

T H E S I S

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A STUDY OF IRRIGATED PASTURES WITH SUPPLEMENTS  
FOR FATTENING STEERS  
IN COLORADO

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Submitted by

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for the Degree of Master of Science

Colorado Agricultural College

Fort Collins, Colorado

October 22, 1929

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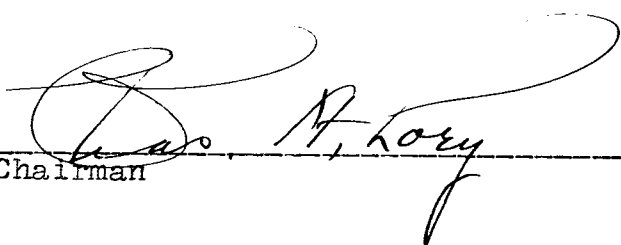
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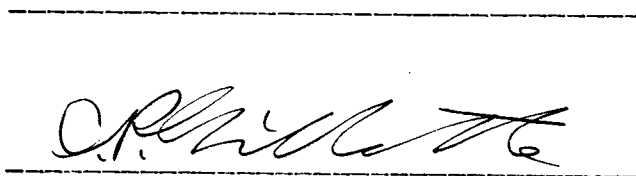
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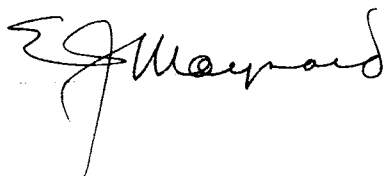
  
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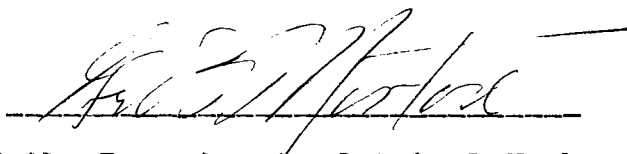
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October 22, 1929

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### Introduction

In Colorado, especially in the northern part, alfalfa is grown extensively under irrigation. Only a limited use has been made of it as a pasture, due primarily to the widespread belief that alfalfa could not be pastured by cattle without death loss. Under certain conditions alfalfa has the tendency to cause bloating. Death sometimes occurs if the bloating is severe. If there could be found some method of preventing this death loss, the alfalfa could be pastured and the expense of harvesting and feeding hay would be eliminated.

Sweet clover is growing in importance as a soil renovator, and is used in short crop rotations but it has the same tendency that green alfalfa has for causing cattle to bloat.

Morton's pasture-grass mixture is very popular in Colorado as a pasture for dairy cattle, sheep and beef cattle.

An experiment was to be conducted at the Colorado Agricultural Experiment Station during the summer of 1929 for the purpose of comparing the above named pastures for fattening steers. An opportunity was thus offered for a detailed study of the three pastures, under irrigated conditions, for fattening steers.

### Review of Literature

Cattle have grown and fattened upon grass since their earliest history. It is a natural feed for cattle. But since land values have rapidly increased, especially in this country during the last century, it is doubtful if it is profitable to continue to grow pasture grasses for the fattening of cattle.

Could not the land be forced to yield cultivated crops that would supply more feed for cattle than would pastures? Morton (19) partly answered that question as follows; "On the Islands of Jersey and Guernsey, cattle are being pastured upon land having a rental value of \$30.00 or more per acre." While it is true that those island cattle are not beef cattle, practically 14 percent of all the cattle in four cornbelt states, according to Wilcox, Collier, Black and McComas (42), are fattened on bluegrass pasture. In West-Central Missouri almost two-thirds of the cattle are fattened on bluegrass pasture. Grimes (13) states that it is more profitable to fatten cattle on grass than it is to full-feed during the winter and sell in the spring. Good (11) writes that cattle have grown and fattened on bluegrass pastures in Kentucky for more than 125 years, and that the entire state is noted for the production of high-class beef.

## Fattening Cattle on Non-Leguminous Pastures

### Western Ranges

During the period of free range, immense herds of cattle were developed and fattened on the range at extremely low cost to the producer, for the grass could be had at little or no cost and practically no provision was, or could be, made for winter feeding those herds.

Hough(16) described this cattleman's Mecca as follows: "By 1888 the buffalo had gone and the Northwest was filled with cattle that had been trailed up from Texas. Trail herds of 2 and 3000 cattle would start from Texas in the spring and reach Montana in the fall, often picking up 2 or 300 extra cattle on the way. The grasses were waist deep, and after the cattle had been there a year or two they were trailed east 5 or 600 miles, well grown and fat to meet the railroad."

The grass-fat cattle, during this open-range period, were not marketed until 3 and 4 years of age. There were several reasons for not marketing them earlier. The demand was for large cattle, and as grass was plentiful and cheap, the larger the animals the more money they would bring the owner.

But for various economical reasons, as shown by McFall (24), Vaughn (35) and Sampton (30), the trend of beef

production is changing from the marketing of 3 and 4-year-old cattle, to the marketing of calves and yearlings. This newer phase of the beef-cattle industry requires somewhat different methods of management than the open-range methods of fattening. The feeding of grain is now quite important according to Richardson (29).

#### Bluestem Grass

McC Campbell, Anderson and Marston (21) <sup>1884</sup> found that calves half full-fed during the winter and full-fed on bluestem grass from August 1 to November 1, returned a net profit of \$20.88 per head greater than the calves half full-fed during the winter and full-fed on bluestem grass from May 5 to November 5.

"This test demonstrates the possibility of using calves to utilize roughage and grass, and to produce high-class, well-finished, light-weight beef which the market now demands." They (22) decided that the gains made on bluestem grass were in direct proportion to the amount of flesh the cattle carried when they went on to the grass. Their average daily gain per head was 2.22 and 2.35 pounds when fattened on bluestem grass as compared to 2.84 pounds for the steers fattened in drylot. They (25) stated that cattle which had been wintered well, grazing without other feed for the first half of the pasture season and then full-fed grain for the

remainder of the summer gave satisfactory results. The grain ration had to be heavy in order to get enough finish to make the most profit.

### Bluegrass

Of all the pasture grasses used in the United States for fattening cattle, bluegrass is probably the most important. Snapp (33) states that bluegrass occupies fully 90 percent of the total area of permanent pastures in the cornbelt where practically all the summer fattening of cattle occurs.

Ellett (7) disagreeing with the popular opinion that all bluegrass is equally valuable for fattening cattle, points out that bluegrass grown principally on limestone soils not only contain more protein than bluegrass not grown on limestone soils, but is more palatable and more digestible, which he claims partly accounts for the superior fattening qualities of the bluegrass grown in Southwest Virginia. Bowers (5), studying the analysis of various bluegrass samples, found that the protein content was actually higher for the bluegrass grown in Southwest Virginia than bluegrass grown in other regions.

The acreage of bluegrass required per steer varies greatly according to stand, season and rainfall, length of grazing season and many other factors, but Snapp (33) found

that on the average in the cornbelt 2 acres of bluegrass would carry a thousand-pound steer thru the grazing period of 100 days.

According to Snapp (33) there are very few cattle fattened on bluegrass alone, for there are very few sections of the cornbelt where the grass is abundant and nutritious enough to put feeder steers in satisfactory killing condition without the aid of grain.

In three consecutive trials, Good (11) found that it paid to feed large amounts of silage and little grain during the winter if the steers were to be fattened on grass alone the following summer. Waters (38) reported that if a steer was to be grazed on grass alone the following summer there would be a fairly definite relation between the gains made during the winter and those possible during the following summer. In other words, he believed that the gains made on grass alone were almost inversely proportional to the gains made the previous winter.

It is, therefore, important that steers be wintered largely on roughages and limited grain feeds if they are to be fattened on grass alone the following summer.

Mumford (25) reported similar results in his steer-feeding experiments. According to Snapp (33), gains made wholly on grass were as a rule from 65 to 75 percent of

gains made when on full feed. Furthermore, he stated that on good pastures that furnish abundance of forage, yearling steers were expected to gain 1.25 to 1.50 pounds per head daily for the entire grazing period, while 2 year-old steers were expected to gain 1.5 to 2.0 pounds per head daily. Henry and Morrison (15) stated that bluegrass is one of the richest grasses in digestible nutrients, but that it should not be relied upon alone for fattening steers. Bluegrass proved to be an excellent early spring pasture but had the tendency to dry up during the hot mid-summer months, reviving after the first fall rains.

An average of 5 years' work by Mumford (26) showed that gains were greater when a nitrogenous supplement was fed to young cattle fattened on bluegrass. In the yearling steer-feeding trials by Gerlaugh (10) the daily gains per steer were 2.33 pounds. The feeding of a protein supplement did not produce the expected finish on Hunt's (17) grass-fattened calves. (Whitson (41) stated that 2 year-old steers should put on one hundred pounds gain with 3 or 4 bushels of corn less, while on pasture than in drylot.) Waters (39) wrote that steers may be made thick and prime on corn and bluegrass without the aid of expensive protein supplements as are required in drylot fattening.

His (39) method of preparing cattle for summer fattening, and for the actual fattening during the summer



is as follows: "If cattle are to be fattened in the summer it is usually best to increase the grain about the middle of February or first of March, and have the cattle in good strong thrifty condition by the time grass comes. The presence of stored fat in winter will not be deleterious to the gains made in summer on full feed, and will materially shorten the summer feed required. No change in feed is to be recommended ordinarily. When grass comes, continue on half grain feed thru May and June but gradually increase until they are on full feed, depending on whether it is important to get the early finish or not."

#### Sudan Grass

Sudan grass, as a pasture crop, is gaining importance in this country as its value is recognized. Most experimental grazing work with sudan grass has been done with dairy cattle and hogs rather than with fattening beef cattle.

(In two trials at the University of Nebraska (12) it was found that 3 acres of sudan grass were enough to carry 10 to 11 full-corn-fed steers, together with pigs following them, for 100 days during the growing season. More pork was produced in both trials with sudan pasture than with sweet-clover pasture. The result of the first trial indicated that sudan grass was a better beef producer than sweet clover.

Sudan grass made cheaper gains than the sweet-clover pasture, or the alfalfa hay in the drylot, but the sweet-clover pasture did not have a very good stand. The results the second year were not quite so favorable to the sudan grass pasture as they were the preceding year.

On the whole sudan grass seems to be rather promising as a pasture for fattening cattle but more experimental work is needed for conclusive results).

#### Bromegrass

Bromegrass has a place in many pasture-grass mixtures, but evidently it is of little importance, or rather little used alone for fattening cattle either with or without grain. Selvig (31) found that bromegrass was inferior to white-blossom and yellow-blossom sweet clover for fattening cattle. In a trial by Shepherd (32) two steers per acre overstocked the bromegrass pasture by at least 25 percent, while the clover pastures were not overstocked.

#### Rye Grass

In a trial at the University of Nebraska (2) when rye grass was used for the first few weeks and then sudan grass used for the remainder of the summer pasturing experiment, 693 pounds of corn and 71 pounds of alfalfa hay were

required per 100 pounds gain as compared to 819 pounds of corn and 138 pounds of alfalfa hay per 100 pounds gain in the drylot. Three steers were allotted per acre of pasture.

#### Fattening Cattle on Leguminous Pastures

Mumford described alfalfa and sweet clover as being admirably adapted to cattle feeding, excepting the tendency they possess for causing bloat, which must be guarded against. "In case of alfalfa this factor was sufficiently important to render its general use for pasture questionable." He stated that cattle fattened on alfalfa and sweet clover required less protein supplement than those fattened on bluegrass.

#### Alfalfa

Blair (4) found that steers made a daily gain of 1.68 pounds per head on Peruvian alfalfa in which sudan grass had been seeded. In a trial by True and McConnell (34) steers gained 1.29 pounds per day for 237 days on alfalfa pasture.

They (34) stated, "Since alfalfa, where conditions are favorable for its production, yields the most abundant and cheapest forage grown in the Southwest, the high protein content may be disregarded, altho theoretically a carbohydrate feed such as a sorghum or grain hay should be fed with it to secure the more thoro utilization of the protein by the animal."

Daily gains per steer of 1.29 and 1.68 pounds are not satisfactory for finishing cattle for the market. The pasture season, in most sections of the country, is too short to put the feeder steer in prime condition on such low daily gains.

#### Sweet Clover

More experimental work apparently has been done with sweet clover as a pasture crop for fattening cattle than with alfalfa.

Shepherd (32) observed that cattle needed their grain ration reduced to a minimum for a few days to induce them to graze sweet clover, but at the end of 3 days they were eating it fairly well. (One acre of sweet clover carried two steers for the 95-day feeding period.) Reasonable precautions were used to prevent bloat and none occurred. A two-year trial at the University of Nebraska (1, 2) tended to show that 3 acres of sweet clover were enough to carry 10 to 11 full-corn-ration steers, together with pigs following them, for the growing season.) In a trial by Selvig (31) the yellow-blossom sweet clover gave slightly better results than the white-blossom variety.

#### Fattening Cattle on Pasture Grass Mixtures

A mixture of grasses is often recommended for pastures. The greatest period of growth of the different grasses does not necessarily come at the same time, thereby

supplying a continuous growth of fresh, tender grass during the growing season.

In a trial by Popp (38) 2 and 3-year-old steers made a daily gain per head of 1.1 kilogram (2.42 pounds) on the Oldenburg marsh pasture, consisting of a mixture of white-clover, rye grass, timothy and meadow barley. Ward, Gray and Loyd (37) found that cottonseed cake fed as a protein supplement to 2 and 3-year-old steers, on a pasture consisting of Japan clover, Johnson grass, crabgrass and bermuda grass, increased materially the rate of gains made by the steers, causing them to finish more quickly. Ward and Peden (36) found that the feeding of cottonseed cake was unprofitable when fed to steers on a pasture consisting of a mixture of bluegrass, sweet clover, orchard grass and herd's grass. The gains were greater but so were the increased costs. In two trials at the Alabama Station (37), the addition of cottonseed cake to the ration proved profitable while the steers were on pasture. The pasture consisted of Johnson-grass, sweet clover, Japan clover, crab grass and bermuda grass. Greater gains and better finish were obtained but less profit was noted by Bennett and Goodell (3) when cottonseed cake was fed to steers on a pasture consisting of a mixture of bermuda grass with some clover and paspalum grass. The pasture containing the steers fed cottonseed cake was inferior to the one in which no cake was fed.

## Types of Pastures Adapted to Fattening Cattle in Colorado

### Mountain and Plains Ranges

Most of the ranges for fattening cattle in Colorado, whether mountain or plains ranges, are subject to the same criticism as the Western ranges, namely, the grass is not abundant enough to finish cattle for the market at the early age the packer prefers them. According to Burdick (6) 20 to 30 acres of grass are required per steer in regions of Colorado where the rainfall varies from 10 to 20 inches annually. He (6) stated that it was impossible to accurately determine the acreage required per steer in mountainous regions.

### Irrigated Pastures

#### Alfalfa

In irrigated sections pastures are irrigated as well as the field crops. Naturally the farmers and cattlemen depend upon the irrigated pastures to furnish grazing for their cattle. The irrigated section of Northern Colorado produces enormous quantities of alfalfa hay. (As alfalfa produces a rank, dense growth of known nutritious value when converted into hay, the idea has been conceived to have cattle graze the alfalfa. That would eliminate the harvesting expense and at the same time finish the cattle for market.)

Haver (14), over a period of several years, has fattened 4000 head of cattle on irrigated pastures. He experienced very little trouble with bloat while cattle were on alfalfa, but corn was kept before the calves at all times, and they were not taken off the pasture once they were turned on until they were ready for market. Calves turned on pasture April 15 were expected to be fat by July 15.

(Average daily gains of 2.33 pounds per steer on alfalfa pasture were obtained by Maynard (18) at the Colorado Station. One acre of pasture carried five steers for the 119-day period.)

(The fattening of cattle on alfalfa pasture is not a general practice. Under certain conditions it has the tendency to cause bloating. For that reason, many cattlemen regard it as a dangerous practice to pasture cattle on green alfalfa.)

#### Sweet Clover

In some sections of Colorado alfalfa does not grow as well as sweet clover. Many farmers are including sweet clover in their crop rotations. The Agricultural Extension Service of Colorado (8,9) has made an effort to interest the cattle owners in its possibility as a pasture crop for fattening cattle for the market. (In a trial at Monte Vista (8) comparing steam rolled barley with corn chops for fattening

steers, while on sweet-clover pasture, the feed required per 100 pounds gain was 397.17 pounds of barley and 0.23 acres of sweet clover, compared to 369.48 pounds of corn and 0.20 acres of sweet clover. One acre of sweet clover carried 1.9 steers for 115 days. In another trial the feed required per 100 pounds gain was 283.20 pounds of barley, 0.31 acres of sweet clover, 41.1 pounds of corn chops and 75.8 pounds of alfalfa hay. One acre of sweet clover supplemented with alfalfa hay carried 1.9 steers for 123 days.)

"The results of both experiments (8, 9), and supported by the experience of farmer feeders, show that young cattle to be summer-fattened on sweet-clover pasture with barley as the principal grain ration, must carry considerable flesh at the start of the summer feeding period."

#### Pasture-Grass Mixtures

Morton (19) after experimenting for twenty years with various pasture-grass mixtures, recommended a mixture of grasses that proved to be very popular in the northern, irrigated district of Colorado. Evidence of the popularity of the mixture was observed on a pasture tour in the vicinity of Fort Collins (27).

Altho variations of the mixture are often used, the standard mixture is as follows:



Morton's Mixture

	<u>Clay Soils</u>	<u>Sandy Loam Soils</u>
Awnless (Western) Bromegrass	15 lbs.	10 lbs.
Orchard Grass	15	10
Meadow Fescue	10	5
Timothy	6	4
Yellow-Blossom Sweet Clover	4	3
	<hr/>	<hr/>
Total Pounds Per Acre	50	32

Results Secured at the  
Colorado Agricultural Experiment Station  
Fattening Range Yearling Steers  
On Irrigated Pastures and Grain

1927 Results

The objects of the 1927 test (18) were to compare Morton's pasture-grass mixture (20) with alfalfa pasture for fattening range steers, and to compare shelled corn with home grown ground barley for fattening steers on pasture.

Ten high-grade Hereford yearling steers directly from the range were put in each 2 acre pasture. There were four lots including the drylot (checklot), making a total of 40 steers in the experiment. There was one alfalfa pasture and two pastures of Morton's pasture-grass mixture, each lot contained 2 acres. The only difference in the two Morton's mixture lots was that one lot of steers was fed shelled corn as the grain ration and the other lot was fed ground barley. The drylot received alfalfa hay in addition to their grain ration of shelled corn. Pigs followed the steers, at the rate of one pig to two steers, in all lots except in lot 4 where ground barley was fed. The steers were turned on pasture June 8, 1927 and taken off October 5, 1927 - a period of 118 days.

{The steers in the drylot fed alfalfa hay and shelled corn made the greatest daily gain per head of 2.40 pounds, while the steers on alfalfa pasture, and fed shelled corn made the next best daily gain of 2.33 pounds per head. Lot 1 steers fed shelled corn and lot 4 steers fed ground barley, both lots on Morton's pasture grass mixture, made daily gains per head of 2.21 and 2.27 pounds respectively.}

In comparing the two Morton's mixture lots it was found that the steers fed ground barley made a slightly greater daily gain, and that they consumed less grain per 100 pounds gain than did the steers fed shelled corn. The steers in the drylot consumed less grain per 100 pounds gain than did the steers in any of the pasture lots, and their average daily grain ration of 13.4 pounds was less than any of the pasture-grass lots. If it had not been for the hog profits per steer, the steers in the alfalfa and Morton's mixture lots receiving shelled corn as the grain ration would have been fed at a loss. The total profits, including hog profits per steer were \$6.28 per steer for the drylot; \$3.12 per steer for the alfalfa pasture; \$1.75 per steer for the Morton's mixture lot that was fed shelled corn; \$7.70 per steer in the Morton's mixture lot that was fed ground barley and not followed by pigs.

Alfalfa pasture was credited at \$24.32 per acre, but

in the experiment discounting the profits per pig, it had a replacement value of minus\$2.90 per acre. It would have been equally as profitable to have fed alfalfa hay at \$21.35 per ton. Alfalfa hay cost \$10.00 per ton. Morton's pasture-grass mixture was also credited at \$24.32 per acre. When shelled corn was fed to steers on the grass mixture, the pasture showed a replacement value of minus \$7.04, or worth \$4.14 less per acre than the alfalfa pasture.

One ton of ground barley replaced 2249 pounds of shelled corn, 19.39 pounds of ground oats and .0071 acres of Morton's mixture. With shelled corn at \$1.95 per hundred pounds, ground oats at \$1.50 per hundred pounds and Morton's mixture at \$24.32 per acre, ground barley was worth \$44.32 per ton for fattening steers.

### 1928 Results

The pasture fattening work during the summer of 1928 (18) was conducted similarly to that of 1927, with the exception of the alfalfa pasture which was winter-killed and, therefore, omitted from the test. The steers were fed similar grain rations to those fed in the 1927 test. The steers in drylot (checklot) were fed shelled corn and alfalfa, and the two Morton's mixture lots were fed shelled corn and ground barley respectively.

The daily gain per steer was fairly uniform in all lots. The greatest daily gains were obtained on the pasture steers, and were contrary to the results obtained in the 1927

test. Gains of 2.44 pounds daily per steer were made by the steers fed shelled corn on Morton's pasture-grass mixture. The steers in the drylot and the barley fed steers on pasture made similar gains of 2.36 pounds per head daily.

At the end of the 139-days fattening pasture, the steers were not considered fat enough for market. They were put in drylot and finished for the winter market.

The average daily grain ration per head was 10 pounds in the drylot, 10.2 pounds in the barley-fed pasture lot and 11.6 pounds in the shelled corn, pasture lot.

The most profit, including the hog profits per steer, was made on the steers fed shelled corn while on pasture. The profit was \$17.42 per steer. The steers fed ground barley while on pasture made a profit per steer of \$17.28. No pigs were in the barley-fed pasture lot. The least profit of \$15.00 per steer was obtained from the drylot.

In comparing lot 2 and 3 in which ground barley and shelled corn was fed, it was found that 1 ton of ground barley replaced 2195.03 pounds of shelled corn, but required in addition 3 pounds of ground oats and .0092 acres of Morton's pasture-grass mixture. With the price of shelled corn at \$39.00 per ton, ground barley was worth \$42.53 per ton. One acre of Morton's pasture-grass mixture valued at \$24.32 per acre replaced 6606.04 pounds of alfalfa hay and 11.18 pounds of ground oats, but required in addition 917.79 pounds of shelled

corn. With alfalfa hay selling at \$13.00 per ton, Morton's pasture-grass mixture had a replacement value of \$25.21 per acre.

{During both tests the steers on pasture consumed more grain than did the steers in drylot}

Steers fed ground barley made a greater profit in 1927 but less in 1928 than the steers fed shelled corn, both lots on pasture.

{In the 1927 test, alfalfa pasture proved to be more profitable than Morton's pasture-grass mixture for fattening steers.}

Probably the most important deduction to be made is that in neither test were the steers fat enough for the market at the end of the pasture season, indicating that yearling steers taken directly from the range cannot be finished for market during the pasture season on irrigated pastures and grain.

Fattening Warmed-Up Yearling Steers on Irrigated  
Pastures and a Grain Ration at the Colorado  
Agricultural Experiment Station

The objects of the experiment were to compare different irrigated pastures for fattening warmed-up yearling steers on a grain ration; to determine the relative value of adding a protein supplement to the grain ration for fattening steers on an irrigated pasture-grass mixture (Morton's); and to demonstrate the value of finishing cattle on pasture for a late summer or an early fall market.

Plan of the Experiment

The 30 yearling steers, that were fed a warming-up ration since February 8 were divided into five lots of six steers each. One lot, a check, was fed in drylot. The pasture lots were as follows: One 2 acre lot of sweet clover, one 2 acre lot of alfalfa and two 2 acre lots of Morton's pasture-grass mixture. One lot of steers received a protein supplement to the grain ration and the other lot received a straight grain ration. Linseed oilmeal was fed as the protein supplement and the maximum amount fed was 1 pound per head daily. The grain ration consisted of one-half ground barley and one-half ground corn by weight. The steers were consuming 10 pounds of the grain mixture per head daily when turned out on pasture May 10.

### Methods of Experimentation

The cattle used in the experiment were 30 dehorned, high-grade Hereford yearling steers of practically the same breeding. They were purchased from R. A. Maxfield, a cattleman living Northwest of Fort Collins, and had been fed a warming-up ration since February 8. The cattle were in thrifty condition when turned on pasture May 10, carrying considerably more flesh than would steers brought directly from the range in the spring.

The steers were divided equally, as far as it was possible to be, into five lots. Individual weights were taken on May 9, 10 and 11. An average of the three weights was taken as the initial weight. The steers were then weighed every 30 days until the end of the experiment, and then 3-day individual weights were taken and averaged to obtain the average final weight of the steers.



Table I

Preliminary Winter "Warming-up" Period  
For the Cattle to be Finished on  
Irrigated Pastures and Grain

15 Calves per lot fed Feb. 8 to May 10, 1929 - 91 days.

Table based on one average calf

Lot Number	:	1	:	2
	:	Barley	:	Barley
	:	C.S. Cake	:	C.S. Cake
Rations Fed	:	Pressed	:	Pressed
	:	Beet Pulp	:	Beet Pulp
	:	Beet Tops	:	Corn Silage
	:	Alfalfa	:	Alfalfa
Feed lot weight at start	:	462.00	:	462.89
Feedlot weight (final)	:	620.56	:	644.22
Gain	:	158.56	:	181.33
Daily Gain	:	1.74	:	1.99
Daily feed fed (pounds)	:		:	
Ground barley	:	2.31	:	2.31
Cottonseed cake	:	.50	:	.50
Pressed beet pulp	:	14.47	:	14.42
Beet tops	:	18.13	:	
Corn silage	:		:	15.90
Alfalfa hay	:	5.59	:	4.40
Mineral mixture*	:	.03	:	.07
Salt	:	.02	:	.04
Feed required per 100 pounds gain	:		:	
Ground barley	:	132.44	:	115.81
Cottonseed cake	:	28.70	:	25.09
Pressed beet pulp	:	830.18	:	723.53
Beet tops	:	1040.62	:	
Corn silage	:		:	797.70
Alfalfa hay	:	320.60	:	220.77
Mineral Mixture	:	1.77	:	3.47
Salt	:	1.39	:	2.23
Feed cost per 100 pounds gain	:	\$7.14	:	\$7.64

Price of feeds used:

Ground barley	\$22.00 per ton
Cottonseed cake	50.00 per ton
Pressed beet pulp	2.49 per ton
Beet tops	2.56 per ton
Corn silage	7.50 per ton
Alfalfa hay	16.00 per ton
Mineral mixture	1.68 per cwt.
Salt	.90 per cwt.

\*Mineral mixture-50% steamed bone meal, 30% lime cake and 20% salt.

### Discussion

The 30 calves were brot to the feedlots February 5, and kept together until February 8. During this time their ration consisted of pressed beet pulp, corn silage and alfalfa hay. On February 8 the calves were divided into two representative lots and fed a "warming-up" ration in drylot for 91 days. They were turned on pasture May 10.

February 11 all calves were vaccinated for hemorrhagic septicemia.

The daily gains per steer of 1.74 pounds for lot 1 and 1.99 for lot 2 were very satisfactory for the low amount of grain and large quantities of roughages fed. The gains were cheap--\$7.14 per hundred pounds gain for the beet top ration and \$7.64 per hundred pounds gain for the corn silage ration, and the total feed cost per head on May 10 amounted to only \$11.32 for the beet top ration and \$13.82 for the corn silage ration. These were relatively low costs for gain.

On May 3 the grain ration was changed to a mixture of one-half ground barley and one-half ground corn by weight. It was increased in both lots 1 pound per day until on May 10 the daily grain ration per steer was 10 pounds. Meanwhile, the beet pulp, corn silage and beet tops were gradually eliminated as the grain was increased,

in preparation for turning the cattle onto the pastures for the summer fattening trial.

The calves when purchased in February cost \$13.00 per hundred-weight. Because of the cheap gains secured the average price per hundred-weight required to break even on May 10 was \$12.29 for lot 1 and \$12.25 for lot 2. An average cost value of \$12.30 per hundred-weight was placed on the steers when they were started on to the pastures May 10.

#### Allotment Considerations

The steers were of the same origin and of practically the same age. Weight, grade, condition and color were the factors considered in dividing them into five similar lots for the summer work.

#### Allotment and Rations Fed

The steers were divided into five representative lots of six steers each according to the allotment considerations.

The grain ration for all the lots consisted of a mixture of one-half ground barley and one-half ground corn by weight. The corn was bought as No. 3 mixed corn. The barley was trebi barley--an improved variety. Both corn and barley were bought from local dealers. The linseed meal fed to the lot 5 steers was part of a quantity that was bought 2 years ago

and had since been stored in the barn. Good quality first-cut alfalfa hay was fed to the lot 1 steers.

The rations for each of the five lots were as follows:

- Lot 1. (Dry or checklot) Ground corn, ground barley, alfalfa hay (handfed) and block salt.
- Lot 2. Ground corn, ground barley, sweet-clover pasture and block salt.
- Lot 3. Ground corn, ground barley, alfalfa pasture and block salt.
- Lot 4. Ground corn, ground barley, Morton's pasture-grass mixture and block salt.
- Lot 5. Ground corn, ground barley, linseed meal, Morton's pasture-grass mixture and block salt.

The daily feed of grain and linseed oilmeal was divided into three feeds and fed at approximately 7:00 a. m., 11:00 a. m., and 4:30 p. m. each day. The daily grain ration, divided into three feeds instead of two, prevented the steers from getting as hungry between feeds. It was believed that if the steers were allowed to become very hungry they would eat greedily of the green legumes and bloat more easily than they would otherwise. Alfalfa hay was hand-fed twice daily to the steers in drylot.

### Water Supply and Equipment

Water was piped to all lots. The watering trough in lot 1 (drylot) was an automatic one, but the others were not. Fresh water was added daily to the supply in each watering trough.

Each lot contained a feed trough 12 feet long and 3.5 feet wide. In lot 1, alfalfa hay was kept in a covered bin to protect it from the weather. There was a shed in lot 1 that furnished shade for the steers, but no shade was allowed steers on pasture. That was done in order to keep the steers from lying in the shade during the heat of the day and eating greedily of alfalfa and sweet-clover in the late afternoon.

### Weights

Individual weights of all steers were taken May 9 to May 11 inclusive, and the average of three weights was taken as the average initial weight. Individual weights were taken every 30 days until the end of the experiment. At the close of the experiment, September 9, 3-day individual weights were again taken. The average of the three was taken as the average final weight.

The steers were kept in drylot until September 15. Group weights were taken just before shipping to Denver.

Duration of Experiment

The steers were turned on to pasture May 10 and removed to drylot September 9, 1929, a period of 122 days. The cattle were kept in drylot 6 days and then shipped to market.

Table II.

Percentage Composition of Grain and Pastures\*

	Water	Ash	Crude Protein	Carbohydrates N-Free Fiber	Extract	Fat
Sweet Clover	:	:	:	:	:	:
Pasture**	:	:	:	:	:	:
(Lot 2)	: 7.9	: 6.7	: 10.64	: 33.46	: 39.20	: 2.10
	:	:	:	:	:	:
Alfalfa Pasture	:	:	:	:	:	:
(Lot 3)	: 7.09	: 9.0	: 14.10	: 32.25	: 35.66	: 1.90
	:	:	:	:	:	:
Morton's Pasture-	:	:	:	:	:	:
Grass Mixture	:	:	:	:	:	:
(Lot 4)	: 7.28	: 13.10	: 8.3	: 29.4	: 39.52	: 2.40
	:	:	:	:	:	:
Morton's Pasture-	:	:	:	:	:	:
Grass Mixture	:	:	:	:	:	:
(Lot 5)	: 5.32	: 11.19	: 9.9	: 29.80	: 41.19	: 2.60
	:	:	:	:	:	:
Ground Barley	: 9.15	: 2.82	: 10.80	: 6.91	: 66.98	: 1.61
	:	:	:	:	:	:
Ground Corn	: 11.31	: 1.63	: 8.23	: 2.31	: 73.05	: 3.47
	:	:	:	:	:	:

\*The analysis of the feeds, with the exception of the linseed oilmeal, was made by the State Dairy Commission Chemist at the Colorado Agricultural College. The manufacturer's analysis of the linseed oilmeal was used. This analysis showed, not less than 34 percent protein, not less than 5 percent fat, not over 10 percent crude fiber and not over 35.5 percent nitrogen-free-extract.

The moisture content of the ground corn, ground barley and linseed oilmeal was taken every 10 days during the pasture period. The average moisture content was 15.4 percent for the ground corn, 10.81 percent for ground barley and 7.58 percent for linseed oil meal.

\*\*Green samples of the legumes and Morton's pasture-grass mixture were taken and analyzed on a dried basis. Samples were taken in the early flowering stage. It will be noted that there was a difference in composition between the two Morton's mixture samples. It was practically impossible to get the same percentage of grasses in each sample.

### Weather Conditions

According to Robert E. Trimble, in charge of weather observation at the Colorado Experiment Station, the total rainfall from May 10 to September 9 was 6.24 inches, and of that amount 67 percent fell from August 1 to September 9. The average temperature from May 10 to June 1 was 55.2 degrees. The average temperature for June was 63.7 degrees; for July 70.4 degrees; for August 70 degrees; and for September 1 to September 9, 52.5 degrees.

### Observation of Animals

The steers were consuming 10 pounds of grain per head daily at the time they were turned on pasture. On the morning of May 10, before being turned on to pasture, the steers were given access to all the pressed beet pulp they would eat. That was done in order to have them well filled when turned on grass and so prevent bloat if possible. After the steers had eaten their fill of the beet pulp they were turned on the various irrigated pastures. Rain began falling soon after the steers were put in the lots, causing some concern for fear that would increase the danger of bloat in the alfalfa and sweet-clover lots, but none occurred.

It was noticed that the steers in the alfalfa and particularly the sweet-clover pasture preferred the grass along the fence to the alfalfa or clover but after 2 or 3



days the steers were eating the alfalfa readily. It seemed that the steers began relishing alfalfa before the steers in the clover lot did the clover. The steers in lot 5 received linseed oilmeal in the grain mixture but did not eat it very readily at first. They were cut back to one-half pounds per head daily for 4 days and then given their regular feed as soon as they showed evidence of eating it. All lots of steers went off grain feed when first turned on to pasture. It was necessary to cut back the grain ration to 4 pounds per steer per day. It was then increased two-thirds pound daily per head, until the steers were consuming 8 pounds daily per head, then the grain was increased one-fourth pound per steer each day. The maximum grain ration for the pasture lots was 12 pounds per steer daily. That amount was fed from July 17 until the close of the experiment. A maximum grain feed of 15 pounds daily per steer was fed in the drylot from June 26 to August 5, when a light shower wet the grain before the steers ate it. The grain apparently soured slightly before it was taken out the next morning. The steers may have eaten some of the soured grain and it affected their digestion causing them to go off feed. At any rate it was necessary to reduce the grain to 12 pounds per steer and they were fed at that rate until the end of the experiment.

### Bloating and Death Loss

It is because green alfalfa has the tendency, under certain conditions, to cause bloating that the veterinarian is prevented from recommending alfalfa pasture for fattening cattle. Dr. G. H. Glover of the Veterinary Department of the Colorado Agricultural College, made the following statement, "I know of no conditions under which alfalfa may be safely used for pasturing cattle. Alfalfa ferments easily. It is not necessarily the quantity that the animal eats that causes bloat but the more succulent the alfalfa the greater the danger of bloat."

One of the steers on sweet-clover pasture died of bloat. The steers had been on pasture 30 days. The clover in the pasture the steers were in was grazed heavily, and the steers were turned on the rank growth of ungrazed clover. Three hours later the steer was dead. The indication was that the steer ate too much leafy, succulent clover.

There was no death loss on alfalfa pasture. Ten steers were fed on grain and alfalfa pasture during the 1927 summer pasture test without death loss. The two tests indicate that the feeding of 10 to 12 pounds of grain per steer per day, and never taking the steers off pasture once they were turned on until ready for market, may eliminate the danger of death loss.

There was some trouble experienced with bloating in the sweet-clover and alfalfa lots. There were two chronic bloaters in the clover lot and one in the alfalfa lot, but the trouble was apparently not due to the pasture, for a chronic bloater also developed in the drylot.

The treatment for bloat was the removal of the gas by the aid of a rubber hose, and then giving the steer a mixture of one-half pint of mineral-oil and one-half pint of castor-oil.

#### Observation and Management of Pastures

The four irrigated pastures were located about three-eighths of a mile west of the experimental barns. Each pasture contained 2 acres and was divided by a cross fence into a north and south pasture of 1 acre each. That allowed for rotation of pastures. Irrigation water was available until August 23. Each pasture was irrigated twice. The south acre was irrigated May 23 and June 29. The north acre was irrigated June 12 and August 23.

It was estimated that the average height of the grass in both Morton's mixture lots on May 10 was 4 inches, and that the average stand was 95 percent. Both pastures were mowed once. Lot 4 yielded 210 pounds of hay and lot 5 yielded 330 pounds. The hay was credited at \$16.00 per ton.

The estimated height of alfalfa May 10 was 5 inches and the estimated stand was 95 percent. The amount of hay cut from the alfalfa pasture was 4440 pounds and credited at \$16.00 per ton.

The stand of sweet clover May 10 was estimated at 85 percent and the average height was 3 inches. The yield of hay was 1700 pounds and credited at \$16.00 per ton.

#### Marketing of Steers

The steers were shipped to the Denver Union Stock Yards September 15 and sold to Armour and Company. The drylot and the Morton's mixture steers fed linseed oilmeal brot \$14.75 per hundred-weight. No steers were culled from either lot.

One steer from the sweet-clover lot was culled and sold at \$13.75 per hundred-weight, reducing the average price per lot to \$14.57 per hundred-weight.

Two steers from the alfalfa lot were culled and sold at \$13.75 per hundred-weight, reducing the average price per lot to \$14.46 per hundred-weight.

Two steers were culled from the Morton's mixture lot that did not receive the linseed oilmeal. They sold at \$13.75 per hundred-weight, reducing the average price for the entire lot to \$14.45 per hundred-weight.

Three of the five cull steers were bloaters. One

was a rangy, shallow-bodied steer, and the other was a steer that appeared sickly during the last two weeks of the experiment, and according to Dr. H. E. Kingman, of the Veterinary Department at the Colorado Agricultural College, was believed to have a foreign body working thru his diaphragm. All five steers were lacking in finish.

Table III

Initial and Final Weights and Individual Steer Gains

From May 10, to Sept. 9, 1929 - 122 days.

Steer No.	:	Initial	:	Final	:	Total	:	Av. Daily
	:	Weight	:	Weight	:	Gain	:	Gain
	:		:		:		:	
Checklot	15	: 586.67	:	930.00	:	343.33	:	2.81
	31	: 681.67	:	878.33	:	196.66	:	1.61
	45	: 756.67	:	1023.33	:	266.66	:	2.19
	51	: 593.33	:	861.67	:	268.34	:	2.20
	53	: 680.00	:	985.00	:	305.00	:	2.50
	65	: 495.00	:	858.33	:	363.33	:	2.98
Total	:	3793.34	:	5536.66	:	1734.32	:	14.29
Average	:	632.22	:	922.78	:	290.55	:	2.38
	:		:		:		:	
*Sweet-clover Pasture	4	: 601.67	:	895.00	:	293.33	:	2.40
	6	: 556.67	:	756.67	:	200.00	:	1.64
	34	: 681.67	:	860.00	:	178.33	:	1.46
	55	: 541.67	:	810.00	:	268.33	:	2.20
	61	: 765.00	:	1025.00	:	260.00	:	2.13
Total	:	3146.68	:	4346.67	:	1199.33	:	9.83
Average	:	629.34	:	869.33	:	239.87	:	1.97
	:		:		:		:	
Alfalfa Pasture	3	: 708.33	:	978.33	:	270.00	:	2.21
	16	: 590.00	:	675.00	:	85.00	:	.70
	35	: 665.00	:	868.33	:	203.33	:	1.67
	43	: 670.00	:	970.00	:	300.00	:	2.46
	64	: 586.67	:	823.33	:	236.66	:	1.94
	66	: 546.67	:	793.33	:	246.66	:	2.02
Total	:	3766.67	:	5108.32	:	1341.32	:	11.00
Average	:	627.78	:	851.39	:	233.55	:	1.83
	:		:		:		:	
Morton's Pasture- Grass Mixture	1	: 607.67	:	773.33	:	166.66	:	1.37
	11	: 621.67	:	898.33	:	276.66	:	2.27
	33	: 698.33	:	963.33	:	265.00	:	2.17
	46	: 621.67	:	835.00	:	213.33	:	1.75
	56	: 570.00	:	740.00	:	170.00	:	1.39
	63	: 670.00	:	905.00	:	235.00	:	1.93
Total	:	3788.34	:	5114.99	:	1326.65	:	10.88
Average	:	631.39	:	852.50	:	221.11	:	1.81
	:		:		:		:	

\*One steer died of bloat.

		: Initial	: Final	: Total	: Av. Daily
Steer No.		: Weight	: Weight	: Gain	: Gain
		:	:	:	:
	5	: 563.33	: 815.00	: 251.67	: 2.06
Morton's Pasture	14	: 713.33	: 973.33	: 260.00	: 2.13
Grass Mixture	36	: 691.67	: 921.67	: 230.00	: 1.89
plus Linseed	41	: 623.33	: 821.67	: 198.34	: 1.63
Oilmeal	44	: 568.33	: 863.33	: 295.00	: 2.42
	54	: 651.67	: 866.67	: 215.00	: 1.76
Total		: 3811.66	: 5261.67	: 1450.01	: 11.89
Average		: 635.28	: 876.95	: 241.67	: 1.98
		:	:	:	:

### Discussion

Daily gains in drylot were 17 percent greater than those made on sweet clover or Morton's pasture-grass mixture plus linseed oilmeal. Daily gains on sweet-clover pasture were 7 percent greater than those on alfalfa pasture. The feeding of linseed oilmeal to steers on Morton's mixture increased the gains 9 percent. The greatest daily gain per steer was 2.98 pounds made in drylot by steer No. 65. The lowest daily gain per steer was .70 pound made on alfalfa pasture by steer No. 16. Steer No. 31 in drylot, No. 6 and 34 in the sweet-clover lot and No. 16 in the alfalfa lot were chronic bloaters. The gains of each one were comparatively low for the lot averages.

If the low gains made by the chronic bloaters had not been figured into the lot averages, the daily gain in the drylot would have increased 6 percent, in the sweet-clover lot 12 percent and in the alfalfa lot 11 percent.



Table IV

Average Daily Feed Per Steer

May 10 to Sept. 9, 1929 - 122 days

Table based on one average steer

Lot Number	: Checklot :	2	:	3	:	4	:	5
	:	:	:	:	:	:	:	: Gr. Corn
	:	: Gr. Corn :	:	:	:	:	:	: Gr. Barley
	:	: Gr. Barley :	: Gr. Corn :	: Gr. Corn :	: Gr. Corn :	: Gr. Corn :	:	: Morton's
Rations Fed	: Gr. Corn :	: Sweet- :	: Gr. Barley :	: Gr. Barley :	: Gr. Barley :	: Gr. Barley :	:	: Mixture
	: Gr. Barley :	: Clover :	: Alfalfa :	: Alfalfa :	: Alfalfa :	: Alfalfa :	:	: Linseed
	: Alf. Hay :	: Pasture :	: Pasture :	: Pasture :	: Pasture :	: Pasture :	:	: Oilmeal
	: Blk. Salt :	: Blk. Salt :	: Blk. Salt :	: Blk. Salt :	: Blk. Salt :	: Blk. Salt :	:	: Blk. Salt
Average Daily	:	:	:	:	:	:	:	:
Feed (pounds)	:	:	:	:	:	:	:	:
Gr. Corn	: 6.15	: 4.96	:	: 4.96	:	: 4.96	:	: 4.96
Gr. Barley	: 6.15	: 4.96	:	: 4.96	:	: 4.96	:	: 4.96
Linseed Oil-	:	:	:	:	:	:	:	:
meal	:	:	:	:	:	:	:	: .96
Alfalfa Hay	: 10.15	:	:	:	:	:	:	:
Sweet-clover	:	:	:	:	:	:	:	:
Hay *	:	: .11	:	:	:	:	:	:
Alfalfa	:	:	:	:	:	:	:	:
Pasture	:	:	:	: 0.00273 A :	:	:	:	:
Sweet-clover	:	:	:	:	:	:	:	:
Pasture	:	: 0.00328 A :	:	:	:	:	:	:
Morton's	:	:	:	:	:	:	:	:
Mixture	:	:	:	:	:	: 0.00273 A :	: 0.00273 A :	:
Block Salt	: .029	: .082	:	: .077	:	: .119	:	: .087
	:	:	:	:	:	:	:	:

\* Steers in lot 2 were in drylot June 12 to June 13, because of excessive irrigation to pasture, and were fed sweet-clover hay until taken back to pasture.

### Discussion

The daily grain ration per steer was the same in all pasture lots. At the start of the experiment all steers were consuming grain at the rate of 10 pounds per head. The steers refused to eat their grain when first turned on pasture and the grain ration was cut back to 4 pounds daily per head. Four pounds was the minimum and 12 pounds was the maximum amount of grain fed to the pasture steers, while a maximum of 15 pounds of grain per day was fed to the drylot steers. The steers in drylot had difficulty in eating that amount and were later cut back to 12 pounds daily per steer. It was thot best to limit the grain ration for the pasture steers to 12 pounds per head, and no difficulty was experienced in getting them to consume that amount. The average daily grain feed for the pasture steers was 9.92 pounds and 12.3 pounds for the checklot steers.

The daily amount of salt eaten was noticeably smaller in the checklot than in any of the pasture lots. It was known that green succulent grass, in the early stages of growth contained more potassium salts than grass in later stages of growth. Alfalfa hay would contain less potassium salts than would the green grasses.

According to Bunge, a physiological chemist, an excess of potassium in feeding stuffs fed to animals, removes

part of the chlorine from the calcium salts in the body. That condition creates a demand for sodium chloride to replenish the chlorine deficiency in the body.

Table V

Feed Required and Feed Cost per 100 Pounds Gain

May 10 to Sept. 9, 1929 - 122 days

Table based on one average steer

Lot Number	: Checklot :	2	:	3	:	4	:	5
	:	:	:	:	:	:	:	:Gr. Corn
	:	:Gr. Corn :	:	:	:	:	:	:Gr. Barley
	:	:Gr. Barley:	Gr. Corn	:Gr. Corn	:Gr. Corn	:Morton's	:	
Rations Fed	:Gr. Corn :	Sweet-	:Gr. Barley:	Gr. Barley:	Gr. Barley:	Mixture	:	
	:Gr. Barley:	Clover :	Alfalfa	:Morton's	:Linseed	:	:	
	:Alf. Hay :	Pasture :	Pasture :	Mixture :	Oilmeal	:	:	
	:Blk. Salt:	Blk. Salt:	Blk. Salt	:Blk. Salt:	Blk. Salt	:	:	
Feed Required:	:	:	:	:	:	:	:	
per 100 Lbs. :	:	:	:	:	:	:	:	
Gain (pounds):	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	
Gr. Corn	: 258.31	: 252.01	: 270.47	: 273.53	: 250.26	:	:	
Gr. Barley	: 258.31	: 252.01	: 270.47	: 273.53	: 250.26	:	:	
Linseed Oil-	:	:	:	:	:	:	:	
meal	:	:	:	:	:	:	:	48.55
Alfalfa Hay	: 426.20	:	:	:	:	:	:	
Sweet-clover	:	:	:	:	:	:	:	
Hay*	:	: 5.83	:	:	:	:	:	
Alfalfa	:	:	:	:	:	:	:	
Pasture	:	:	: 0.1491 A:	:	:	:	:	
Sweet-clover	:	:	:	:	:	:	:	
Pasture	:	: 0.1667 A:	:	:	:	:	:	
Morton's	:	:	:	:	:	:	:	
Mixture	:	:	:	: 0.1508 A:	: 0.1379 A	:	:	
Block Salt	: 1.23	: 4.17	: 4.17	: 6.54	: 4.38	:	:	
Feed Cost Per:	:	:	:	:	:	:	:	
100 Lbs. :	:	:	:	:	:	:	:	
Gain (feedlot):	\$11.04	: \$11.58	: \$11.66	: \$11.81	: \$12.24	:	:	

\*Steers in lot 2 were brot in to drylot June 12, because of excessive irrigation to pasture, and fed sweet-clover hay until taken back to pasture June 13.

Prices of feeds used:

Ground corn	\$1.85 per cwt.	Sweet-clover hay	\$16.00 per ton
Ground barley	22.00 per ton	Alfalfa pasture	24.32 per acre
Linseed oilmeal	60.00 per ton	Sweet-clover pasture	24.32 per acre
Block salt	1.10 per cwt.	Morton's mixture	24.32 per acre
Alfalfa hay	16.00 per ton	Morton's mixture hay	16.00 per ton

### Discussion

The grain consumption of 500.52 pounds per 100 pounds feedlot gain by the pasture steers receiving linseed oilmeal was slightly less than the grain required by either the steers on sweet-clover pasture or those in the checklot. The linseed oilmeal increased the feed cost of 100 pounds gain by \$1.20 over that in the checklot and 66 cents over that in the sweet-clover lot. The gains made on sweet-clover pasture were cheaper than those made on alfalfa pasture or Morton's pasture-grass mixture. The cheapest gains were made by the checklot steers receiving alfalfa hay as roughage.

One ton of linseed oilmeal replaced 958.60 pounds of ground corn, 958.60 pounds of ground barley, .5315 acres of Morton's mixture and 88.98 pounds of salt. At present feed prices, 1 ton of linseed oilmeal showed a replacement value of \$42.18 or \$17.82 less than cost.

One acre of alfalfa, pastured by three steers, replaced 2858.48 pounds of alfalfa hay in producing gains, but in addition required 81.56 pounds of ground corn, 81.56 pounds of ground barley and 19.72 pounds of salt. At present prices 1 acre of alfalfa pasture had a replacement value of \$20.24 or \$4.08 less than the cost of production. When it was considered that 2220 pounds of hay was cut from

this 1 acre of alfalfa, in addition to pasturing the steers, the total value per acre would be \$38.00 or \$13.68 more than cost of production.

One acre of sweet clover pastured by two and five-tenths steers replaced 2556.69 pounds of alfalfa hay, 37.79 pounds of ground corn, 37.79 pounds of ground barley in producing gains, but in addition required 34.97 pounds of sweet-clover hay and 17.63 pounds of salt. At present feed prices 1 acre of sweet-clover pasture had a replacement value of \$21.10 or \$3.22 less than the cost of production, in addition to pasturing the steers 850 pounds of hay was cut from 1 acre of sweet clover, making the total value per acre \$27.90 or \$3.58 above cost of production.

One acre of Morton's mixture pastured by three steers replaced 2826.26 pounds of alfalfa hay in producing gains, but in addition required 100.93 pounds of ground corn, 100.93 pounds of ground barley and 35.21 pounds of salt. At present feed prices 1 acre of Morton's pasture-grass mixture had a replacement value of \$19.24 or \$5.08 below cost of production, but in addition to pasturing the steers 105 pounds of hay was cut from an acre of pasture making the total value per acre of \$20.08 or \$4.24 below cost of production.

Table VI

Weights, Gains and Daily Feed (Market Basis)

Six\* yearling steers per lot, fed 128 days,  
May 10, 1929 to Sept. 15, 1929

Table based on one average steer					
Lot Number	Checklot	2	3	4	5
					Gr. Corn
		Gr. Corn			Gr. Barley
		Gr. Barley	Gr. Corn	Gr. Corn	Morton's
Rations	Gr. Corn	Sweet-	Gr. Barley	Gr. Barley	Mixture
Fed**	Gr. Barley	Clover	Alfalfa	Morton's	Linseed
	Alf. Hay	Pasture	Pasture	Mixture	Oilmeal
	Blk. Salt	Blk. Salt	Blk. Salt	Blk. Salt	Blk. Salt
Feedlot wt.					
at Start	632.22	629.34	627.78	631.39	635.28
Market wt.					
at Denver	895.83	854.00	840.00	850.83	863.33
Shipping					
Shrinkage(%)	4.10	2.18	3.54	3.22	3.54
Gain at Mar-					
ket	263.61	224.66	212.22	219.44	228.06
Daily Gain					
(market wt.)	2.06	1.76	1.66	1.71	1.78
Daily Feed					
Fed (pounds)					
Gr. Corn	6.16	5.02	4.99	5.02	5.02
Gr. Barley	6.16	5.02	4.99	5.02	5.02
Linseed Oil-					
meal					.97
Alfalfa Hay	10.60		.34		
Sweet-clover					
Hay		.59			
Morton's Mix-					
ture Hay				.47	.33
Alfalfa					
Pasture			0.0026 A		
Sweet-clover					
Pasture		.003125 A			
Morton's					
Mixture				0.0026 A	0.0026 A
Block Salt	.029	.079	.074	.115	.083

\* One steer in lot 2 died of bloat--five steers in lot 2.

\*\* Sweet-clover hay, alfalfa hay and Morton's mixture hay fed in lots 2, 3, 4 and 5 respectively from Sept. 9 to Sept. 15.

Table VII

Feed Required and Feed Costs per 100 Pounds Gain  
(at Market)

Six\* yearling steers per lot, fed 128 days,  
May 10, 1929 to Sept. 15, 1929

Table based on one average steer					
Lot Number	Checklot	2	3	4	5
					Gr. Corn
		Gr. Corn			Gr. Barley
		Gr. Barley	Gr. Corn	Gr. Corn	Morton's
Rations	Gr. Corn	Sweet	Gr. Barley	Gr. Barley	Mixture
Fed**	Gr. Barley	Clover	Alfalfa	Morton's	Linseed
	Alf. Hay	Pasture	Pasture	Mixture	Oilmeal
	Blk. Salt	Blk. Salt	Blk. Salt	Blk. Salt	Blk. Salt
Feed Required:					
per 100 Lbs. :					
Gain (at mar-					
ket) :					
Gr. Corn :	299.13	286.12	300.90	292.92	281.62
Gr. Barley :	299.13	286.12	300.90	292.92	281.62
Linseed Oil-					
meal :					54.23
Alfalfa Hay :	493.15		20.42		
Sweet-clover					
Hay :		33.83			
Morton's Mix-					
ture Hay :				27.34	18.27
Alfalfa Pas-					
ture :			0.1571 A		
Sweet-clover					
Pasture :		0.1780 A			
Morton's					
Mixture :				0.1519 A	0.1462 A
Block Salt :	1.42	4.47	4.48	6.72	4.64
Feed Cost per:					
Cwt. Gain :	\$12.79	\$13.09	\$12.91	\$12.62	\$13.70
(at market) :					

Cost of feeds used:

Ground corn	\$1.85 per cwt.	Sweet-clover hay	\$16.00 per ton
Ground barley	22.00 per ton	Alfalfa pasture	24.32 per acre
Linseed oilmeal	60.00 per ton	Sweet-clover pasture	24.32 per acre
Block salt	1.10 per cwt	Morton's mixture	24.32 per acre
Alfalfa hay	16.00 per ton	Morton's mixture hay	16.00 per ton

\*One steer in lot 2 died of bloat--five steers in lot 2.

\*\* Sweet-clover hay, alfalfa hay and Morton's mixture hay fed in  
lots 2, 3, 4 and 5 respectively from Sept. 9 to Sept. 15.



Table VIII

Financial Statement

Based on Average Feed Prices and Sale of Steers

Table based on one average steer					
Lot Number	: Checklot	: 2*	: 3	: 4	: 5
	:	:	:	:	: Gr. Corn
	:	: Gr. Corn	:	:	: Gr. Barley
	:	: Gr. Barley	: Gr. Corn	: Gr. Corn	: Morton's
Rations Fed	: Gr. Corn	: Sweet-	: Gr. Barley	: Gr. Barley	: Mixture
	: Gr. Barley	: Clover	: Alfalfa	: Morton's	: Linseed
	: Alf. Hay	: Pasture	: Pasture	: Mixture	: Oilmeal
	: Blk. Salt	: Blk. Salt	: Blk. Salt	: Blk. Salt	: Blk. Salt
Cost per Steer:	:	:	:	:	:
at Feedlot	:	:	:	:	:
at \$12.30	:	:	:	:	:
per Cwt.	: 77.76	: 77.41	: 77.22	: 77.66	: 78.14
Feed cost per:	:	:	:	:	:
Steer	: 33.72	: 29.41	: 27.40	: 27.69	: 31.24
Est. fixed	:	:	:	:	:
cost includ-	:	:	:	:	:
ing interest:	:	:	:	:	:
equipment	:	:	:	:	:
and labor**	: 7.14	: 6.62	: 6.62	: 6.63	: 6.64
Shipping and	:	:	:	:	:
selling exp.:	: 2.72	: 2.54	: 2.54	: 2.56	: 2.61
Total cost at:	:	:	:	:	:
market	:	:	:	:	:
(Denver)	: 121.34	: 115.98	: 113.78	: 114.54	: 118.63
Selling wts.:	:	:	:	:	:
lbs. (Denver)	: 895.83	: 854.00	: 840.00	: 850.83	: 863.33
Result of	:	:	:	:	:
market sale	:	:	:	:	:
No. steers	:	:	:	:	:
at \$14.75	:	:	:	:	:
per cwt.	: 6	: 4	: 4	: 4	: 6
No. steers at:	:	:	:	:	:
\$13.75 per	:	:	:	:	:
cwt.	: 0	: 1	: 2	: 2	: 0
Selling price:	:	:	:	:	:
per cwt.	: \$14.75	: \$14.57	: \$14.46	: \$14.45	: \$14.75
Gross receipt:	:	:	:	:	:
per steer	: \$132.13	: \$124.43	: \$121.46	: \$122.94	: \$127.34
Profit per	:	:	:	:	:
steer	: \$10.79	: \$8.45	: \$7.68	: \$8.40	: \$8.71

Table VIII  
(Cont'd)  
Financial Statement

Based on Average Feed Prices and Sale of Steers

Table based on one average steer					
Lot Number	:Checklot	: 2	: 3	: 4	: 5
	:	:	:	:	:Gr. Corn
	:	:Gr. Corn	:	:	:Gr.Barley
	:	:Gr.Barley	:Gr. Corn	:Gr. Corn	:Morton's
Rations Fed	:Gr. Corn	: Sweet-	:Gr.Barley	:Gr.Barley	: Mixture
	:Gr.Barley	: Clover	: Alfalfa	:Morton's	: Linseed
	:Alf. Hay	: Pasture	: Pasture	: Mixture	: Oilmeal
	:Blk. Salt	:Blk. Salt	:Blk. Salt	:Blk. Salt	:Blk. Salt
Dressing per-	:	:	:	:	:
centage	:	:	:	:	:
(based on	:	:	:	:	:
2.5% shrink-	:	:	:	:	:
age in cooler:	59.35	: 59.95	: 60.85	: 58.53	: 60.48
No. steers	:	:	:	:	:
with off-	:	:	:	:	:
colored car-	:	:	:	:	:
cass	: 0	: 5	: 6	: 6	: 4
Selling price:	:	:	:	:	:
per cwt.to	:	:	:	:	:
break even	: 13.54	: 13.58	: 13.55	: 13.46	: 13.74
Margin over	:	:	:	:	:
purchase	:	:	:	:	:
price per	:	:	:	:	:
cwt. needed	:	:	:	:	:
to breakeven:	: 1.24	: 1.28	: 1.25	: 1.16	: 1.44

\* One steer in lot 2 died of bloat--five steers in lot 2; six steers in lots 1, 3, 4 and 5.

\*\* Developed from studies from Economics Department, Colorado Agricultural College.

### Discussion

The shipping shrinkage in the checklot was 24 percent greater than the average for the pasture lots. The daily gains on alfalfa pasture were 6 percent less than those on sweet-clover pasture. The daily gains made on sweet-clover pasture were only 1 percent less than those made on Morton's pasture-grass mixture and linseed oilmeal.

The grain required per 100 pounds gain on the feedlot basis for the two Morton's mixture lots was 9 percent less for the lot receiving linseed oil meal, but the difference decreased to 4 percent per 100 pounds gain on the market basis.

One acre of alfalfa pastured by three steers replaced 3009.1 pounds of alfalfa hay in producing gains, but in addition required 11.27 pounds of ground corn, 11.27 pounds of ground barley and 19.48 pounds of salt. At present feed prices 1 acre of alfalfa pasture had a replacement value of \$23.53 per acre, but in addition to pasturing the steers 2220 pounds of hay was cut from the acre, thereby, increasing the value to \$41.29 per acre. According to figures of the Economics Department of the Colorado Agricultural College, the cost of harvesting 1 acre of alfalfa with an average yield of 2.47 tons per acre was \$8.33. Only 2220 pounds of hay was harvested and the steers consumed the remainder, saving a harvesting charge of \$4.59 per acre which added to \$41.29 further increased

the acre value to \$45.88. Three steers fattened in drylot were worth \$32.02 more than three steers fattened on 1 acre of alfalfa pasture. The total value of 1 acre of alfalfa pasture then decreased to \$13.86 or \$10.46 below cost of production.

One acre of sweet clover pastured by two and five-tenths steers replaced 2770.51 pounds of alfalfa hay, 73.08 pounds of ground corn and 73.08 pounds of ground barley in producing gains, but in addition required 190.06 pounds of sweet-clover hay and 17.13 pounds of salt. At present feed prices, 1 acre of sweet-clover pasture had a replacement value of \$22.60, but in addition to pasturing the steers 850 pounds of hay was cut from 1 acre, increasing the value to \$29.40. By using the same figures from the Economics Department of the Colorado Agricultural College, that were used in finding the saving in grazing alfalfa, it was found that the saving resulted in \$6.90 per acre of sweet clover. The value of 1 acre of sweet clover was then further increased to \$36.30. Two and five-tenths steers fattened in drylot were worth \$19.27 more than two and five-tenths steers fattened on sweet-clover pasture. The total value of 1 acre of sweet-clover pasture then decreased to \$17.03 per acre or \$7.29 below cost of production.

One acre of Morton's mixture pastured by three steers replaced 3246.54 pounds of alfalfa hay, 40.89 pounds of ground corn and 40.89 pounds of ground barley in producing gains, but in addition required 179.99 pounds of Morton's mixture hay and 34.89 pounds of salt. At present feed prices 1 acre of Morton's pasture grass had a replacement value of \$25.36 per acre, but in addition to pasturing the steers 105 pounds of hay was cut from the acre, increasing the value to \$26.20. By using the same figures from the Economics Department of the Colorado Agricultural College, that were used in finding the saving in grazing alfalfa, it was found that the saving resulted in \$8.15 per acre which increased the value per acre to \$34.35. Three steers fattened in drylot were worth \$27.57 more than three steers fattened on 1 acre of Morton's pasture-grass mixture. That amount deducted from \$34.35 left \$6.78 as the total value of 1 acre of Morton's pasture grass or \$17.54 less than cost of production.

One ton of linseed oilmeal replaced 416.74 pounds of ground corn, 416.74 pounds of ground barley, .210 acres of Morton's mixture and 76.71 pounds of salt in producing gains. With present feed prices, one ton of linseed oilmeal had a replacement value of \$20.92. The steers in lot 5 that fed only 742 pounds of linseed oilmeal sold for \$26.38 more

than the steers in lot 4 that did not get any linseed oilmeal. Crediting the linseed oilmeal with the difference in value, 1 ton of linseed oilmeal would have made a difference of \$71.11 in value between the two lots. The total value of 1 ton of linseed oilmeal when fed with Morton's pasture-grass mixture and grain would be \$92.03 or \$32.03 above cost.

The feed cost per 100 pounds market gain was lowest in the Morton's mixture lot without the protein supplement. The highest cost per 100 pounds market gain was in the Morton's mixture lot fed linseed oilmeal.

Twenty-four of the twenty-nine steers sold at \$14.75 per hundred-weight. Five head were culled and sold at \$13.75 per hundred-weight. On that basis the steers in lot 4 brot the lowest price of \$14.45 per hundred-weight. Steers in lot 1 and 5 brot the average price of \$14.75 per hundred-weight. No steers were culled from either lot.

A record of the color of each steer's carcass was obtained at Armour and Company packing plant. The carcasses of all steers in the checklot were of a desirable white color. Two carcasses from the pasture-fed linseed oilmeal lot were of a desirable color and a third carcass from the same lot was only slightly off-color, but the other carcasses from the pasture steers were off-colored--a yellowish colored

fat that was not desired by the packers. The fact that the only desirable colored carcasses from the pasture lots were from the linseed oilmeal lot indicated that the protein supplement may have had some influence in eliminating the yellow color from the carcass fat. That would be important to the producer.

According to E. Martin, head beef salesman, of Armour and Company, there was a difference in price of about 50 cents per hundred pounds in favor of the steer that dressed out a white-fat carcass. There was no discrimination in price of the experimental steers when purchased on foot, for the difference in carcass color was not known until they were slaughtered.

### Summary

(The least daily gains of 1.66 pounds per steer were made on alfalfa pasture. The greatest daily gains of 2.06 pounds per steer were made in drylot. Daily gains made on sweet-clover pasture were only 0.02 pounds less than those made on Morton's mixture with a protein supplement.

The least amount of grain per 100 pounds of market gain was 563.24 pounds, and was consumed by the Morton's mixture steers fed the protein supplement. The most grain per 100 pounds market gain was 601.80 pounds, and was consumed by steers on alfalfa pasture.

One acre of alfalfa pasture had a total value of \$10.46; 1 acre of sweet clover \$17.03; and 1 acre of Morton's pasture-grass mixture \$6.78. One ton of linseed oilmeal was worth \$92.03 or at \$60.00 per ton it increased the value of 1 acre of Morton's mixture to \$12.77.

The lowest feed cost of \$12.62 per 100 pounds market gain was obtained from the Morton's mixture lot not fed linseed oilmeal. The highest feed cost per 100 pounds market gain was \$13.70 , required in the Morton's pasture-grass lot fed, in addition, the protein supplement. But profits were greater there than in any other pasture lot.)

The drylot steers and the pasture steers fed linseed oilmeal brot the top price of \$14.75 per hundred-weight. The Morton's mixture steers not fed the protein supplement



brot \$14.45 per hundred-weight--the lowest average of all lots.

The fat covering the carcasses of all steers from the drylot was of a desirable white color, but of the 23 pasture steers only two carcasses had the desired white covering of fat, and those were from the linseed oil meal lot. The carcasses from the remaining 21 pasture steers were covered with a yellowish-colored fat, which was undesirable from the packers' viewpoint.

The greatest profit per steer was \$10.79 and obtained in drylot. The least profit per steer was \$7.68, obtained from the alfalfa pasture steers.

A comparison of the profit per steer was made with the 1928-29 winter calf feeding experiment in order to determine if it was more profitable to rough calves thru the winter on cheap roughages and a low grain ration, and fatten on irrigated pastures and grain during the summer for the early fall market, or to fatten calves in the winter for the spring market. Fifty-nine calves were sold in the spring at an average profit per calf of \$12.77. The 23 pasture-fattened steers averaged \$8.31 profit per steer, or \$4.46 less profit than for the calf fattened in winter in a drylot.

### Conclusions

It was more profitable to fatten steers in drylot than on any of the irrigated pastures.

The greatest net returns per acre of pasture were derived from pasturing steers on sweet clover, and were 30 percent less than the production costs per acre.

An acre of sweet clover supplemented with grain was worth \$6.57 more than an acre of alfalfa pasture supplemented with grain.

An acre of Morton's pasture grass mixture supplemented with grain produced 2 percent cheaper gains and 9 percent more profit per steer than an acre of alfalfa pasture supplemented with grain. However, the total value of an acre of Morton's mixture, including the value of the harvested hay, was only 65 percent as much as an acre of alfalfa pasture.

Altho the popular opinion is that alfalfa cannot be pastured without death loss the results of this test and one previous test show that this is possible if the following precautions are observed: Have the steers consuming a daily grain ration of 8 to 10 pounds per head when first turned onto the pasture, feed the grain three times daily instead of twice, do not furnish any shade, and once the cattle are on pasture do not remove them except when they are ready for market. Similar precautions observed with cattle pastured on sweet

clover did not entirely eliminate death loss. One of the six steers started on experiment died of bloat on sweet-clover pasture. Apparently sweet-clover pasture is more dangerous than alfalfa pasture.

Based upon the amount of hay weighed back and credited per acre, the alfalfa pasture appeared to be understocked by at least 40 percent. The two Morton's mixture lots were stocked to capacity but the sweet-clover pasture would have carried an additional steer per acre.

The feed production of the several pastures was measured both by their carrying capacity and by the hay produced in addition.

A protein supplement was responsible for 9 percent greater gains, 2 percent higher selling price per hundred-weight and 4 percent greater profit per steer when fed with Morton's pasture-grass mixture and grain.

Review of Thesis\*

Introduction. In Colorado, especially in the northern part, alfalfa is grown extensively under irrigation. Only a limited use has been made of it as a pasture, due primarily to the widespread belief that alfalfa could not be pastured by cattle without death loss. Under certain conditions green alfalfa has the tendency to cause a condition known as bloating. Death sometimes occurs if the bloating is severe. If there could be found some method of preventing death loss, the alfalfa could be pastured and the expense of harvesting and feeding hay could be eliminated.

Sweet clover is growing in importance as a soil renovator and is used in short crop rotations, but it has the same tendency that green alfalfa has for causing cattle to bloat.

Morton's pasture-grass mixture is very popular in Colorado as a pasture for dairy cattle, sheep and beef cattle.

During the summer of 1929, an experiment was to be conducted at the Colorado Agricultural Experiment Station for the purpose of comparing the above named pastures for fattening steers. An opportunity was thus offered for a

\*Included with the review is the plan of the thesis.

detailed study of the three pastures, under irrigated conditions, for the fattening of steers.

The plan of the thesis was to make a general study of all the summer fattening work with cattle fattened on different pasture grasses. The next step was to confine the study to cattle fattened on irrigated pasture in Colorado. The results of the Fattening of "Warmed-up" Yearling Steers on Irrigated Pastures with Supplements, at the Colorado Agricultural Experiment Station, were to be given in detail.

### Review of Literature

Fattening Cattle on Non-Leguminous Pastures. The pastures of the non-leguminous type that were studied included Western ranges (2), bluestem grass (3), bluegrass (4), brome grass (7), sudan grass (7) and rye grass (8).

Until the last few decades practically all the cattle fattened in the United States were fattened as 3 and 4-year-old steers (2). Grass was plentiful and cheap. Cattle were usually fattened without grain just as they were in their wild stage of existence.

Conditions have changed and are still changing. Grass is no longer as cheap as formerly. Fat cattle are now usually marketed as yearlings and 2-year-old steers

(A number by the word refers to the page number where topics are discussed in detail.)

instead of older aged cattle (2). Different methods of fattening cattle from those formerly used are being tested. Many different pasture grasses are improved and tested for fattening cattle.

The method of fattening cattle on pastures with and without grain has been tried (6). The former method has been more successful for there are few sections of the United States in which the grass is abundant and nutritious enough to finish cattle for the market on grass alone (4). Half full-feeding calves in winter and full-feeding of the grain in summer has given satisfactory results (3).

Average daily gains per steer of 2.33 pounds were reported for yearling steers fattened on grass with a protein and grain supplement (6). The feeding of a protein supplement invariably increased the gains, but not always the profit (6).

Fattening Cattle on Leguminous Pastures. Sweet clover and alfalfa were the ones studied under the leguminous type of pastures. Alfalfa and the clovers are admirably adopted to fattening cattle with the exception of the tendency they have for causing bloat.(8). There is a widespread belief that because of that tendency they are entirely unsuited for pasturing cattle.

A protein supplement was not needed for cattle pastured on legumes, due to their high protein content (9). Low daily gains of 1.68 pounds per steer have been reported on alfalfa pasture. Sweet clover was not usually relished by cattle when first turned on pasture and the grain ration in some cases was reduced to a minimum (9).

The pasture-grass mixtures usually, but not always, contained a legume. Gains were invariably greater if a protein supplement was added to the ration of cattle fattened on pasture-grass mixtures and grain but the profits were not always increased with the increase in gains.

Types of Pastures Adapted to Fattening Cattle in Colorado. The ranges of Colorado usually do not receive enough rainfall to furnish the luxuriant growth of grass necessary to finish the cattle for market.

The irrigated pastures have been tested for fattening cattle. In one test average daily gains of 2.33 pounds per steer were reported on irrigated alfalfa pasture supplemented with grain (12).

A popular irrigated pasture for Northern Colorado is one known as Morton's pasture-grass mixture. The mixture contains brome grass, orchard grass, meadow fescue, timothy and yellow-blossom sweet clover (13).

In one test comparing Morton's pasture-grass mixture with alfalfa pasture, the mixture gave inferior results (14). The next year Morton's mixture gave results that were more satisfactory (17). The alfalfa was winter-killed and not included in the test. Cattle fattened on irrigated sweet-clover pasture made daily gains of 1.61 pounds per steer but were not finished at the end of the feeding period (13).

The results of all the fattening work on irrigated pastures indicate that steers brot directly from the range and fattened on irrigated pastures and grain cannot be finished for the market during the pasture season.

Fattening "Warmed-up" Yearling Steers  
on Irrigated Pastures with Supplements  
at the Colorado Agricultural Experiment Station

Thirty steers were brot off the range in February and fed until May 10 on a cheap ration composed principally of pressed beet pulp, beet tops and corn silage. The daily grain ration per head consisted of 2 pounds of ground barley, and was supplemented with one-half pound cottonseed cake. On May 10 the steers were divided into five lots of six steers each. Four lots were turned on irrigated pastures



and the other lot kept in drylot and fed alfalfa hay for roughage. All lots were fed a mixture of grain composed of equal parts by weight of ground corn and ground barley. The irrigated pastures were: sweet clover, alfalfa and two pastures of Morton's pasture-grass mixture--one lot was fed the regular grain ration and the other fed the regular grain ration with a protein supplement. The steers were taken off the pasture September 9, a total of 122 days on pasture.

The following conclusions were derived from the results obtained during the test:

It was more profitable to fatten steers in drylot than on any of the irrigated pastures.

The greatest net returns per acre of pasture were derived from pasturing steers on sweet clover, and were 30 percent less than the production costs per acre.

An acre of Morton's pasture-grass mixture supplemented with grain produced 2 percent cheaper gains and 9 percent more profit per steer than an acre of alfalfa pasture supplemented with grain. However, the total value of an acre of Morton's mixture, including the value of the harvested hay, was only 65 percent as much as an acre of alfalfa pasture.

Altho the popular opinion is that alfalfa cannot be pastured without death loss the results of this test and one previous test show that this is possible if the following precautions are observed: Have the steers consuming a daily grain ration of 8 to 10 pounds per head when first turned onto the pasture, feed the grain three times daily instead of twice, do not furnish any shade, and once the cattle are on pasture do not remove them except when they are ready for market. Similar precautions observed with cattle pastured on sweet clover did not entirely eliminate death loss. One of the six steers started on experiment died of bloat on sweet-clover pasture.

Based upon the amount of hay weighed back and credited per acre, the alfalfa pasture appeared to be understocked by at least 40 percent. The two Morton's mixture lots were stocked to capacity but the sweet-clover pasture would have carried an additional steer per acre.

The feed production of the several pastures was measured both by their carrying capacity and by the hay produced in addition.

A protein supplement was responsible for 9 percent higher gains, 2 percent higher selling price per hundred-weight and 4 percent greater profit per steer when fed with Morton's pasture-grass mixture and grain.

### BIBLIOGRAPHY

1. Animal Husbandry Department, University of Nebraska.  
Mimeographed Report of Summer Cattle Feeding on Sweet-clover and Sudan Grass Pastures. Cattle 116 and 119, 1923-1924.
2. Animal Husbandry Department, University of Nebraska.  
Mimeographed Report of Summer Cattle Feeding on Sweet-clover and Sudan Grass Pastures. Cattle 121-A, 1925.
3. Barnett, E. and Goodell, C. J., Feeding Cottonseed Meal to Steers on Grass. Miss. Agr. Exp. Sta. Cir. 50, 1923.
4. Blair, R. E., Pasturing Alfalfa with Cattle. U. S. D. A. Dept. of Plant Industry. Yuma Experimental Farm, Yuma, Arizona. 1916.
5. Bowers, W. E., Is There a Difference in Bluegrass? Hoard's Dairyman. Je. 22, 1917.
6. Burdick, R. T., Reinholt, Martin, and Klemmedson, G. S. A Study of Ranch Organization in Eastern Colorado. Colo. Agr. Exp. Sta. Bul. 327, p. 36, Jan., 1928.
7. Ellett, W. B., The Bluegrass of Southwest Virginia. Vir. Agr. Exp. Sta. Bul. 180, p. 90-96.
8. Agricultural Extension Service, Colo. Agr. College, San Luis Valley Summer Cattle Feeding Demonstration at Monte Vista, Colo. Agr. College, 1927.
9. Agricultural Extension Service, Colo. Agr. College, San Luis Valley Summer Cattle Feeding Demonstration at Monte Vista, Colo. Colo. Agr. Extension Cir. 1011, 1928.
10. Gerlaugh, Paul, Drylot Versus Pasture Feeding. Ohio Farmer, Dec. 8, 1928.
11. Good, E. S., Wintering Steers With and Without Corn Silage Preparatory to Finishing on Grass Without Grain. Ky. Agr. Exp. Sta. Bul. 267, p. 82, 92, 93. Apr. 1926.
12. Gray, Dan T., and Ward, W. F., Fattening Steers on Pasture in Alabama. Ala. Agr. Exp. Sta. Bul. 151, 1910.

13. Grimes, J. C. Winter Feeding and Time of Marketing Steers. Ala. Agr. Exp. Sta. Ann. Rpt. p. 13, 1926.
14. Haver, Frederick W., Information to Writer. Feb. 27, 1929.
15. Henry and Morrison, Feeds and Feeding, p. 527-532, 1922.
16. Hough, E., The Old Trails. Saturday Evening Post, Sept. 15, 1919.
17. Hunt, R. E., Finishing Heavy Steers on Bluegrass Pasture Supplemented With Various Amounts of Cottonseed Meal. Vir. Agr. Exp. Sta. Ann. Rpt. p. 47-50, 1920.
18. Maynard, E. J., Unpublished Data. Colo. Agr. Exp. Sta.
19. Morton, G. E., Mimeographed Copy of Talk Over Station K.O.A. on Irrigated Pastures, Mar. 23, 1928. Colo. Exp. Sta.
20. Morton, G. E., Morton's Pasture Grass Mixture. Mimeographed Sheet 9806. Colo. Agr. Exp. Sta.
21. McCampbell, C. W., Anderson, B. M. and Marston, H. W., Cattle Feeding Investigations. Kan. Agr. Exp. Sta. Cir. 117. Sept., 1925.
22. McCampbell, C. W., Anderson, B. M. and Marston, H. W., Cattle Feeding Investigations. 1924-25. Kan. Agr. Exp. Sta. Cir. 128, p. 1-13. Oct. 1926.
23. McCampbell, C. W., Anderson, B. M., and Marston, H. W., Cattle Feeding Investigations. 1926-27. Kan. Agr. Exp. Sta. Cir. 143, p. 7-13. Aug. 1928.
24. McFall, Robert James., The World's Meat, p. 75 and 133. 1927.
25. Mumford, F. B., Fattening Cattle on Bluegrass Pasture. Mo. Agr. Exp. Sta. Bul. 90, p. 527-532, 1911.
26. Mumford, Herbert W., Beef Production, p. 104-110. 1908
27. Pasture Tour in Progress. Ft. Collins Express-Courier, June 17, 1929.

28. Popp, M., Value of Oldenburg Marsh Pasture. Landw Jahrb. 44, U. S. D. A. Exp. Sta. Record, 1914.
29. Richardson, L. A., Summer Finishing of Beef Cattle in Tennessee. Tenn. Agr. Exp. Sta. Pub. 149, Je. 1927.
30. Sampson, Arthur W., Livestock Husbandry on Range and Pasture, p. 285, 1928.
31. Selvig, C. G., Fattening Cattle on Sweet-clover and Bromegrass Pastures. Minn. Agr. Exp. Sta. Rpt. 1926.
32. Sheperd, J. H., Sweet Clover Experiments in Pasturing. N. D. Agr. Exp. Sta. Bul. 211, Ju, 1927.
33. Snapp, Roscoe R., Beef Cattle, p. 330-344, 1925.
34. True, Gordon H. and T. F. McConnell, Steer Feeding Experiment. Ariz. Agr. Exp. Sta. Bul. 50. My. 30, 1905.
35. Vaughn, H. W., Types and Market Classes of Livestock, p. 99-101, 1927.
36. Ward, W. F. and Peden, F. T., Wintering and Fattening Beef Cattle in North Carolina. U. S. D. A. Bul. 628. Ja. 1918.
37. Ward, W. F., Gray, T. and Loyd, E. R., Fattening Steers on Summer Pasture in the South. U. S. D. A. Bul. 777 Ja. 10, 1919.
38. Waters, H. J., Wintering Yearling Cattle. Mo. Agr. Exp. Sta. Bul. 75, p. 46-50. Apri. 1907.
39. Waters, H. J. Fattening Cattle for the Market. Mo. Agr. Exp. Sta. Bul. 76, p. 35-42. Dec. 1907.
40. Waters, H. J. Beef Production on High-Priced Land. Mo. Agr. Exp. Sta. Cir. 24, p. 23, 1908.
41. Whitson, Jay. Summer Steer Feeding, Wallace Farmer. My. 14, 1926.
42. Wilcox, Collier, Black and McComas. Cost and Method of Fattening Beef Cattle in the Corn-Belt. U. S. D. A. Technical Bul. 23. Dec. 1927.