



University of Arizona

College of Agriculture

Agricultural Experiment Station

RATIONS FOR FATTENING RANGE CALVES IN ARIZONA

By

E. B. STANLEY



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RATIONS FOR FATTENING RANGE CALVES IN ARIZONA

E. B. STANLEY

INTRODUCTION

The cattle-feeding investigations conducted at the Salt River Valley Experiment Farm, Mesa, have for the past few years been directed exclusively to feeding trials with range calves. The first of this series of experiments was made in 1925-26 and the results were published in Station Bulletin No. 116. The plan of this trial was elaborated upon and a series of four succeeding tests was conducted terminating with the 1929-30 trial. In Arizona successful calf fattening is based upon a limited use of concentrates and upon a short feeding period. The results of the tests have their greatest significance when interpreted in the light of these conditions.

The prevailing high level of local prices of grain feeds is not conducive to their intensive use for fattening calves in Arizona. Cottonseed meal is used almost exclusively as the concentrate supplement for fattening older cattle. The extent to which it can be used to supplement the grain allowance for fattening calves is considered an important phase of the experiments herein reported.

OBJECTS OF THE EXPERIMENTS

A series of four feeding tests was carried out. The third or 1928-29 trial is presented only as a supplement to the others. This test was identical with the preceding two except for the fact that the cattle came from a drouth-stricken range and had undergone a setback in their growth. The results of this trial offer an interesting comparison with the other tests. The same general plan was followed throughout the entire series of tests affording the following studies and comparisons:

1. The use of cottonseed meal as a substitute for different portions of barley in the calf-fattening ration.
2. The economy of fattening calves on a ration of alfalfa hay, hegarí silage, and cottonseed meal, and supplementing these with rolled barley during the latter half of the feeding period.
3. The practicability of fattening high-grade range calves in Arizona.
4. In addition to the above major objectives of the investigation,

studies which did not continue throughout the entire series were made as follows:

- a. Heifer calves *versus* steer calves (one trial, 1926-27).
- b. Rolled barley *versus* cracked hegari (two trials, 1927-28, 1929-30).
- c. The amount of cottonseed meal that can be safely fed in the ration (two trials, 1926-27, 1927-28).
- d. The addition of a simple mineral to the ration (one trial, 1926-27).
- e. The economy of silage in the ration (one trial, 1926-27).

EXPERIMENTAL PROCEDURE

ANIMALS USED

High-grade range calves of mixed Hereford and Shorthorn breeding with a preponderance of the former were purchased during the month of October. These were at weaning age, 6 to 9 months old.

ALLOTMENT

The calves were divided into eight lots of 10 to 12 head each. An additional lot of two to four calves was used in the first two trials. The allotment in so far as possible was made on a uniform basis with respect to sex, weight, quality, and condition of the calves. Heifer calves were used in lots 1, 2, 3, and 4 and steer calves in lots 5, 6, 7, and 8 with the exception of lot 5 in the 1926-27 trial which had both steers and heifers.

WEIGHTS

Each calf was numbered with a neck strap. On the first day of each of the three consecutive day initial and final weighings individual weights were taken and on each of the 2 following days lot weights were taken. The calves were also weighed as lots at the close of each 30-day period.

FEED LOTS

The feed lots were unsheltered, woven wire enclosures. Each lot was equipped with an automatic drinking cup, a manger, and a rack for hay.

EXPERIMENTAL FEEDING PERIOD

The length of the period was 180 days.

METHOD OF FEEDING

Prior to the beginning of the experiment a preliminary period of 7 to 21 days was allowed to accustom the calves to their feed and surroundings.

All feeding was done by hand. The hay and silage were full-fed twice daily throughout the trials. The concentrates were fed at the rate of 1 pound per head daily at the beginning of the test, gradually increased to 6 pounds in 90 days, and to a maximum of 8 pounds in 140 to 150 days or an average of 5.5 to 6 pounds for the entire 180-day period. The concentrates were mixed and fed and followed a half-hour later by the silage and hay. The cottonseed meal in lot 8, being the sole concentrate during the first half of the test, was mixed with the silage. Water and block salt were available at all times. All feeds were weighed and recorded as fed.

FEEDS USED

ALFALFA HAY

Baled alfalfa hay of the second and third cuttings grown on the Station farm was used throughout the tests. The quality ranged from good to choice, and it was fed with very little waste.

SILAGE

Hegari silage produced on the Station farm was fed exclusively except to lots 1 to 4 inclusive in the 1926-27 trial which received corn silage. The silage was of good, uniform quality. The grain yield of the hegari averages approximately 3,800 pounds per acre, and the crop as a whole averaged 12 to 14 tons of silage.*

ROLLED BARLEY

Grown locally and purchased from local mills.

CRACKED HEGARI

Grown locally and purchased from local mills.

COTTONSEED MEAL

This feed was of choice quality and manufactured by local mills.

CHEMICAL ANALYSIS

Samples of the different feeds used in each trial were taken at different intervals and analyzed by the Agricultural Chemistry Department. The analyses are shown in the appendix.

*Hegari is preferable to corn as a silage crop in southern Arizona, yielding from 3 to 5 tons more silage per acre. In cattle feeding trials conducted at this Station (Bul. 108) comparisons of these two crops as silage revealed no material difference in their feeding value.

DISCUSSION OF RESULTS

COTTONSEED MEAL AS A SUBSTITUTE FOR DIFFERENT PORTIONS OF BARLEY IN THE CALF-FATTENING RATION

Three trials each with four lots of heifer calves were conducted to study the extent to which cottonseed meal could be substituted for barley when fed with alfalfa hay and hegari silage.* Lot 1 was fed barley as a check lot and lots 2, 3, and 4 received barley and cottonseed meal in the following respective proportions: five parts barley and one part cottonseed meal, four parts barley and two parts cottonseed meal, three parts barley and three parts cottonseed meal. An average of the results are shown in table I.

TABLE I.—COTTONSEED MEAL AS A SUBSTITUTE FOR DIFFERENT PORTIONS OF BARLEY IN THE CALF-FATTENING RATION.

(Average of results of three trials—1926-27, 1927-28, 1929-30.)

| Lot No. | Lot 1 | Lot 2 | Lot 3 | Lot 4 |
|----------------------------------|--------------------|--------------------|--------------------|--------------------|
| Animals used..... | (10-12) Heifers | (10-12) Heifers | (10-12) Heifers | (10-12) Heifers |
| Average initial weight..... | 379 | 386 | 386 | 384 |
| Average final weight..... | 734 | 744 | 757 | 751 |
| Average daily gains..... | 1.97 | 1.99 | 2.06 | 2.04 |
| <i>Average daily ration:</i> | | | | |
| Hegari silage..... | 13.7 | 13.8 | 14.1 | 14.1 |
| Alfalfa hay..... | 5.67 | 5.81 | 6.04 | 6.16 |
| Rolled barley..... | 5.78 | 4.81 | 3.87 | 2.90 |
| Cottonseed meal..... | ..... | .96 | 1.93 | 2.88 |
| Ttl. Feed required per cwt. gain | 1,281 | 1,287 | 1,265 | 1,283 |
| Feed cost per cwt. gain..... | \$9.22 | \$9.10 | \$8.71 | \$8.69 |

FINANCIAL STATEMENT

| | | | | |
|-----------------------------|---------|---------|---------|---------|
| Purchase price per cwt..... | \$ 9.18 | \$ 9.18 | \$ 9.18 | \$ 9.18 |
| Initial cost per calf..... | 34.79 | 35.43 | 35.43 | 35.25 |
| Feed cost per calf..... | 32.44 | 32.10 | 31.99 | 31.52 |
| Total cost per calf..... | 69.54 | 69.84 | 69.76 | 69.10 |
| Selling price per cwt..... | 10.65 | 10.65 | 10.65 | 10.65 |
| Returns per calf..... | 75.05 | 76.04 | 77.43 | 76.68 |
| Profit per calf..... | 5.51 | 6.20 | 7.67 | 7.58 |
| Necessary margin..... | .69 | .60 | .42 | .41 |

Cost of feeds per ton:

| | | | |
|----------------------|---------|---------------|---------|
| Rolled barley..... | \$38.00 | Silage | \$ 5.50 |
| Cottonseed meal..... | 32.00 | Alfalfa | 12.00 |

*Corn silage fed first trial. See description of feeds.

The rate and efficiency of the gains made by each of the four lots were practically identical. A slightly greater daily gain and a small increased consumption of hay and silage occurred in the two lots receiving the higher allowances of cottonseed meal. It may be concluded from these results that substitution up to one-half the barley allowance in a ration with alfalfa hay and silage can be made without materially influencing the rate and efficiency of gains. A 50-percent replacement of barley with cottonseed meal effected a saving of 5.25 percent in the feed cost of producing 100 pounds of gain.

TABLE II.—COTTONSEED MEAL AS A SUBSTITUTE FOR DIFFERENT PORTIONS OF BARLEY IN THE CALF-FATTENING RATION WITHOUT SILAGE.

(Average of results of two trials, 1927-28, 1929-30.)

| Lot number | Lot 5 | Lot 6 |
|--|--------------|--------------|
| Animals used..... | Steers 11 | Steers 11 |
| Average initial weight..... | 444 | 444 |
| Average final weight..... | 829 | 812 |
| Average daily gain..... | 2.14 | 2.05 |
| <i>Average daily ration:</i> | | |
| Alfalfa hay..... | 13.4 | 13.2 |
| Rolled barley..... | 4.70 | 3.76 |
| Cottonseed meal..... | .95 | 1.87 |
| Total feed required per cwt. gain..... | 908 | 920 |
| Feed cost per cwt. gain..... | \$9.36 | \$8.83 |

FINANCIAL STATEMENT

| | | |
|------------------------------|---------|---------|
| Purchase price, per cwt..... | \$10.05 | \$10.05 |
| Initial cost per calf..... | 44.62 | 44.62 |
| Feed cost per calf..... | 36.02 | 35.19 |
| Total cost per calf..... | 83.37 | 82.41 |
| Selling price cwt..... | 11.65 | 11.65 |
| Returns per calf..... | 92.67 | 90.87 |
| Necessary margin..... | .42 | .31 |
| Profit per calf..... | 9.30 | 8.46 |

Cost of feeds per ton:

| | | | |
|----------------------|---------|------------------|-------|
| Rolled barley..... | \$39.50 | Alfalfa hay..... | 13.50 |
| Cottonseed meal..... | 34.50 | | |

Like amounts and proportions of barley and cottonseed meal as fed lots 2 and 3 in the preceding comparison—five parts barley and one part cottonseed meal, four parts barley and two parts cottonseed meal—were fed with alfalfa hay as the only roughage to two lots of steer calves, lots 5 and 6, in two trials. A comparison of the results made by the two lots is afforded in table II. No particular significance would be attached to the slight advantage in the rate, efficiency, and economy of gains made by the calves in lot 5 fed the 5-1 barley-meal mixture if it were not for the greater tendency to bloat by the calves in lot 6 fed the 4-2 barley-meal mixture. The calves in the latter lot were susceptible to chronic bloating and did not take their feed as readily as did the calves fed the smaller proportion of cottonseed meal. The uniformity of the results and conditions which obtained in both trials point unfavorably to a more liberal proportion of cottonseed meal than the five parts barley and one part cottonseed meal mixture when fed with alfalfa hay as the sole roughage.

THE ECONOMY OF FATTENING CALVES ON A RATION OF
ALFALFA HAY, HEGARI SILAGE AND COTTONSEED
MEAL, SUPPLEMENTED WITH ROLLED BARLEY
THE LATTER HALF OF FEEDING PERIOD

The fixed concentrate allowance, approximating 6 pounds, fed to all other lots in this investigation was further limited in the case of one lot of steer calves in three trials. Barley was withheld in the first half of the feeding period during which time an average of 2.7 pounds of cottonseed meal per head was fed with a full feed of alfalfa hay and silage. Barley was added in an amount equal to the cottonseed meal the latter half of the feeding period, and the total mixture made to correspond to the concentrate allowance then being fed to the other lots. In table III the average of the results obtained in three trials from this method of feeding are given in comparison with lot 5 fed a ration of alfalfa hay, rolled barley, and cottonseed meal during the same trials.

The calves fed silage gained 2.11 pounds per head daily for the entire period, which is a creditable showing considering the limited use of concentrates. In the 1926-27 trial a comparison was made of this ration with one which was similar except for the omission of cottonseed meal and a barley allowance aggregating 1.3 pounds more than the concentrates in the former lot. The calves fed the smaller concentrate allowance ate 3.4 pounds more of silage and .6 pound more of hay per head daily, and gained 2.23 pounds at a feed cost of \$5.89 per 100 pounds gain. The other lot in comparison made an average daily gain per calf of 2.28 pounds at a feed cost of \$6.96 per 100 pounds gain.

TABLE III.—THE ECONOMY OF FATTENING CALVES ON A RATION OF ALFALFA HAY, HEGARI SILAGE AND COTTONSEED MEAL SUPPLEMENTED WITH ROLLED BARLEY THE LATTER HALF OF THE FEEDING PERIOD, IN COMPARISON WITH A RATION WITHOUT SILAGE.

(Average of three trials, 1926-27, 1927-28, 1929-30.)

| Lot number | Lot 5 | Lot 8 |
|--|-----------------|-----------------|
| Animals used..... | Steers 10-12 | Steers 10-12 |
| Average initial weight..... | 411 | 413 |
| Average final weight..... | 805 | 793 |
| Average daily gain..... | 2.19 | 2.05 |
| <i>Average daily ration:</i> | | |
| Hegari silage..... | ..... | 16.3 |
| Alfalfa Hay..... | 12.73 | 6.93 |
| Rolled barley..... | 4.87 | 1.61 |
| Cottonseed meal..... | .98 | 3.24 |
| Total feed required per cwt. gain..... | 853 | 1330 |
| Feed cost per cwt. gain..... | \$8.47 | \$7.99 |

FINANCIAL STATEMENT

| | | |
|----------------------------|---------|---------|
| Purchase price cwt..... | \$ 9.18 | \$ 9.18 |
| Initial cost per calf..... | 37.72 | 37.91 |
| Feed cost per calf..... | 33.07 | 30.14 |
| Total cost per calf..... | 73.24 | 70.47 |
| Selling price cwt..... | 10.65 | 10.65 |
| Returns per calf..... | 82.32 | 81.15 |
| Profit per calf..... | 9.08 | 10.68 |
| Necessary margin..... | .30 | .08 |

Cost of feeds per ton:

| | | | |
|----------------------|---------|------------------|---------|
| Rolled barley..... | \$38.00 | Alfalfa hay..... | \$12.00 |
| Cottonseed meal..... | 32.00 | Silage | 5.50 |

The average feed cost per 100 pounds gain for the three trials where this method of feeding was followed amounted to \$7.99 as compared with \$8.44 made by lot 5. These two lots, the former fed silage and a reduced amount of concentrates, and the latter receiving no silage and a greater allowance of concentrates made the most rapid and economical gains secured in this series of studies. While there is not a wide

difference in the economy of the two rations, the silage ration is to be preferred though it is shown that silage is not indispensable to the calf-fattening ration for profit making. The cattle feeder can fatten calves successfully and profitably with alfalfa hay, barley, and cottonseed meal.

TABLE IV.—STEER CALVES VERSUS HEIFER CALVES.
(One trial, 1926-27.)

| Lot Number | Lot 1 | Lot 2 | Lot 5 | Lot 6 |
|---|---------------|---------------|---|--------------|
| Animals used | Heifers 12 | Heifers 12 | Heifers 6 Steers 8 | Steers 12 |
| Average initial weight | 340 | 338 | Heifers 330 Steers 364 Average 347 | 357 |
| Average final weight.... | 717 | 724 | Heifers 720 Steers 798 Average 759 | 768 |
| Average daily gain..... | 2.10 | 2.14 | Heifers 2.17 Steers 2.41 Average 2.29 | 2.28 |
| <i>Average daily ration:</i> | | | | |
| Hegari silage..... | ..... | ..... | ..... | 12.9 |
| Corn silage..... | 12.7 | 12.9 | ..... | ..... |
| Alfalfa hay..... | 4.53 | 4.76 | 11.34 | 5.14 |
| Rolled barley..... | 6.06 | 5.06 | 5.21 | 6.07 |
| Cottonseed meal..... | ..... | 1.01 | 1.04 | ..... |
| Total feed required per cwt. gain..... | 1112 | 1108 | 744 | 1055 |
| Feed cost per cwt. gain | \$7.44 | \$7.14 | \$6.60 | \$6.96 |

FINANCIAL STATEMENT

| | | | | |
|--------------------------|---------|---------|--|---------|
| Purchase price cwt. ... | \$ 7.44 | \$ 7.44 | \$ 7.44 | \$ 7.44 |
| Initial cost per calf... | 25.28 | 25.14 | Heifers 24.55 Steers 27.09 Average 25.82 | 26.57 |
| Feed cost per calf..... | 28.10 | 27.55 | 27.18 | 28.58 |
| Total cost per calf..... | 55.55 | 54.85 | Heifers 53.85 Steers 56.49 Average 55.17 | 57.38 |
| Selling price cwt..... | 8.65 | 8.65 | 8.65 | 8.65 |
| Returns per calf... .. | 59.57 | 60.10 | Heifers 59.79 Steers 66.25 Average 63.02 | 63.76 |
| Profit per calf..... | 4.02 | 5.25 | Heifers 5.94 Steers 9.76 Average 7.85 | 6.38 |
| Necessary margin..... | .63 | .45 | Heifers .35 Steers .07 Average .13 | .34 |

Cost of feeds per ton:

| | | | |
|----------------------|---------|------------------|---------|
| Rolled barley..... | \$35.00 | Silage | \$ 5.00 |
| Cottonseed meal..... | 26.00 | Alfalfa hay..... | 8.00 |



A



B

Fig. 1.—A. Steer used in 1927-28 test, at close of feeding period.
B. Heifer used in 1927-28 test, at close of feeding period.

STEER CALVES *VERSUS* HEIFER CALVES

One lot of heifer calves, one of steer calves, and one of steer and heifer calves mixed were fed in the 1926-27 trial as a further study of the comparative feeding qualities of steer and heifer calves, which was started in the preceding trial*. The heifer calves in lot 1 and steer calves in lot 6 were each fed a ration of alfalfa hay, silage, and rolled barley, the heifer calves receiving corn silage and the steer calves hegari silage.† The steer and heifer calves in lot 5 were fed a mixture of barley and cottonseed meal with alfalfa hay. The results are given in table IV.

Comparison of lots 1 and 6 shows a slight advantage of the steer calves in the rate of gain and feed required to produce 100 pounds of gain. The steer calves returned a profit of \$2.36 more per head and required a necessary margin per 100 pounds of 34 cents, the heifer calves requiring a margin of 63 cents. The heifer calves acquired a marketable finish fully two weeks earlier than did the steer calves.

No apparent adverse effects resulted in feeding the steer and heifer calves together in lot 5. Check lots were not available to afford a direct comparison. However, the high average daily gain of 2.41 pounds made by the steer calves and the gain of 2.17 pounds made by the heifers in the mixed lot correspond favorably with gains made by steers and heifers when fed separately. Similar results were obtained in the preceding trial.‡

From the results of the above comparisons and the 1925-26 test it is concluded that steer calves made slightly greater and more economical gains than did heifer calves.

THE ADDITION OF A SIMPLE MINERAL MIXTURE TO A RATION OF ALFALFA HAY, HEGARI SILAGE, AND ROLLED BARLEY

In a preceding trial (1925-26) it was observed that calves fed a ration of alfalfa hay, corn silage, and rolled barley manifested an appetite for what appeared to be mineral matter. On weighing days in particular when turned out of their lots the calves would immediately start licking up soil. No other symptoms indicating a deficiency in the ration were noticed. In the trial following this observation, two lots of steer calves were fed rations of alfalfa hay, hegari silage, and rolled barley, adding to one a mineral mixture of equal parts steamed bone meal and finely ground limestone.

*Ariz. Exp. Sta. Bul. 116.

†See description of feeds.

‡Ariz. Exp. Sta. Bul. 116.

TABLE V.—THE ADDITION OF A SIMPLE MINERAL MIXTURE TO A RATION OF ALFALFA HAY, HEGARI SILAGE AND ROLLED BARLEY.

(One trial, 1926-27.)

| Lot number | Lot 6 | Lot 7 |
|--|--------------|--------------|
| Animals used..... | Steers 12 | Steers 12 |
| Average initial weight..... | 357 | 357 |
| Average final weight..... | 768 | 763 |
| Average daily gain..... | 2.28 | 2.24 |
| <i>Average daily ration:</i> | | |
| Hegari silage..... | 12.9 | 12.3 |
| Alfalfa hay..... | 5.14 | 4.92 |
| Rolled barley..... | 6.07 | 6.05 |
| Minerals ..... | ..... | .065 |
| Total feed required per cwt. gain..... | 1055 | 1041 |
| Cost cwt. gain..... | \$6.96 | \$7.21 |

FINANCIAL STATEMENT

| | | |
|----------------------------|---------|---------|
| Purchase price cwt..... | \$ 7.44 | \$ 7.44 |
| Initial cost per calf..... | 26.57 | 26.74 |
| Feed cost per calf..... | 28.58 | 29.10 |
| Total cost per calf..... | 57.38 | 58.09 |
| Selling price cwt..... | 8.65 | 8.65 |
| Returns per calf..... | 63.76 | 63.36 |
| Profit per calf..... | 6.38 | 5.27 |
| Necessary margin..... | .34 | .49 |

Cost of feeds per ton:

| | | | |
|--------------------|---------|----------------------|---------|
| Rolled barley..... | \$35.00 | Silage | \$ 5.00 |
| Hay | 8.00 | Minerals (cwt.)..... | 8.40 |

It will be observed in table V that the results of both lots are practically identical. The addition of one ounce per head daily of the mineral mixture did not improve the ration, the added cost proving unprofitable in this trial.

ROLLED BARLEY VERSUS CRACKED HEGARI

Two lots of steer calves were each fed for two trials rations of alfalfa hay, hegari silage, and cottonseed meal supplemented with rolled barley and cracked hegari, respectively. Each grain was fed in the

proportion of four parts to two parts of cottonseed meal. A comparison of the average of the results of these two lots for the two trials in table VI reveals no difference in the feeding values of these two feeds. The average daily gains for both lots were identical in each trial and the difference in the amount of feed to produce 100 pounds of gain was less than 1 percent. Any difference between the costs of barley and hegari should determine their relative value to the feeder when fed with alfalfa hay and cottonseed meal.

TABLE VI.—ROLLED BARLEY VERSUS CRACKED HEGARI.
(Average of two trials, 1927-28, 1929-30.)

| Lot number | Lot 6 | Lot 7 |
|------------------------------|-----------------|-----------------|
| Animals used..... | Steers 10-12 | Steers 10-12 |
| Average initial weight..... | 444 | 443 |
| Average final weight..... | 812 | 811 |
| Average daily gain..... | 2.05 | 2.05 |
| Alfalfa hay..... | 13.2 | 13.1 |
| Rolled barley..... | 3.76 | ..... |
| Cottonseed meal..... | 1.87 | 1.88 |
| Cracked hegari..... | ..... | 3.77 |
| Total feed required..... | 919 | 917 |
| Feed cost per cwt. gain..... | \$8.83 | \$9.01 |

FINANCIAL STATEMENT

| | | |
|----------------------------|---------|---------|
| Purchase price cwt..... | \$10.05 | \$10.05 |
| Initial cost per calf..... | 44.62 | 44.52 |
| Feed cost per calf..... | 35.19 | 35.21 |
| Total cost per calf..... | 82.41 | 82.31 |
| Selling price cwt..... | 11.65 | 11.65 |
| Returns per calf..... | 90.87 | 90.75 |
| Profits per calf..... | 8.46 | 8.44 |
| Necessary margin..... | .52 | .52 |

Cost of feeds per ton:

| | | | |
|----------------------|---------|---------------------|---------|
| Rolled barley..... | \$39.50 | Cracked hegari..... | \$40.00 |
| Cottonseed meal..... | 34.50 | Alfalfa hay..... | 13.50 |

THE PRACTICABILITY OF FATTENING HIGH-GRADE CALVES IN ARIZONA

With a ready outlet for fat calves on the baby beef order both locally and on the California markets and a plentiful supply of feeder calves to draw upon, the advisability of finishing calves in Arizona for market is reduced to a consideration of feed costs. It is recognized that young stock will make more efficient and economical gains than will older cattle. However, they require a longer period to fatten and calves as a rule cost more per 100 pounds. Mature cattle will make greater daily gains, reach a marketable finish more quickly, and require less feed per 100 pounds live weight than do younger cattle. There is less risk in feeding young cattle, yet the opportunity to make large profits is greater with older cattle.

The prevailing high cost of grain feeds above the level of corn belt prices is the principal factor curtailing extensive calf-fattening operations in this State. Calves require grain in the fattening ration, hence the preference by feeders for yearlings and older cattle which are fattened on roughage and cottonseed meal generally to the exclusion of grain.

Prime condition in baby beef which can be attained only by heavy grain feeding is not an absolute market requirement for this class of cattle in our southwestern markets. Young cattle weighing a minimum of 750 pounds with a moderate degree of finish are acceptable for slaughter in the baby beef class. The discriminating market that pays a fair premium for highly finished young cattle is not yet available to Arizona feeders.

The various rations fed in the calf-feeding trials in this series of tests have produced a finish satisfactory to local and California buyers. It is believed that the allowance of concentrates approximates the minimum allowance essential for producing the necessary gain and finish. The relative merits of the several rations fed have been discussed in groups according to the particular objective of their comparison. A complete summary of these results except those of the supplementary studies are shown in table VII. The results shown for lots 1, 2, 3, 4, 5, and 8 are an average of three trials and those for lots 6 and 7 are an average of the results obtained in two trials.

All lots returned a profit over the period of the tests taken as a whole, representing the winter feeding seasons of 1926-27, 1927-28, and 1929-30. The average feed costs are shown at the bottom of the table. In determining the net returns, labor costs were not charged and no credit was given for the manure. Lots, 3, 4, 5, and 8 were the most profitable of all the lots, showing a net return per calf of \$7.67, \$7.58, \$9.08, and \$10.68, respectively. Had steer calves instead of heifer calves

TABLE VII.—SUMMARY OF RESULTS OF CALF-FEEDING TRIALS. (Lots 1, 2, 3, 4, 5, 8—average of three trials, 1926-27, 1927-28, 1929-30; lots 6 and 7—average of two trials, 1927-28, 1929-30.)

| Lot number | I | II | III | IV | V | VI | VII | VIII |
|-------------------------------------|------------------|------------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Animals used..... | Heifers 10-12 | Heifers 10-12 | Heifers 10-12 | Heifers 10-12 | Steers 10-12 | Steers 10-12 | Steers 10-12 | Steers 10-12 |
| Average initial weight..... | 379 | 386 | 386 | 384 | 411 | 444 | 443 | 413 |
| Average final weight..... | 734 | 744 | 757 | 751 | 805 | 812 | 811 | 793 |
| Total gain..... | 355 | 358 | 371 | 357 | 394 | 368 | 368 | 380 |
| Average daily gain..... | 1.97 | 1.99 | 2.06 | 2.04 | 2.19 | 2.05 | 2.05 | 2.11 |
| <i>Average daily ration:</i> | | | | | | | | |
| Hegari silage..... | 13.71 | 13.83 | 14.08 | 14.16 | ..... | ..... | ..... | 16.30 |
| Alfalfa hay..... | 5.67 | 5.81 | 6.04 | 6.16 | 12.73 | 13.17 | 13.07 | 6.93 |
| Rolled barley..... | 5.78 | 4.81 | 3.87 | 2.90 | 4.87 | 3.76 | 3.77† | 1.61 |
| Cottonseed meal..... | ..... | .96 | 1.93 | 2.38 | .98 | 1.87 | 1.88 | 3.24 |
| <i>Feed required per cwt. gain:</i> | | | | | | | | |
| Hegari silage..... | 698 | 700 | 687 | 696 | ..... | ..... | ..... | 770 |
| Alfalfa hay..... | 290 | 295 | 296 | 304 | 585 | 643 | 640 | 330 |
| Rolled barley..... | 293 | 243 | 188 | 142 | 223 | 184 | ..... | 76 |
| Cottonseed meal..... | ..... | 49 | 94 | 141 | 45 | 92 | 92 | 154 |
| Cracked hegari..... | ..... | ..... | ..... | ..... | ..... | ..... | 185 | ..... |
| Total feed required..... | 1,281 | 1,287 | 1,265 | 1,283 | 853 | 919 | 917 | 1,330 |
| Feed cost cwt. gain..... | \$9.22 | 9.10 | 8.71 | 8.69 | 8.47 | *8.83 | *9.01 | 8.00 |
| Purchase price cwt..... | 9.25 | 9.25 | 9.25 | 9.25 | 9.25 | 10.25 | 10.25 | 9.25 |
| Cost cwt.—start experiment..... | 9.18 | 9.18 | 9.18 | 9.18 | 9.18 | 10.05 | 10.05 | 9.18 |
| Cost cwt.—start experiment..... | 34.79 | 35.43 | 35.43 | 35.25 | 37.72 | 44.62 | 44.52 | 37.91 |
| Feed cost per calf..... | 32.44 | 32.10 | 31.99 | 31.52 | 33.07 | 35.19 | 35.21 | 30.14 |
| Interest 8%..... | 1.58 | 1.58 | 1.61 | 1.60 | 1.72 | 1.80 | 1.78 | 1.69 |
| Marketing cost..... | .73 | .73 | .73 | .73 | .73 | .80 | .80 | .73 |
| Total cost per calf..... | 69.54 | 69.84 | 69.76 | 69.10 | 73.24 | 82.41 | 82.31 | 70.47 |
| Selling price cwt..... | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 11.65 | 11.65 | 10.65 |
| Returns per calf..... | 75.05 | 76.04 | 77.43 | 76.68 | 82.32 | 90.87 | 90.75 | 81.15 |
| Profit per calf..... | 5.51 | 6.20 | 7.67 | 7.58 | 9.08 | 8.46 | 8.44 | 10.68 |
| Necessary margin cwt..... | .69 | .60 | .42 | .42 | .30 | .52 | .52 | .08 |

*Average feed costs for 3 years used in other lots.

†Cracked hegari.

Costs of feed per ton: Rolled barley, \$38; cottonseed meal, \$32; alfalfa hay, \$12; silage, \$5.50; cracked hegari, \$40.

been fed in lots 3 and 4, a greater profit would undoubtedly have been realized. The rations fed in these four lots have produced the largest and most economical gains. There is little choice between them, though a preference would be made for the ration fed to lot 8, which produced the greatest profit. The feeder without silage will find the ration fed in lot 5 very satisfactory. The calves in this lot have made the greatest gains and returned a profit of \$1.60 less per calf than lot 8. The heifer calves in lots 3 and 4 made identical gains and because of the greater proportion of meal to barley in the latter lot, the calves in this lot made slightly cheaper gains than did lot 3.

No differentiation was made in the selling price of the different lots. The profits realized by the respective lots were made on a margin of approximately \$1.50 per 100 pounds. The calves in lots 4, 5, and 8 required necessary margins of, respectively, 42, 29, and 7 cents per 100 pounds

TABLE VIII.—FEED COSTS PER 100 POUNDS EACH 30-DAY FEEDING PERIOD.

(Average of three trials, 1926-27, 1927-28, 1929-30.)

| Lot No. | Period I | Period II | Period III | Period IV | Period V | Period VI | Average |
|---------|----------|-----------|------------|-----------|----------|-----------|---------|
| I | \$5.21 | \$7.59 | \$9.47 | \$10.28 | \$11.18 | \$13.27 | \$9.50 |
| II | 5.04 | 7.34 | 9.21 | 9.76 | 11.48 | 12.87 | 9.28 |
| III | 5.07 | 6.99 | 9.31 | 9.20 | 10.19 | 12.55 | 8.89 |
| IV | 4.95 | 7.23 | 9.38 | 9.13 | 9.18 | 11.76 | 8.61 |
| V | 5.21 | 7.32 | 8.53 | 9.27 | 9.12 | 11.52 | 8.49 |
| *VI | 6.30 | 7.83 | 10.05 | 10.73 | 10.70 | 13.09 | 9.78 |
| *VII | 6.46 | 7.86 | 9.53 | 10.45 | 11.38 | 12.94 | 9.77 |
| VIII | 4.84 | 6.05 | 7.87 | 8.91 | 9.27 | 12.11 | 8.17 |

*Two trials, 1927-28, 1929-30, and average of feed costs over corresponding period.

to meet the costs incident to the feeding operation. It is reasonable to conclude from the foregoing results that the calf feeder will require a margin of \$1.50 per 100 pounds on his calves to realize a profit.

Reference to table VII will show the average amount and cost of feed required to produce 100 pounds of gain for the entire feeding period. In table VIII are shown the feed costs for each successive 30-day period. Considering all of the lots as a whole, the cost increased with each period amounting to 132 percent in the sixth or last period more than the cost for the first period. The percentage cost increased for each period over the first period was as follows: Period 2, 30th-60th day, 35 percent; period 3, 60th-90th day, 70 percent; period 4, 90th-120th day, 80 percent; period 5, 120th-150th day, 92 percent; period 6, 150th-180th day, 132 percent. The percentage increase in cost of each period over the preceding period was as follows: Period 2, 27 percent; period 3, 27 per-

cent; period 4, 8 percent; period 5, 8 percent; period 6, 30 percent. The foregoing figures indicate the rate of increase in the feed cost per 100 pounds of gain that will occur when fattening calves under the methods followed in this investigation. A significant point to observe in the costs for the different periods is the pronounced upturn of 30 percent in the last 30-day period. This points to the impracticability of prolonging the feeding period more than 180 days. The feeder should take stock of his costs toward the end of 150 days of feeding when the calves, particularly the heifers, begin to acquire a marketable finish.

The dressing percent of the individual lots was obtained only for the 1929-30 trial. The heifer calves in lots 1, 2, 3, and 4 gave an average yield of 61.03 percent and the steer calves in lots 5, 6, 7, and 8 dressed 59.41 percent based on the warm weights. The variation in the yield among the heifer lots did not exceed .7 of 1 percent and .8 of 1 percent in the steer lots. These records indicate the fairly high and uniform finish produced on high-grade range calves fed for a period of 180 days.

SUPPLEMENTARY OBSERVATIONS

THE AMOUNT OF COTTONSEED MEAL THAT CAN BE SAFELY FED IN THE CALF-FATTENING RATION

One odd lot of two steer calves in the 1926-27 trial and another of two steer calves and two heifer calves in the 1927-28 trial were fed alike to observe the maximum tolerance of 6- to 8-month-old calves for cottonseed meal when fed with alfalfa hay, rolled barley, and hegari silage. The more liberal use of cottonseed meal in cattle-feeding rations in Arizona is not in accordance with feeding practices advocated in the eastern and midwestern sections of the country.

Because of its abundant and comparatively cheap supply, local feeders have reported favorable results with amounts that had generally been recognized as harmful to the health of the animals. Some light on this problem is shown in table IX.

The calves were managed and fed in the same manner accorded the other lots. The hay and silage were full-fed, the rolled barley and cottonseed meal allowed in equal parts for the first half of the trial. The barley was then gradually withdrawn and the cottonseed meal increased. The barley was omitted from the ration for the last 65 days of the trials. A maximum daily consumption of 9 pounds per head was attained without any disturbing effects. The calves consumed an average of 4.5 pounds of cottonseed meal and 1.33 pounds of barley per head for the period of the trials. Their average daily gain of 1.96 pounds at a

TABLE IX.—THE AMOUNT OF COTTONSEED MEAL, THAT CAN BE SAFELY FED IN THE CALF-FATTENING RATION.

(Average of two trials, 1926-27, 1927-28.)

| | |
|--|--------------|
| Lot number— | IX |
| Animals used..... | 3 |
| Average initial weight..... | 365 pounds |
| Average final weight..... | 718 pounds |
| Average daily gain..... | 1.96 pounds |
| Average daily ration: | |
| Hegari silage..... | 13.0 pounds |
| Alfalfa hay..... | 4.48 pounds |
| Rolled barley..... | 1.34 pounds |
| Cottonseed meal..... | 4.49 pounds |
| Total feed consumed per cwt. gain..... | 1,190 pounds |
| Feed cost per cwt. gain..... | \$ 7.50 |
| Financial statement: | |
| Purchase price per cwt..... | 8.02 |
| Initial cost per calf..... | 29.04 |
| Feed cost per calf..... | 26.38 |
| Total cost per calf..... | 57.43 |
| Selling price cwt..... | 10.33 |
| Returns per calf..... | 71.20 |
| Profits per calf..... | 13.77 |
| Necessary margin..... | .31 |
| Cost of feeds per ton: | |
| Rolled barley..... | \$ 37.00 |
| Silage..... | 5.00 |
| Cottonseed meal..... | 30.00 |
| Alfalfa hay..... | 10.00 |

feed cost of \$7.50 compared favorably with the results of the other lots fed the same period, 1926-27 and 1927-28.

The results would indicate that the class of cattle fed in these trials will consume a high proportional allowance of cottonseed meal with no disturbing effects when fed with silage, alfalfa hay, and rolled barley.

SILAGE IN CALF-FATTENING RATION

The plan of this series of calf-fattening tests did not include a direct comparison of the economy of rations with and without silage. While both were fed, the animals were not of uniform sex in the respective lots or minor differences existed in the amount of concentrates in the rations. In certain designated respects comparisons of rations with and without silage were afforded which merited consideration. Reference is made to the results in tables III and IV.

It is possible to compare a silage ration as fed in lot 2 with a no-silage ration fed in lot 5, table IV, with respect only to the average daily gains made by the heifer calves of the two lots. With both rations differing only in regard to the silage, but the calves in lot 5 being both steers and

heifers, the only measure afforded for comparison was the average daily gain of 2.14 pounds made by the heifer calves in lot 2 with the gain of 2.17 pounds made by the heifer calves in lot 5. The similarity of their respective gains indicates that silage does not add to the nutritional value of the ration of alfalfa hay, barley, and cottonseed meal as fed in this trial. On the basis of the amount of feed required to produce 100 pounds of gain, 2.3 pounds of silage replaced 1 pound of alfalfa hay. Because of the sex difference of the animals in the two lots, the replacement value of silage as above determined is not accurate. It is in line, however, with the results obtained in a calf-fattening test in 1925-26 by Guilbert of the California Station. It was found in this experiment that $2\frac{1}{2}$ to 3 pounds of corn silage replaced 1 pound of alfalfa hay on the basis of the feed required for 100 pounds of gain. The silage was added to rations of alfalfa hay and barley and alfalfa hay, barley, and cottonseed meal.

The results of the two lots of steer calves in table III are comparable in showing the relative costs of a ration including silage and one without silage. Reference is made to the discussion of results in table III. The silage-fed calves brought a greater net return but not at a sufficient margin to make silage an essential to the calf-fattening ration. A comparison of the feed requirements of the two lots shows that 2.1 pounds of silage were equivalent to 1 pound of alfalfa hay. The smaller amount of concentrates fed to the silage lot may account for the rather high replacement value of silage with alfalfa hay.

THE EFFECT OF IMPAIRED GROWTH UPON THE ABILITY OF YEARLING CATTLE TO FATTEN

The use of yearling cattle instead of calves in the 1928-29 trial makes it a study apart from the calf-feeding series. Calves not being available for this trial, cattle of yearling age were procured. They were as a whole above the average quality of range cattle but were in "drouthy" condition, having come from a drouth-stricken range where they had undergone a setback in growth. Their average weight at the beginning of the test was 460 pounds per head exceeding only by 60 pounds the average of the beginning weights of the calves in the three calf-feeding trials.

The identical plan of the latter two calf-feeding trials was adopted. A corresponding allotment of the animals was made, heifers being used in the first four lots and steers in the last four. In lots 1, 2, and 5 there were nine animals each and ten in the other lots. The rations and method of feeding in the calf-feeding trials were likewise duplicated. The results are given in table X.

The cattle as a group were not vigorous feeders and manifested a stunted capacity for feed throughout the test. A comparison of the results of the one trial with this class of yearling cattle, with an average of the results of the three calf-feeding tests is afforded in tables X and VII. The yearlings taken as a group were fed 10 percent more roughage, made a 13-percent smaller daily rate of gain and required 23 percent more feed to produce 100 pounds of gain compared with an average of the results of the three calf-feeding trials.

In lots 5, 6, and 7, receiving rations of alfalfa hay, rolled barley, and cottonseed meal, half of the animals were attacked with chronic cases of bloat. One of the steers in lot 7 died and one steer was taken from each of lots 5 and 7. The bloating was checked upon the addition of silage to the ration during the last 61 days of the test. One heifer in lot 3 died from an acute attack of bloat.

Similar trouble was encountered in the corresponding lots with calves in the calf-feeding trials but only to a minor extent. Fewer of the calves were affected and individual cases of bloating were not so severe. More trouble was encountered with bloating in lots 6 and 7 than in lot 5. Barley and hegari respectively fed in the proportions of four parts each, with two parts cottonseed meal composed the concentrate mixture in lots 6 and 7, while lot 5 received five parts barley and one part cottonseed meal. The calves fed silage were not troubled. In a report of the results of a feeding trial with yearling steers at the Montana Station, Vinke and Pearson commented as follows with regard to bloating trouble: "In some of the trials conducted at this station serious difficulties have been encountered with so-called 'barley bloat.' When steers fed on a ration of barley and alfalfa are increased up to 7 pounds per head daily they often start to bloat and continue to bloat until they are on full feed, when the trouble practically stops except for a small percentage of steers which have become chronic bloaters." The cattle fed hegari were troubled equally as much with the chronic bloating as the barley-fed animals in lot 6. The maximum daily allowance of barley and hegari was 5.36 pounds and 2.64 pounds of cottonseed meal fed to lots 6 and 7. In lot 5, where the least trouble with bloating occurred of the three affected lots, a maximum of 6.67 pounds of barley was fed with 1.33 pounds of meal.

The consistent and pronounced sub-average reaction of the cattle to the various rations fed in this trial is in accordance with the natural behavior of young cattle whose growth has been seriously impaired.

The substitution of different portions of the barley allowance in the hay-silage rations fed in lots 1 to 4, inclusive, produced the same results as were obtained in the calf-fattening tests. The replacement of one-

TABLE X.—A SUMMARY OF THE RESULTS OF FATTENING YEARLING CATTLE WHOSE GROWTH HAD BEEN RETARDED.

(One trial October 23, 1928, to April 21, 1929—Per head basis, 180 days.)

| Lot | I Heifers | II Heifers | III Heifers | IV Heifers | V Steers | VI Steers | VII Steers | VIII Steers |
|-------------------------------------|-----------|------------|-------------|------------|----------|-----------|------------|-------------|
| Animals used..... | 9 | 9 | 10 | 10 | 9 | 10 | 10 | 10 |
| Average initial weight..... | 443 | 456 | 455 | 454 | 468 | 471 | 472 | 465 |
| Average final weight..... | 751 | 760 | 783 | 787 | 797 | 808 | 791 | 778 |
| Total gain..... | 308 | 304 | 328 | 333 | 329 | 337 | 319 | 313 |
| Average daily gain..... | 1.71 | 1.69 | 1.82 | 1.85 | 1.83 | 1.87 | 1.78 | 1.74 |
| <i>Average daily ration:</i> | | | | | | | | |
| Rolled barley..... | 6.09 | 5.05 | 4.01 | 3.03 | 5.01 | 4.05 | ..... | 1.80* |
| Cracked hegari..... | ..... | ..... | ..... | ..... | ..... | ..... | 3.96 | ..... |
| Cottonseed meal..... | ..... | 1.01 | 2.00 | 3.03 | 1.01 | 2.03 | 1.98 | 3.49 |
| Alfalfa hay..... | 6.27 | 6.69 | 6.80 | 7.01 | 11.86 | 11.01 | 10.53 | 7.19 |
| Hegari silage..... | 15.89 | 15.51 | 16.29 | 17.15 | 4.04† | 4.44† | 4.66† | 17.35 |
| <i>Feed required per cwt. gain:</i> | | | | | | | | |
| Rolled barley..... | 357 | 299 | 220 | 164 | 273 | 217 | ..... | 103 |
| Cracked hegari..... | ..... | ..... | ..... | ..... | ..... | ..... | 223 | ..... |
| Cottonseed meal..... | ..... | 60 | 109 | 154 | 55 | 109 | 112 | 200 |
| Alfalfa hay..... | 367 | 397 | 373 | 379 | 647 | 590 | 593 | 412 |
| Hegari silage..... | 931 | 979 | 893 | 923 | 220 | 238 | 262 | 994 |
| Total feed required..... | 1655 | 1735 | 1595 | 1635 | 1195 | 1154 | 1190 | 1709 |
| Cost per cwt. gain..... | \$14.53 | \$14.93 | \$13.61 | \$13.65 | \$13.78 | \$13.10 | \$14.28 | \$13.66 |

TABLE X.—FINANCIAL STATEMENT.

| Lot | I | II | III | IV | V | VI | VII | VIII |
|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Cost per cwt. start experiment | \$12.30 | \$12.30 | \$12.30 | \$12.30 | \$12.30 | \$12.30 | \$12.30 | \$12.30 |
| Initial cost per head..... | 54.49 | 56.09 | 55.97 | 55.84 | 57.56 | 57.93 | 58.06 | 57.20 |
| Feed cost per head..... | 44.75 | 45.39 | 44.64 | 45.45 | 45.34 | 44.15 | 45.55 | 47.76 |
| Interest | 2.18 | 2.24 | 2.24 | 2.23 | 2.30 | 2.32 | 2.32 | 2.29 |
| Marketing cost. | .60 | .60 | .60 | .60 | .60 | .60 | .60 | .60 |
| Total cost..... | 102.02 | 104.32 | 103.45 | 104.12 | 105.80 | 105.00 | 106.53 | 102.85 |
| Selling price..... | 12.60 | 12.60 | 12.50 | 12.60 | 12.60 | 12.60 | 12.60 | 12.60 |
| Returns per head..... | 90.72 | 90.34 | 90.97 | 93.87 | 99.67 | 97.65 | 98.03 | 94.25 |
| Loss per head. | 11.30 | 13.98 | 12.48 | 10.25 | 6.13 | 7.35 | 8.50 | 8.60 |
| Necessary margin..... | 1.87 | 2.25 | 2.03 | 1.68 | 1.08 | 1.25 | 1.39 | 1.45 |

Feed cost per ton: Rolled barley, \$40; cracked hegari, \$48; cottonseed meal, \$35; alfalfa hay, \$20; hegari silage, \$8.

*Fed last 90 days.

†Fed first 12 and last 61 days.

third to one-half of the barley gave a greater net return than the straight barley or five parts barley and one part meal mixture. A comparison of the barley-cottonseed meal mixtures of 5-1 (lot 5) and 4-2 (lot 6) fed with alfalfa hay revealed a slight advantage of the latter mixture. In the calf-feeding trials the 5-1 mixture gave more favorable results.

Rolled barley was slightly superior to cracked hegari though no difference was shown in their comparative feeding value in the calf-feeding tests.

The ration of alfalfa hay, hegari silage, and cottonseed meal supplemented with rolled barley during the latter half of the feeding period which was productive of the most economical gains in the calf-feeding trials was slightly excelled by the alfalfa hay, barley, and cottonseed meal ration fed to lot 6. This can be attributed to the inability of the cattle to consume more of the bulkier ration.

SUMMARY

High-grade range calves weighing 375 to 450 pounds can be fed to gain at least 2 pounds per head daily at a feed cost of about \$9 per 100 pounds of gain. They can acquire a satisfactory market finish in 150 to 180 days and return a profit on a margin of \$1.50 to \$2 per 100 pounds, f. o. b. shipping point.

Rolled barley and cottonseed meal were fed in proportions of 5-1, 4-2, 3-3, totaling an average of 5.8 pounds per head daily with and without hegari silage. Alfalfa hay was fed to all lots. In rations with silage, substitution up to one-half the barley allowance with cottonseed meal was made without materially influencing the rate and efficiency of gains and at a saving of 5.75 percent in the feed cost per 100 pounds gain. In rations without silage the barley-cottonseed meal ratio of 5-1 proved superior to the ratio of 4-2. This ration of alfalfa hay, rolled barley, and cottonseed meal (5-1) was productive of the most rapid gains of all rations in the study and was exceeded only slightly in economy of gains by lot 8.

No difference in the relative feeding value of cracked hegari and rolled barley was revealed in the two trials comparing these feeds.

A ration of alfalfa hay, hegari silage, and cottonseed meal supplemented with a limited allowance of barley during the latter half of the feeding period was productive of the most economical returns.

Results obtained in the first trial of this series of tests substantiate the findings of a preceding trial, to-wit:

- a. The steer calves made slightly greater and more economical gains than the heifer calves, the latter acquiring a quicker finish.
- b. Feeding steer and heifer calves together did not prove objectionable.

The addition of a simple mineral mixture to a ration of alfalfa hay, rolled barley, and cottonseed meal did not prove profitable nor were any beneficial results apparent. (One trial.)

In a comparison of the results made by two lots of heifer calves in the 1926-27 test fed a barley-cottonseed meal mixture (5-1) and alfalfa hay, the addition of silage to the ration did not affect the rate of gain.

Observation made in the 1926-27 and 1927-28 trials indicate that the class of cattle fed in these tests will consume a high proportional allowance of cottonseed meal with no disturbing effects when fed with silage, alfalfa hay, and rolled barley. The average ratio of cottonseed meal to barley for the entire feeding period was 4 to 1, while during the last 65 days of the tests the barley was omitted from the ration and the calves were fed a maximum allowance of 9 pounds of cottonseed meal per head daily.

The yearling cattle which had previously undergone a serious setback in their growth, fed in the 1928-29 test, consumed 10 percent more roughage, made a 13-percent smaller daily rate of gain, and required 23 percent more feed to produce 100 pounds of gain than the average of the results of three calf-feeding trials.

Young cattle fed a ration of alfalfa hay, rolled barley or cracked hegari, and cottonseed meal are liable to attacks of chronic bloating. More trouble with bloating occurred among the calves fed the 4-2 grain and meal mixture than those receiving the 5-1 mixture.

APPENDIX

Following are the chemical analyses of feeds used in three of the four feeding tests. The analyses for the fourth period (1929-30) were not made.

ANALYSES OF FEEDS USED IN TRIALS—AIR-DRY BASIS—1926-27
TRIAL BY H. V. SMITH, ASSISTANT AGRICULTURAL CHEMIST.
(Percentage basis)

| Feed | Moisture | Ash | Protein | Fat | Fiber | Carbohy- drates N F. E. |
|--------------------|----------|------|---------|------|-------|-------------------------------|
| Rolled barley | 7.10 | 2.76 | 12.56 | 2.64 | 6.46 | 68.48 |
| Cottonseed meal | 5.53 | 6.84 | 45.50 | 6.78 | 2.09 | 33.26 |
| Hegari | 11.00 | 1.34 | 4.87 | 1.85 | 1.44 | 79.50 |
| Hegari silage | 6.25 | 7.54 | 6.75 | 2.00 | 16.49 | 60.97 |
| Corn silage | 7.00 | 6.48 | 6.87 | 2.17 | 21.87 | 55.61 |
| Alfalfa hay | 6.93 | 8.99 | 16.06 | 2.22 | 25.86 | 39.94 |

ANALYSES OF FEEDS USED IN TRIALS—AIR-DRY BASIS—1927-28, BY
H. V. SMITH, ASSISTANT AGRICULTURAL CHEMIST

(Percentage basis.)

| | Moisture | Ash | Protein | C. Fat | C. Fiber | N. F. E. |
|-----------------|----------|------|---------|--------|----------|----------|
| Alfalfa hay | 4.29 | 8.04 | 13.14 | 1.38 | 34.32 | 38.83 |
| Cottonseed meal | 4.65 | 6.54 | 41.40 | 6.98 | 11.46 | 28.97 |
| Cracked Hegari | 7.59 | 1.99 | 8.74 | 3.20 | 1.46 | 77.02 |
| Rolled barley | 6.38 | 2.93 | 10.38 | 2.86 | 3.94 | 73.51 |
| Hegari silage | 8.89 | 7.58 | 5.37 | 2.40 | 27.14 | 48.62 |

ANALYSES OF FEEDS USED IN TRIALS—AIR-DRY BASIS—1928-29, BY
M. R. ISAACSON, ASSISTANT AGRICULTURAL CHEMIST.

(Percentage basis.)

| | Moisture | Ash | Protein | Fat | C. Fiber | N. F. E. |
|-----------------|----------|------|---------|-------|----------|----------|
| Rolled barley | 9.03 | 2.64 | 11.00 | 12.32 | 5.29 | 57.92 |
| Cracked hegari | 10.22 | 1.61 | 9.81 | 13.20 | 2.26 | 62.90 |
| Cottonseed meal | 6.61 | 4.46 | 41.62 | 10.57 | 9.03 | 21.21 |
| Alfalfa hay | 8.36 | 7.17 | 13.00 | 8.53 | 21.76 | 41.18 |