley	Ground corn
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	9	9	9	9	9	9
Feedlot weight at start	853.9	839.2	827.8	823.0	843.0	838.7
Final feedlot weight	1147.2	1082.6	1060.9	1040.4	1072.6	1105.6
Gain	293.3	243.4	233.1	217 4	229.6	266.9
Daily gain	2.33	1.93	1.85	1.73	1.82	2.12
Daily ration fed:						
Ground corn	.....	.....	.....	.....	.....	10.60
Ground barley	.....	.....	5.77	8.47	11.34	.....
Beet molasses	3.87	3.89	3.20	.....	.....	.....
Cottonseed cake	2.97	3.00	.....	.....	.....	.....
Corn silage	.....	22.96	21.02	20.88	.....	.....
Wet beet pulp	77.02	.....	.....	.....	.....	.....
Alfalfa	7.66	9.35	8.51	8.51	16.69	18.57
Feed required per cwt. gain at feedlot:						
Ground corn	.....	.....	.....	.....	.....	500.7
Ground barley	.....	.....	312.1	491.1	622.3	.....
Beet molasses	166.2	201.3	173.0	.....	.....	.....
Cottonseed cake	127.5	155.2	.....	.....	.....	.....
Corn silage	.....	1188.7	1135.9	1210.2	.....	.....
Wet beet pulp	3308.3	.....	.....	.....	.....	.....
Alfalfa	329.2	484.1	459.9	493.2	915.7	876.7
Feed cost per cwt. gain at feedlot	$6.15	$7.98	$7.90	$9.11	$9.26	$8.52
Selling price per cwt.	$17.25	$17.00	$17.00	$16.75	$16.25	$16.00
Dressing percentage	61.0	59.5	59.8	62.3	59.4	60.5

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1918–19

Charles I. Bray in charge

3-year-old steers, fed 157-day feeding period, Nov. 16, 1918 to April 22, 1919

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Preliminary period Nov. 16 to Dec. 26.	Wet pulp Alfalfa	Pastured tops Alfalfa	Dried tops Alfalfa	Beet-top silage Alfalfa	Corn silage Alfalfa	Alfalfa
Fattening period Dec. 26 to April 26.	Wet pulp Molasses Cottonseed cake	Wet pulp Molasses Cottonseed cake	Dried molasses Beet pulp Cottonseed cake	Beet-top silage Corn silage Molasses Cottonseed cake	Corn silage Molasses Cottonseed cake	Molasses Cottonseed cake
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	971.0	971.3	972.0	970.0	970.3	970.9
Final feedlot weight	1316.0	1304.5	1241.0	1212.0	1245.5	1133.5
Gain	345.0	333.2	269.0	242.0	275.2	162.6
Daily gain	2.20	2.12	1.71	1.54	1.75	1.04
Daily ration fed: Perliminary period—40 days.						
Siloed beet pulp	77.25	.....	.....	.....	.....	.....
Pastured beet tops (acres)	.....	.01	.....	.....	.....	.....
Dried beet tops	.....	.....	33.88	.....	.....	.....
Beet-top silage	.....	.....	.....	43.50	.....	.....
Corn silage	.....	.....	.....	.....	33.50	.....
Alfalfa	8.71	6.94	18.63	19.81	10.98	34.65
Fattening period—117 days.						
Siloed beet pulp 103 days	93.79	91.75	.....	.....	.....	.....
Dried molasses beet pulp	.....	.....	7.61	.....	.....	.....
Corn silage (lots 1 and 2—14 days, lot 4—56 days)	38.57	38.57	.....	33.75	40.68	.....
Beet-top silage—61 days	.....	.....	.....	45.90	.....	.....
Beet molasses 89 days	4.09	4.09	.....	3.62	4.09	4.09
Cottonseed cake	2.43	2.43	2.43	2.75	2.43	4.04
Alfalfa	10.47	9.29	20.83	13.53	10.20	25.30
Feed required per cwt. gain at feedlot:						
Siloed beet pulp	3695.7	2836.1	.....	.....	.....	.....
Pastured beet tops (acres)	.....	.12	.....	.....	.....	.....
Dried beet tops	.....	.....	503.7	.....	.....	.....
Beet-top silage	.....	.....	.....	1876.0	.....	.....
Corn silage	156.5	162.1	.....	781.0	2216.6	.....
Dried molasses beet pulp	.....	.....	330.9	.....	.....	.....
Beet molasses	105.5	109.2	.....	133.1	132.3	223.9
Cottonseed cake	82.3	85.2	105.6	133.1	103.2	290.9
Alfalfa	456.2	409.4	1182.9	981.3	593.1	2673.1
Feed cost per cwt. gain at feedlot	$6.26	$5.98	$9.23	$12.64	$9.59	$16.39
Selling price per cwt.	$15.65	$15.75	$14.85	$14.75	$15.00	$14.00
Dressing percentage	62.1	61.4	59.4	59.1	60.2	57.9

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1919-20

E. J. Maynard in charge

2-year-old steers—fed Nov. 12, 1919 to April 21, 1920—161 days

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Preliminary period Nov. 12 to Dec. 22—40 days.	Wet pulp Alfalfa	Pastured tops Alfalfa	Dried tops Alfalfa	Beet-top silage Alfalfa	Corn silage Alfalfa	Alfalfa
Fattening period Dec. 22 to April 21—121 days.	Wet pulp Molasses Cottonseed cake	Wet pulp Molasses Cottonseed cake	Dried Molasses Beet pulp Cottonseed cake	Beet-top silage Dried Molasses Beet pulp	Corn silage Molasses Cottonseed cake	
Salt self-fed	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	860.3	860.7	860.2	868.5	867.8	866.3
Final feedlot weight	1226.0	1172.5	1109.0	1108.0	1190.0	1009.5
Gain	365.7	311.8	248.8	239.6	322.2	143.2
Daily gain	2.27	1.94	1.55	1.49	2.00	0.89
Daily ration fed:						
Preliminary period 40 days.						
Siloed beet pulp	62.33	.....	.....	.....	.....	.....
Pastured beet tops (acres)	.....	.013	.....	.....	.....	.....
Dried beet tops	.....	.....	18.53	.....	.....	.....
Beet-top silage	.....	.....	.....	23.34	.....	.....
Corn silage	.....	.....	.....	.....	35.05	.....
Alfalfa	15.46	13.00	15.60	18.13	12.51	24.40
Fattening period 121 days.						
Siloed beet pulp	85.69	81.26	.....	.....	.....	.....
Beet-top silage	.....	.....	.....	20.14	.....	.....
Corn silage	.....	.....	.....	.....	35.78	.....
Dried molasses beet pulp	.....	.....	9.79	6.71	.....	.....
Beet molasses	3.49	3.48	2.48	.....	3.47	.....
Cottonseed cake	2.51	2.52	.....	2.31	2.56	.....
Alfalfa	9.23	9.42	12.47	12.11	7.31	23.98
Feed required per cwt. gain at feedlot:						
Siloed beet pulp	3517.3	3153.0	.....	.....	.....	.....
Pastured beet tops (acres)	.....	.16	.....	.....	.....	.....
Dried beet tops	.....	.....	297.8	.....	.....	.....
Beet-top silage	.....	.....	.....	1407.3	.....	.....
Corn silage	.....	.....	.....	.....	1778.9	.....
Dried molasses beet pulp	.....	.....	476.0	339.1	.....	.....
Beet molasses	115.4	135.2	.....	.....	130.4	.....
Cottonseed cake	82.9	97.8	120.6	116.5	96.2	.....
Alfalfa	474.6	532.5	857.3	914.4	429.8	2708.8
Feed cost per cwt. gain at feedlot	$5.93	$6.73	$9.00	$11.12	$7.83	$10.84
Selling price per cwt.	$12.50	$12.25	$12.00	$11.80	$12.50	$11.00
Dressing percentage (cold)	62.5	61.8	62.2	60.5	63.0	56.6
Carcass rank in cooler	1	3	4	5	2	6

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1920-21

E. J. Maynard in charge

2-year-old steers—fed Nov. 10, 1920 to June 4, 1921—205 days

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Preliminary period Nov. 10 to Dec. 20—40 days.	Wet pulp Alfalfa	Pastured tops Alfalfa	Dried tops Alfalfa	Beet-top silage Alfalfa	Corn silage Alfalfa	Alfalfa
Fattening period Dec. 20 to June 4—165 days.	Wet pulp Molasses	Wet pulp Molasses	Dried molasses beet pulp	Beet-top silage Grain mixture*	Corn silage Molasses	Dried molasses beet pulp Corn silage
Salt self-fed.	Cottonseed cake Alfalfa	Cottonseed cake Alfalfa	Cottonseed cake Alfalfa	Cottonseed cake Alfalfa	Cottonseed cake Alfalfa	Cottonseed cake Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	790.0	799.5	795.0	796.3	796.8	795.5
Final feedlot weight	1229.5	1213.0	1173.5	1163.0	1155.0	1187.5
Gain	439.5	413.5	378.5	366.7	358.7	392.0
Daily gain	2.14	2.02	1.85	1.79	1.75	1.91
Daily ration fed:						
Preliminary period (40 days)						
Siloed beet pulp	54.49	.....	.....	.....	.....	.....
Pastured beet tops (acres)	.....	0.010	.....	.....	.....	.....
Dried beet tops	.....	.....	17.95	.....	.....	.....
Beet-top silage	.....	.....	.....	19.98	.....	.....
Corn silage	.....	.....	.....	.....	28.50	.....
Alfalfa	16.43	5.88	17.45	17.33	10.68	22.95
Fattening period (165 days).						
Siloed beet pulp (lot 1—165 days) (lot 2—135 days)	78.37	78.83	.....	.....	.....	.....
Beet-top silage	.....	.....	.....	19.55	.....	.....
Beet molasses	3.33	3.34	.....	.....	3.34	.....
Dried molasses beet pulp	.....	.....	10.97	5.43	.....	7.28
Barley	.....	.....	.....	5.43	.....	.....
Corn silage (lot 2—32 days) (lots 5 and 6—165 days)	.....	33.95	.....	.....	32.23	31.23
Cottonseed cake	2.36	2.50	2.54	2.42	2.54	2.41
Alfalfa	9.63	10.10	13.17	8.80	8.09	5.82
Feed required per cwt. gain at feedlot:						
Siloed beet pulp	3438.1	2573.6	.....	.....	.....	.....
Pastured beet tops (acres)	.....	.10	.....	.....	.....	.....
Dried beet tops	.....	.....	189.7	.....	.....	.....
Beet-top silage	.....	.....	.....	1097.6	.....	.....
Corn silage	.....	262.8	.....	.....	1800.3	1314.4
Dried molasses beet pulp	.....	.....	478.0	244.5	.....	308.8
Barley	.....	.....	.....	244.5	.....	.....
Beet molasses	124.8	133.3	.....	.....	153.6	.....
Cottonseed cake	88.7	99.8	110.5	108.8	116.6	101.3
Alfalfa	511.0	460.0	758.4	548.8	491.1	479.3
Feed cost per cwt. gain at feedlot	$6.15	$6.52	$8.37	$10.52	$8.54	$8.71
Selling price per cwt.	$9.00	$8.50	$8.25	$8.00	$8.25	$8.25
Dressing percentage (cold)	63.0	62.9	61.6	61.4	59.9	61.5

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1921-22

E. J. Maynard in charge

3-year-old steers—fed Dec. 3 to April 22—140-day feeding period

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed	Molasses Cottonseed cake Wet pulp	Corn* Molasses Cottonseed cake Sunflower silage	Corn Cottonseed cake Sunflower silage	Barley Cottonseed cake Sunflower silage	Dried molasses beet pulp Cottonseed cake Sunflower silage	Dried molasses beet pulp Cottonseed cake Corn silage
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	1054.2	1058.8	1054.5	1051.7	1051.8	1053.7
Final feedlot weight	1047.8	1262.5	1319.7	1267.7	1344.8	1385.3
Gain	353.7	203.7	265.2	216.0	293.0	331.6
Daily gain	2.53	1.46	1.89	1.54	2.09	2.37
Daily ration fed:						
Ground corn	.....	9.60	10.26	.....	.....	.....
Ground barley	.....	.....	.....	10.40	.....	.....
Dried molasses beet pulp	.....	.....	.....	.....	11.35	11.34
Beet molasses	5.74	5.98	.....	.....	.....	.....
Cottonseed cake	2.54	2.63	2.34	2.36	2.57	2.58
Wet beet pulp	112.80	.....	.....	.....	.....	.....
Sunflower silage	.....	24.50	24.32	24.50	24.50	.....
Corn silage	.....	.....	.....	.....	.....	24.51
Alfalfa	8.14	13.29	12.08	9.75	9.60	6.84
Feed required per cwt. gain at feedlot:						
Ground corn	.....	235.6	541.6	.....	.....	.....
Ground barley	.....	.....	.....	674.2	.....	.....
Dried molasses beet pulp	.....	.....	.....	.....	542.3	478.7
Beet molasses	227.4	410.8	.....	.....	.....	.....
Cottonseed cake	100.4	181.0	123.7	153.0	122.6	108.7
Wet beet pulp	4463.4	.....	.....	.....	.....	.....
Sunflower silage	.....	1684.1	1284.1	1588.4	1170.4	.....
Corn silage	.....	.....	.....	.....	.....	1034.7
Alfalfa	322.1	913.1	637.5	631.8	458.8	288.9
Feed cost per cwt. gain at feedlot	$6.65	$13.59	$12.26	$13.90	$9.71	$8.63
Selling price per cwt.	$8.25	$8.00	$8.25	$8.25	$8.25	$8.25
Dressing percentage	63.7	62.3	61.5	62.4	63.0	62.5
Carcass rank in cooler	2	6	5	4	1	3

*Corn fed last 50 days.

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1922-23

E. J. Maynard in charge

Yearling steers—fed Nov. 25 to May 24—180 days

After 30-day period on rough feeds, Oct. 26 to Nov. 25

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed	Wet beet pulp Molasses Cottonseed cake	Sunflower silage Barley Molasses	Sunflower silage Barley	Sunflower silage Barley Cottonseed cake	Sunflower silage Dried molasses beet pulp Cottonseed cake	Corn Silage Dried molasses beet pulp Cottonseed cake
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	700.8	715.7	716.5	712.8	722.7	708.7
Final feedlot weight	1122.3	1127.8	1094.0	1119.8	1119.0	1126.8
Gain	421.5	412.2	377.5	407.0	396.3	418.2
Daily gain	2.34	2.29	2.10	2.26	2.20	2.32
Daily feed fed:						
Ground barley	.....	10.2	10.8	10.6	.....	.....
Beet molasses	4.1	3.7	.....	.....	.....	.....
Dried molasses beet pulp	.....	.....	.....	.....	10.7	10.2
Wet beet pulp	67.9	.....	.....	.....	.....	.....
Sunflower silage	.....	15.2	18.3	15.7	15.6	.....
Corn silage	.....	.....	.....	.....	.....	13.0
Cottonseed cake	2.1	.....	.....	2.1	2.1	2.1
Alfalfa	7.5	8.0	8.8	7.3	7.7	7.4
Feed required per cwt. gain at feedlot:						
Ground barley	.....	445.1	517.0	466.7	.....	.....
Beet molasses	174.2	163.2	.....	.....	.....	.....
Dried molasses beet pulp	.....	.....	.....	.....	484.9	437.4
Wet beet pulp	2897.8	.....	.....	.....	.....	.....
Sulflower silage	.....	663.9	871.7	694.7	708.1	.....
Corn silage	.....	.....	.....	.....	.....	561.3
Cottonseed cake	90.1	.....	.....	93.3	95.8	90.8
Alfalfa	319.8	348.2	420.9	323.3	351.0	319.2
Feed cost per cwt. gain at feedlot	$5.28	$7.21	$7.86	$8.25	$7.61	$7.10
Selling price per cwt.	$10.38	$9.99	$9.86	$10.14	$10.35	$10.33
Dressing percentage (warm)	64.7	63.1	63.3	63.0	63.8	65.5
Carcass grade	92	89	87	88	87	93

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1923–24

E. J. Maynard in charge

Yearling steers—fed Dec. 12 to June 15—186 days

(Table based on one average steer)

Lot number	1	2	3	4	5	6
Ration fed	Wet pulp Molasses Cottonseed cake	Barley	Barley Sunflower silage	Barley Sunflower silage Cottonseed cake	Barley Corn silage	Barley Molasses Corn silage
Salt self-fed.	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Number steers per lot	10	10	10	10	10	10
Feedlot weight at start	762.7	757.5	759.8	757.3	756.8	758.2
Final feedlot weight	1223.0	1124.0	1157.5	1158.5	1178.0	1180.0
Gain	460.3	366.5	397.7	401.2	421.2	421.8
Daily gain	2.47	1.98	2.21	2.18	2.26	2.27
Daily feed fed:						
Ground barley	.....	11.64	12.12	11.84	11.18	11.57
Beet molasses	3.87	.....	.....	.....	.....	3.86
Siloed beet pulp	78.93	.....	.....	.....	.....	.....
Sunflower silage	.....	.....	17.94	18.13	.....	.....
Corn silage	.....	.....	.....	.....	18.17	18.29
Cottonseed cake	1.87	.....	.....	1.61	.....	.....
Alfalfa	9.24	15.32	10.86	8.44	8.09	7.22
Feed required per cwt. gain at feedlot:						
Ground barley	.....	589.0	549.8	542.6	521.6	510.1
Beet molasses	156.2	.....	.....	.....	.....	170.2
Siloed beet pulp	3189.3	.....	.....	.....	.....	.....
Sunflower silage	.....	.....	813.7	831.0	.....	.....
Corn silage	.....	.....	.....	.....	802.2	806.7
Cottonseed cake	75.5	.....	.....	73.8	.....	.....
Alfalfa	373.5	775.3	492.5	386.8	357.3	318.3
Feed cost per cwt. gain at feedlot	$5.35	$8.40	$8.34	$9.10	$7.92	$8.36
Selling price per cwt.	$9.61	$9.16	$9.53	$9.39	$9.61	$9.62
Dressing percentage (warm)	63.3	62.1	61.3	61.4	62.5	63.6
Carcass grade	96	92	94	93	94	91

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1924-25

E. J. Maynard in charge

Steers and heifer calves mixed—fed Nov. 19 to June 15—208 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed Salt self-fed.	Barley Corn fodder Linseed-oil cake Alfalfa	Barley Corn silage Linseed-oil cake Alfalfa	Barley Corn and soybean silage Linseed-oil cake Alfalfa	Barley Cull potatoes Linseed-oil cake Alfalfa	Barley Potato silage Linseed-oil cake Alfalfa	Corn Corn silage Linseed-oil cake Alfalfa
Number calves per lot	10	10	10	10	9	10
Feedlot weight at start	344.7	347.8	345.5	348.5	358.0	348.5
Final feedlot weight	774.0	785.0	795.5	782.5	807.2	781.5
Gain	429.3	437.2	450.0	434.0	449.2	433.0
Daily gain	2.06	2.10	2.16	2.09	2.16	2.08
Daily feed fed:						
Ground barley	6.88	6.88	6.89	6.88	6.89	.....
Ground corn	.....	.....	.....	.....	.....	6.83
Corn fodder	4.14	.....	.....	.....	.....	.....
Corn silage	.....	9.16	.....	.....	.....	9.15
Corn and soybean silage	.....	.....	9.16	.....	.....	.....
Cull potatoes	.....	.....	.....	9.05	.....	.....
Potato silage	.....	.....	.....	.....	7.44	.....
Linseed oil cake	1.04	1.03	1.04	1.04	1.04	1.04
Alfalfa	4.75	4.90	5.86	6.70	6.71	5.67
Feed required per cwt. gain at feedlot:						
Ground barley	337.1	331.5	322.1	333.5	324.6	.....
Ground corn	.....	.....	.....	.....	.....	332.3
Corn fodder	200.2	.....	.....	.....	.....	.....
Corn silage	.....	437.5	.....	.....	.....	441.1
Corn and soybean silage	.....	.....	425.0	.....	.....	.....
Cull potatoes	.....	.....	.....	417.3	.....	.....
Potato silage	.....	.....	.....	.....	331.2	.....
Linseed-oil cake	50.3	49.2	48.0	49.7	48.0	49.8
Alfalfa	230.0	233.1	270.9	321.2	311.9	272.4
Feed cost per cwt. gain at feedlot	$6.16	$5.87	$5.90	$6.00	$5.88	$6.40
Selling price per cwt.	$10.78	$10.81	$10.89	$10.73	$10.72	$10.64
Dressing percentage (cold)	58.4	59.7	59.3	60.1	58.7	59.9
Carcass grade	96	92	91	93	91	91

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1925-26

E. J. Maynard in charge

Steer and heifer calves mixed—fed Nov. 6 to May 25—200 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed Alfalfa hay in all lots. Salt self-fed.	Corn fodder Wet pulp Barley Cottonseed cake	Corn silage Wet pulp Barley Cottonseed cake	Corn silage Dried pulp Barley Cottonseed cake	Corn silage Dried molasses pulp Barley Cottonseed cake	Corn silage Dried pulp Barley Linseed-oil cake	Corn silage Dried pulp Corn Linseed-oil cake
Number of calves per lot	10	10	10	10	10	10
Feedlot weight at start	350.9	348.1	348.7	348.8	353.1	349.1
Final feedlot weight	756.3	743.4	740.1	734.8	740.5	761.8
Gain	405.3	395.3	391.4	386.0	387.5	412.7
Daily gain	2.03	1.98	1.96	1.93	1.94	2.06
Daily feed fed:						
Ground barley	5.42	5.44	3.34	3.34	3.34	.....
Ground corn	.....	.....	.....	.....	.....	3.32
Dry cut corn fodder	3.97	.....	.....	.....	.....	.....
Corn silage	.....	7.81	9.33	9.26	10.46	10.45
Siloed beet pulp	13.00	12.71	.....	.....	.....	.....
Dried beet pulp	.....	.....	3.32	.....	3.32	3.31
Dried molasses beet pulp	.....	.....	.....	3.32	.....	.....
Cottonseed cake	.93	.93	.94	.94	.....	.....
Linseed-oil cake	.....	.....	.....	.....	.94	.94
Alfalfa	4.51	4.57	4.51	4.20	4.48	4.53
Feed required per cwt. gain at feedlot:						
Ground barley	267.5	275.1	170.7	172.8	172.4	.....
Ground corn	.....	.....	.....	.....	.....	160.5
Dry cut corn fodder	195.9	.....	.....	.....	.....	.....
Corn silage	.....	395.3	476.5	479.9	539.7	506.4
Siloed beet pulp	641.2	643.1	.....	.....	.....	.....
Dried beet pulp	.....	.....	169.7	.....	171.4	160.2
Dried molasses beet pulp	.....	.....	.....	171.8	.....	.....
Cottonseed cake	46.1	47.2	47.8	48.5	.....	.....
Linseed-oil cake	.....	.....	.....	.....	47.3	45.3
Alfalfa	222.6	231.4	230.5	217.4	231.2	219.6
Feed cost per cwt. gain at feedlot	$5.64	$5.48	$5.51	$5.51	$5.83	$5.66
Selling price per cwt.	$9.00	$9.00	$9.00	$9.00	$9.00	$9.00
Dressing percentage (cold)	62.0	62.5	62.3	62.4	63.6	62.5
Carcass grade	98	96	96	95	96	97

1926-27

E. J. Maynard in charge

Steer and heifer calves mixed—fed Nov. 30 to June 8—190 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6	7	8
Ration fed Alfalfa hay in all lots. Salt self-fed.	Corn fodder Wet pulp Barley Cottonseed cake	Corn silage Wet pulp Barley Cottonseed cake	Corn silage Dried pulp Barley Cottonseed cake	Corn silage Dried molasses pulp Barley Cottonseed cake	Corn silage Dried pulp Barley Linseed-oil cake	Corn silage Dried pulp Corn Linseed-oil cake	Barley Wet pulp Cottonseed cake	Barley Pressed pulp Cottonseed cake
Number calves per lot	10	10	10	10	10	10	10	10
Feedlot weight at start	349.7	348.0	347.3	349.8	349.5	351.0	351.2	350.2
Final feedlot weight	735.0	760.9	751.4	757.3	748.8	747.8	739.3	746.9
Gain	385.3	412.9	404.1	407.5	399.3	396.8	388.1	396.8
Daily gain	2.03	2.17	2.13	2.14	2.10	2.09	2.04	2.09
Daily feed fed:								
Ground barley	3.95	4.26	3.80	3.82	3.80		4.02	4.01
Ground corn						3.82		
Dry cut corn fodder	3.07							
Corn silage		8.65	9.06	9.07	9.07	9.07		
Siloed or pressed beet pulp	20.10	20.43					26.27	26.52
Dried beet pulp			3.39		3.45	3.47		
Dried molasses beet pulp				3.47				
Cottonseed cake	1.05	1.05	1.05	1.05			1.05	1.05
Linseed-oil cake					1.05	1.05		
Alfalfa	3.70	3.49	3.86	4.21	4.07	4.39	6.09	6.49
Feed required per cwt. gain at feedlot:								
Ground barley	194.6	195.9	178.8	178.0	180.9		196.8	192.2
Ground corn						182.8		
Dry cut corn fodder	151.4							
Corn silage		398.2	426.2	422.7	431.4	434.1		
Siloed or pressed beet pulp	991.0	939.8					1285.9	1269.8
Dried beet pulp			159.6		164.0	166.3		
Dried molasses beet pulp				162.0				
Cottonseed cake	52.0	48.5	49.6	49.2			51.6	50.5
Linseed-oil cake					50.2	50.5		
Alfalfa	182.7	160.7	181.7	196.3	193.9	210.3	298.2	310.6
Feed cost per cwt. gain at feedlot:	$4.87	$4.69	$5.24	$5.28	$5.53	$5.82	$4.61	$4.91
Selling price per cwt.	$10.55	$10.80	$10.70	$10.65	$10.75	$10.60	$10.65	$10.65
Dressing percentage (cold)	61.5	62.1	62.6	62.5	63.6	62.7	61.4	62.4
Carcass grade	86	85	84	81	92	87	86	85

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1927-28

E. J. Maynard in charge

Calves—fed Nov. 22 to May 27—187 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed Alfalfa hay, minerals and salt self-fed.	Steers Barley Cottonseed cake Siloed beet pulp	Heifers Barley Cottonseed cake Siloed beet pulp	Steers Barley Cottonseed cake Siloed beet pulp Corn silage	Steers Barley Cottonseed cake Beet tops	Steers Barley Cottonseed cake	Steers Barley Cottonseed cake Pressed beet pulp
Number calves per lot	9	10	10	10	9	9
Feedlot weight at start	378.9	364.8	375.2	375.8	382.2	381.3
Final feedlot weight	776.7	711.0	747.0	708.5	768.3	782.8
Gain	397.8	346.2	371.8	332.7	386.1	401.5
Daily gain	2.13	1.85	1.99	1.78	2.06	2.15
Daily feed fed:						
Ground barley	5.00	5.01	5.01	5.05	7.13	5.00
Siloed beet pulp	28.02	22.56	16.01	.....	.....	.....
Pressed beet pulp	.....	.....	.....	.....	.....	22.03
Corn silage	.....	.....	6.13	.....	.....	.....
Sugar beet tops	.....	.....	.....	6.71	.....	.....
Cottonseed cake	1.07	1.07	1.07	1.06	1.06	1.06
Alfalfa	5.77	5.68	4.72	7.09	9.60	7.29
Feed required per cwt. gain at feedlot:						
Ground barley	235.0	270.8	252.1	283.8	345.1	233.1
Siloed beet pulp	1316.5	1218.9	805.3	.....	.....	.....
Pressed beet pulp	.....	.....	.....	.....	.....	1026.0
Corn silage	.....	.....	308.1	.....	.....	.....
Sugar beet tops	.....	.....	.....	376.9	.....	.....
Cottonseed cake	50.1	57.7	53.6	59.8	51.5	49.5
Alfalfa	271.4	307.1	237.2	398.6	464.8	389.3
Feed cost per cwt. gain at feedlot	$4.86	$5.38	$5.29	$5.46	$5.82	$5.38
Selling price per cwt.	$13.30	$13.35	$13.33	$13.21	$13.40	$13.40
Dressing percentage (cold)	58.6	61.0	61.2	58.1	58.7	60.5
Carcass grade	94	97	97	93	94	99

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1928–29

E. J. Maynard and H. B. Osland in charge

Calves—fed Nov. 8 to May 22—195 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed Alfalfa hay, minerals and salt self-fed.	Steers Barley Cottonseed cake Siloed beet pulp	Heifers Barley Cottonseed cake Siloed beet pulp	Steers Barley Cottonseed cake Siloed beet pulp Corn silage	Steers Barley Cottonseed cake Beet tops	Steers Barley Cottonseed cake	Steers Barley Cottonseed cake Pressed beet pulp
Number of calves per lot	9	10	10	10	10	10
Feedlot weight at start	351.9	322.5	353.5	354.0	350.3	351.3
Final feedlot weight	747.8	654.5	726.8	742.2	729.3	754.5
Gain	395.8	332.0	373.3	388.2	379.1	403.3
Daily gain	2.03	1.70	1.91	1.99	1.94	2.07
Daily feed fed:						
Ground barley	4.81	4.41	4.80	5.12	6.10	4.68
Siloed beet pulp	20.86	17.05	11.06	.....	.....	.....
Pressed beet pulp	.....	.....	.....	.....	.....	20.11
Corn silage	.....	.....	6.45	.....	.....	.....
Sugar beet tops	.....	.....	.....	5.40	.....	.....
Cottonseed cake	.98	.94	.99	.99	.97	.99
Alfalfa	4.95	4.12	3.96	7.15	7.61	5.19
Feed required per cwt. gain at feedlot:						
Ground barley	236.9	259.0	250.7	257.1	313.8	226.5
Siloed beet pulp	1027.7	1001.7	577.6	.....	.....	.....
Pressed beet pulp	.....	.....	.....	.....	.....	972.2
Corn silage	.....	.....	336.8	.....	.....	.....
Sugar beet tops	.....	.....	.....	271.2	.....	.....
Cottonseed cake	48.4	55.2	51.6	49.7	50.0	47.8
Alfalfa	244.0	241.7	207.1	359.3	391.3	250.8
Feed cost per cwt. gain at feedlot	$4.55	$4.84	$5.06	$4.81	$5.22	$4.68
Selling price per cwt.	$13.13	$13.25	$13.25	$13.14	$13.03	$13.14
Dressing percentage (cold)	60.1	61.1	60.3	58.0	59.2	61.2
Carcass grade	93	99	99	93	94	96

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1929–30

E. J. Maynard and H. B. Osland in charge

Steer calves—fed Nov. 19 to June 2—195 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed	Barley Cottonseed cake Wet pulp Cull potatoes Alfalfa, minerals and salt self-fed.	Barley Cottonseed cake Wet pulp	Barley Cottonseed cake Potato corn-fodder silage	Barley Cottonseed cake Corn silage	Barley Cottonseed cake Cull potatoes	Barley Cottonseed cake
Number of calves per lot	10	10	10	10	10	8
Feedlot weight at start	418.8	421.2	421.2	420.8	424.8	424.4
Final feedlot weight	832.0	824.0	809.5	820.0	781.5	805.6
Gain	413.2	402.8	388.3	399.2	356.7	381.3
Daily gain	2.12	2.07	1.99	2.05	1.83	1.96
Daily feed fed:						
Ground barley	5.09	5.09	5.09	5.09	5.09	6.41
Cottonseed cake	.98	.98	.98	.98	.98	.98
Cull potatoes	8.46	.....	.....	.....	15.47	.....
Wet beet pulp	21.47	27.83	.....	.....	.....	.....
Potato-corn fodder silage	.....	.....	13.69	.....	.....	.....
Corn silage	.....	.....	.....	13.79	.....	.....
Alfalfa	5.17	5.01	4.99	4.65	6.16	9.84
Feed required per cwt. gain at feedlot:						
Ground barley	237.6	243.3	244.8	245.3	272.5	317.2
Cottonseed cake	46.8	47.9	48.2	48.3	53.7	49.3
Cull potatoes	419.7	.....	.....	.....	868.3	.....
Wet beet pulp	1009.4	1358.4	.....	.....	.....	.....
Potato-corn fodder silage	.....	.....	673.1	.....	.....	.....
Corn silage	.....	.....	.....	679.9	.....	.....
Alfalfa	258.1	255.6	251.6	239.0	351.9	501.6
Feed cost per cwt. gain at feedlot	$5.30	$4.85	$5.52	$5.50	$6.27	$5.67
Selling price per cwt.	$10.50	$10.65	$10.51	$10.46	$10.36	$10.57
Dressing percentage (cold)	60.8	59.9	60.6	59.7	59.3	59.4
Carcass grade	90	92	90	89	85	91

TABLES SHOWING FEEDING TESTS BY YEARS—Continued

1930-31

H. B. Osland in charge

Steer calves—fed Nov. 26 to June 8—194 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6
Ration fed	Barley Cottonseed cake	Barley Cottonseed cake	Barley Cottonseed cake	Barley Cottonseed cake	Barley Cottonseed cake	Barley Cottonseed cake
	Wet pulp	Wet pulp	Potato corn-fodder silage	Corn silage	Cull potatoes	
Alfalfa, minerals and salt self-fed.	Cull potatoes					
Number of calves per lot	10	10	10	10	10	8
Feedlot weight at start	411.7	415.3	415.0	413.5	414.3	421.9
Final feedlot weight	844.0	848.5	799.0	785.0	822.0	831.3
Gain	432.3	433.2	384.0	371.5	407.7	409.4
Daily gain	2.23	2.23	1.98	1.91	2.10	2.11
Daily feed fed:						
Ground barley	3.92	3.92	3.92	3.92	3.92	5.77
Cottonseed cake	.98	.98	.98	.98	.98	.98
Cull potatoes	8.86				17.32	
Wet beet pulp	21.39	29.84				
Potato-corn fodder silage			17.42			
Corn silage				17.40		
Alfalfa	6.91	6.65	5.72	3.86	8.99	12.12
Feed required per cwt. gain at feedlot:						
Ground barley	176.0	175.7	198.2	204.9	186.7	273.3
Cottonseed cake	44.1	44.0	49.6	51.3	47.7	46.5
Cull potatoes	397.5				824.2	
Wet beet pulp	959.8	1336.6				
Potato-corn fodder silage			880.2			
Corn silage				908.8		
Alfalfa	310.3	298.0	289.2	201.4	427.9	574.2
Feed cost per cwt. gain at feedlot	$4.85	$4.34	$5.74	$5.54	$5.62	$5.53
Selling price per cwt.	$7.65	$7.90	$7.60	$7.70	$7.85	$7.60
Dressing percentage (cold)	58.6	59.1	58.3	59.8	59.9	57.8
Carcass grade	87	87	86	86	85	86

1931-32

H. B. Osland in charge

Steer calves—fed Nov. 18 to May 31—194 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6	7	8
Ration fed Alfalfa, minerals, and salt self-fed in all lots.	Ground corn Ground barley .5 pound cottonseed cake Wet pulp	Ground corn Ground barley 1 pound cottonseed cake Wet pulp	Ground corn Ground barley 1.5 pounds cottonseed cake Wet pulp	Ground corn Ground barley 1 pound linseed-oil cake Wet pulp	Ground corn Ground barley 1 pound flaxseed Wet pulp	Ground barley 1 pound cottonseed cake Wet pulp	Cracked wheat 1 pound cottonseed cake Wet pulp	Ground corn Cracked wheat 1 pound cottonseed cake Wet pulp
Number calves per lot	10	10	10	9	10	10	10	9
Feedlot weight at start	423.0	422.5	427.3	420.7	420.8	421.5	423.8	422.4
Final feedlot weight	845.0	846.0	853.5	838.9	877.0	839.0	840.0	887.8
Gain	422.0	423.5	426.2	418.2	456.2	417.5	416.2	465.4
Daily gain	2.18	2.18	2.20	2.16	2.35	2.15	2.15	2.40
Daily feed fed:								
Ground corn	2.46	2.46	2.46	2.46	2.40			2.47
Ground barley	2.46	2.46	2.46	2.46	2.40	4.58		
Cracked wheat							4.93	2.47
Cottonseed cake	.49	.98	1.45			.98	.98	.98
Linseed-oil cake				.98				
Flaxseed					.98			
Wet beet pulp	25.65	25.49	25.50	25.31	25.01	25.50	24.31	25.19
Alfalfa	6.97	6.67	6.50	6.09	6.28	5.84	6.20	7.43
Feed required per cwt. gain at feedlot:								
Ground corn	113.1	112.9	112.2	114.3	102.0			102.8
Ground barley	113.1	112.9	112.2	114.3	102.0	212.9		
Cracked wheat							229.7	102.8
Cottonseed cake	22.7	45.0	66.2			45.6	45.8	41.0
Linseed-oil cake				45.5				
Flaxseed					41.7			
Wet beet pulp	1179.4	1167.7	1160.8	1174.5	1063.5	1184.9	1133.3	1050.0
Alfalfa	320.6	305.6	295.9	282.8	267.0	271.1	288.8	309.9
Feed cost per cwt. gain at feedlot:	$4.54	$4.84	$5.13	$4.94	$4.30	$4.49	$4.93	$4.64
Selling price per cwt.	$5.75	$5.75	$5.75	$5.75	$5.50	$5.70	$5.55	$5.70
Dressing percentage (cold)	59.3	59.9	60.5	59.6	60.9	58.1	59.5	59.9
Carcass grade	83	86	83	82	85	83	83	82

1932–33

H. B. Osland in charge

Steer calves—fed Nov. 8 to May 17—190 days

(Table based on one average calf)

Lot number	1	2	3	4	5	6	7
Ration fed Alfalfa, minerals, and salt self-fed in all lots.	Ground corn Ground barley .5 pound cottonseed cake Wet pulp	Ground corn Ground barley 1 pound cottonseed cake Wet pulp	Ground corn Ground barley 1.5 pounds cottonseed cake Wet pulp	Ground corn Ground barley 1 pound linseed-oil cake Wet pulp	Ground corn Ground barley 1 pound flaxseed Wet pulp	Ground barley 1 pound cottonseed cake Wet pulp	Ground corn Cracked wheat 1 pound cottonseed cake Wet pulp
Number calves per lot	9	9	9	10	10	8	10
Feedlot weight at start	362.6	365.9	363.0	363.2	364.2	378.3	366.0
Final feedlot weight	756.9	765.9	757.6	763.0	779.2	785.6	778.2
Gain	394.3	400.0	394.6	399.8	415.0	407.3	412.2
Daily gain	2.08	2.11	2.08	2.10	2.18	2.14	2.17
Daily feed fed							
Ground corn	2.35	2.35	2.28	2.35	2.35		2.35
Ground barley	2.35	2.35	2.28	2.35	2.35	4.64	
Cracked wheat							2.35
Cottonseed cake	.49	.96	1.35			.97	.96
Linseed-oil cake				.97			
Flaxseed					.97		
Wet beet pulp	20.15	20.14	20.10	20.15	19.88	20.13	19.95
Alfalfa	7.26	6.57	6.27	6.79	5.98	6.92	6.57
Feed required per cwt. gain at feedlot:							
Ground corn	113.3	111.5	109.6	111.7	107.6		108.3
Ground barley	113.3	111.5	109.6	111.7	107.6	216.5	
Cracked wheat							108.3
Cottonseed cake	23.6	45.8	64.9			45.2	44.5
Linseed-oil cake				45.9			
Flaxseed					44.2		
Wet beet pulp	971.1	956.8	967.6	957.6	910.2	939.0	919.6
Alfalfa	349.7	311.9	302.0	322.9	273.6	323.0	302.9
Feed cost per cwt. gain at feedlot:	$4.55	$4.73	$4.97	$4.94	$4.37	$4.58	$4.67
Selling price per cwt	$5.95	$6.05	$6.00	$5.95	$6.05	$6.00	$5.95

Cattle shipped to California; no market data available.

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