UNIVERSITY OF IDAHO
College of Agriculture

Formulation of

Idaho Steer
Fattening Rations

T. B. KEITH
W. P. LEHRER, JR.
R. F. JOHNSON

**IDAHO Agricultural
Experiment Station**

**Bulletin No. 296
February 1959**

Conclusions

1. There is an increase in the rate of gain and a decrease in the feed required for each unit of gain when the ratio of concentrate to roughage is increased to 2 : 1 from a ratio of 1 : 2.

2. There is a slight increase in the rate of gain and a decrease in feed requirements when the ratio of concentrate to roughage is increased from 2 : 1 to a 4 : 1. This increase in rate of gain is not economical under all conditions.

3. The inclusion of a protein concentrate in a concentrate mixture of barley, oats and dried molasses beet pulp did not improve the ration when alfalfa hay was used as the roughage.

4. The inclusion of a 10 percent soybean oil meal mixture in a concentrate mixture of barley, oats and dried molasses beet pulp increased the rate and economy of gains of steer calves when the roughage mixture included 50 percent or more of the dry matter as corn silage.

5. A ration containing a roughage of two-thirds of the dry matter as corn silage made more efficient gains than a ration containing a roughage mixture with 50 percent of the dry matter as corn silage.

How To Use a Nomograph

The scale on the extreme right of the nomograph presents a range in the prices per ton of roughage. The scale on the extreme left presents a range in the prices per 100 lb. of a concentrate mixture.

The intermediate scales present the average feed costs of 100 lb. gain. These values do not include other items of costs, such as labor, insurance, interest, taxes, etc.

A straight line drawn from any point on the left scale to any point on the right scale will give the reader the cost of 100 lb. gain for steers fed any ration combination.

Formulation of
Idaho Steer Fattening Rations

T. B. KEITH,[1] W. P. LEHRER, JR.,[2] *and* R. F. JOHNSON[3]

WHAT will be the most economical and efficient level of alfalfa hay, alfalfa hay-corn silage mixture, concentrate mixture and protein supplement for a steer fattening ration?

Because the answer to this question, constantly asked by the Idaho steer feeder, will vary from month to month, year to year, and from section to section, it has been the program of extensive feeding experiments* at the University of Idaho, Caldwell Branch Station, Caldwell, Idaho.

Out of the studies reported in this publication, covering the period 1948 to 1957, have come a series of nomographs and histograms that will serve as a guide to the feeder in formulating his own ration.

Financial Evaluation

The financial evaluation of a feeding trial is of value to a feeder only when interpreted in the light of conditions existing at the time the feeder desires to use it. Conclusions based on feed costs prevailing at the time the experiment was conducted may be of little or no value to the average steer feeder, since feed prices vary in different steer feeding sections and from time to time. For these reasons, graphical charts were made to determine feed costs of combinations of rations for a wide range of feed prices.

Nomographs have been constructed for the purpose of estimating the comparative cost of average total feed required for each 100 lb. gain of fattening steers. Nomographs are presented on the comparative costs of gains of steers fed different ratios of concentrate to roughage, different allowances of soybean oil meal and two silage levels. The nomographs are shown in figures 1, 2, 3, 4, and 5.

Histograms are presented to demonstrate differences in rates of gains and feed required per 100 lb. gain.

1. Animal Husbandman
2. Associate Animal Husbandman
3. Superintendent of the University of Idaho, Caldwell Branch Experiment Station, Caldwell, Idaho. Deceased March 13, 1958
* Idaho Experiment Station: Bul. No. 290; Res. Bul. No. 26; Res. Bul. No. 32; Res. Bul. No. 40.
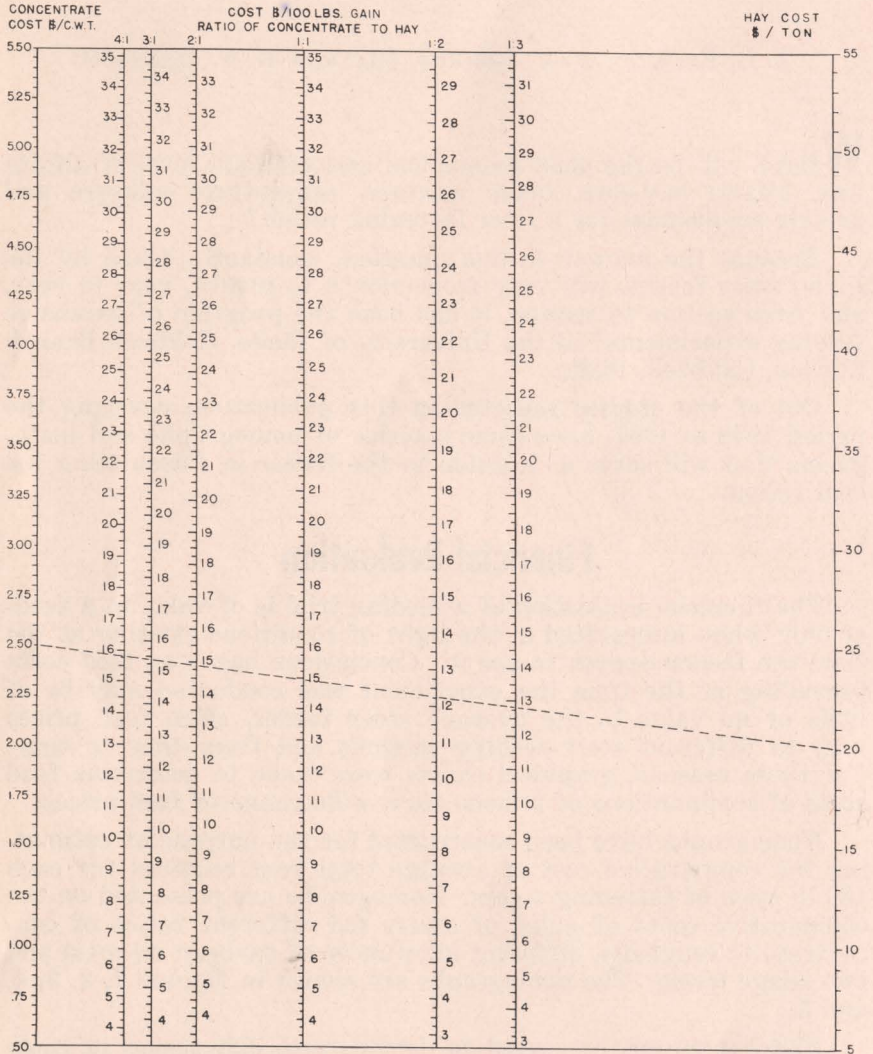
Figure 1.—A nomograph for rapid calculation of feed costs per 100 lb. gain of steer calves fed six different ratios of concentrate to alfalfa hay.

For Rapid Calculation of Feed Costs

FEED costs of 100 lb. gain with varying price relationships for steer calves fed six different ratios of concentrate to alfalfa hay are presented in Figure 1. For example, if the cost of the concentrate mixture is $2.50 per 100 lb. and the alfalfa hay is $20.00 per ton, place a straight edge on the extreme left scale at $2.50 and on the extreme right scale at $20.00, the costs of 100 lb. gain of steers fed each ratio of concentrate to alfalfa hay is approximately as follows: 4 : 1—$15.75; 3 : 1—$15.40; 2 : 1—$14.90; 1 : 1—$14.95; 1 : 2—$12.25 and 1 : 3—$12.80.
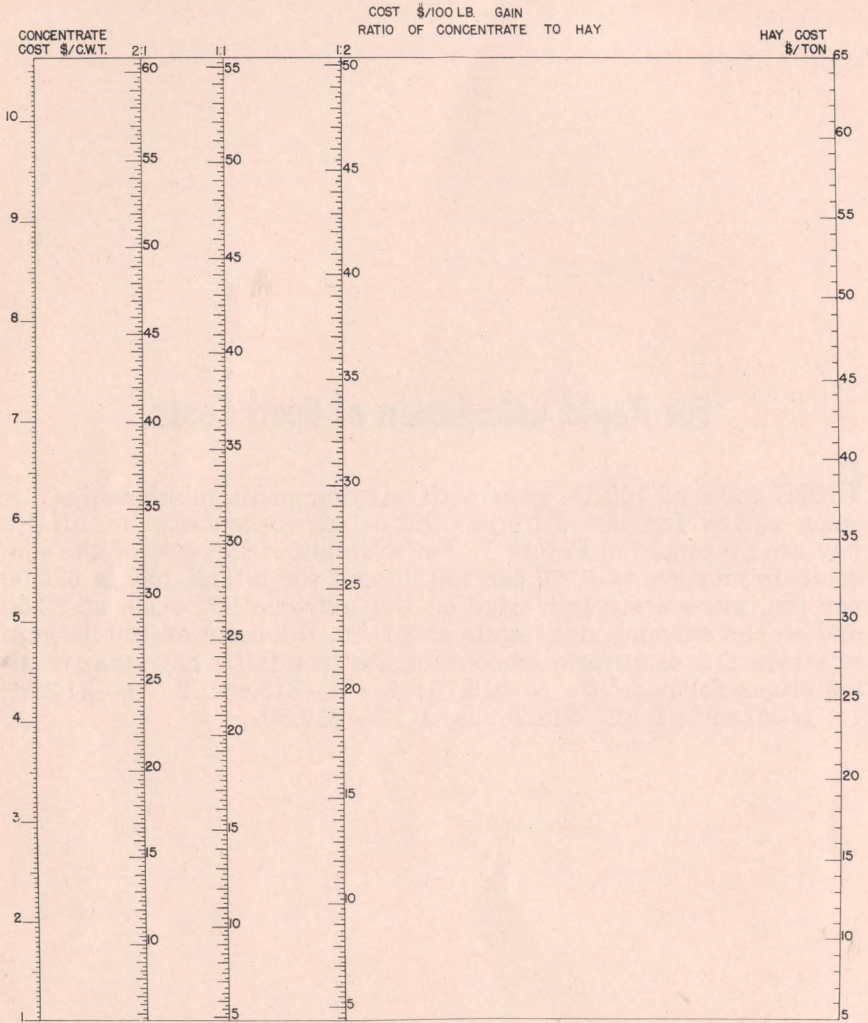
Figure 2.—A nomograph designed for rapid calculation of feed cost per 100 lb. gain of steer calves fed three different ratios of concentrate to alfalfa hay.

Concentrate-Alfalfa Hay Calculations

THE ratio of concentrate to roughage (on air dry basis) fed to fattening steers throughout most of the feeding areas of Idaho will seldom be higher than 2 : 1. Therefore, a nomograph was constructed with three ratios of concentrate to roughage where the roughage component was entirely alfalfa (Figure 2) to compare with three ratios of concentrate to roughage where the roughage component was a mixture of alfalfa hay and corn silage (Figure 3).

If the steer feeder desires to determine the most economical ratio of concentrate to roughage to feed, where the roughage is entirely alfalfa hay and costs $20.00 per ton, when the concentrate mixture costs $2.50 per 100 lb., he may place a straight edge on the left scale at $2.50 and the other end of the straight edge on the extreme right at $20.00, and determine the cost of 100 lb. gain. The feed costs per 100 lb. gain for the different ratios are as follows: 1 : 2—$12.50; 1 : 1—$13.75; 2 : 1—$14.00.

If the concentrate mixture is worth $3.00 per 100 lb. and alfalfa hay is worth $30.00 per ton, the feed costs for the different ratios are as follows: 1 : 2—$17.50; 1 : 1—$17.75; 2 : 1—$18.50.

COST $/100 LB. GAIN

CONCENTRATE COST $/C.W.T.   2:1   1:1   RATIO OF CONCENTRATE TO ROUGHAGE   1:2   ROUGHAGE MIXTURE COST $/TON
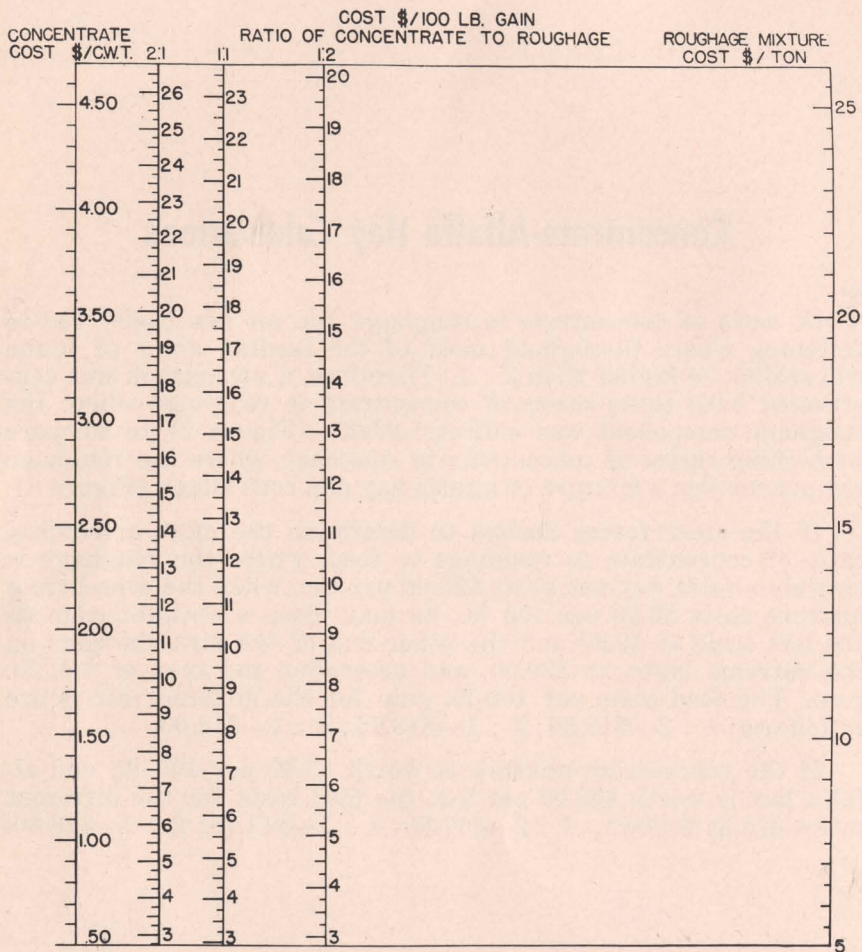
Figure 3.—A nomograph designed for rapid calculation of feed costs per 100 lb. gain of steer calves fed three different ratios of concentrate to roughage (corn silage and alfalfa hay air-dry basis.)

Concentrate-Roughage Calculations

FIGURE 3 presents a nomograph on the cost of 100 lb. gain of steers fed three ratios of concentrate to roughage where the roughage mixture was composed of an average 20 parts of alfalfa hay and 80 parts of corn silage.

If the steer feeder desires to determine the ratio of concentrate to roughage (corn silage and alfalfa hay) to feed, when the concentrate mixture costs $2.50 per 100 lb. and the roughage costs $18.00 per ton, the feed costs per 100 lb. gain of the steers fed the different ratios, are as follows 1 : 2—$12.00; 1 : 1—$13.50; 2 : 1—$14.50.

If the concentrate mixture is worth $3.00 per 100 lb. and the roughage is worth $25.00 per ton, the feed costs for the steers fed the different ratios are as follows: 1: 2—$15.25; 1 : 1—$16.75; 2 : 1—$18.00.

The greatest change in rate of gain occurred within the groups of steers fed the ratio of concentrate to roughage of 2 : 1, 1 : 1 and 1 : 2. There is a lesser change in the performance of feeder steers when the ratios of concentrate to roughage range from 2 : 1 and 3 : 1, 3 : 1 and 4 : 1 and 1 : 2 and 1 : 3. This is due to the fact that the greater percentage change of concentrate in the total composition of the ration takes place between the ratios of concentrate to roughage of 2 : 1, 1 : 1 and 1 : 2 than between the other ratios. A change from a ration containing a concentrate to roughage ratio of 1 : 1 to a ration containing a ratio of 2 : 1 causes a 33.3 percent increase in the concentrate mixture.

A change in the ratio of concentrate to roughage of 2 : 1 to 3 : 1 causes a change of only 12.6 percent increase in the concentrate mixture. A change in the ratio of concentrate to roughage of 2 : 1 to 1 : 2 accounts for a double allowance of roughage and a 50 percent reduction in the concentrate. Small changes in the concentrate intake will account for small differences in the performance of fattening steers. Therefore, it would be logical to expect a greater difference in the performance of those steers fed the ratios of concentrate to roughage of 1 : 2, 1 : 1 and 2 : 1 than those steers fed the ratios of concentrate to roughage of 2 : 1, 3 : 1, and 4 : 1.
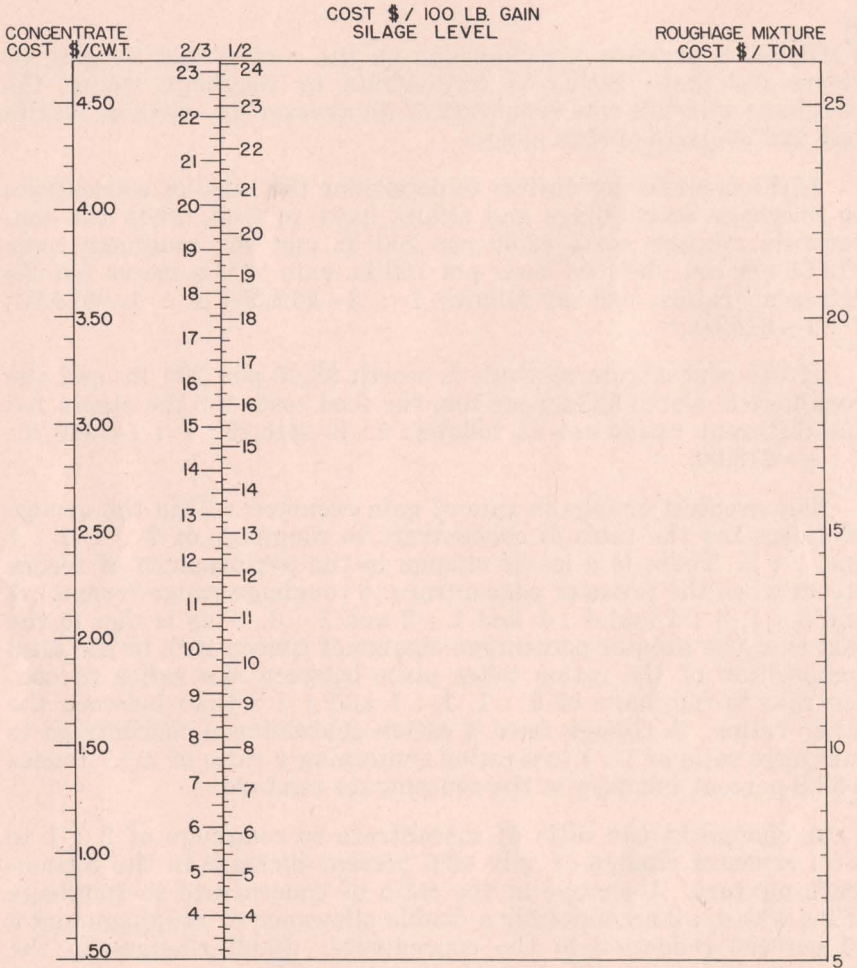
COST $ / 100 LB. GAIN
SILAGE LEVEL

CONCENTRATE
COST $/C.W.T.   2/3 1/2

ROUGHAGE MIXTURE
COST $ / TON

```
                      23┬ ┬24
  ─ 4.50           22 ┤  ├ 23                                        ┤25
                      21 ┤  ├ 22
                         ┤  ├ 21
  ─ 4.00           20 ┤  ├
                      19 ┤  ├ 20
                         ┤  ├ 19
                      18 ┤  ├
  ─ 3.50           17 ┤  ├ 18                                        ┤20
                         ┤  ├ 17
                      16 ┤  ├
                         ┤  ├ 16
  ─ 3.00           15 ┤  ├ 15
                      14 ┤  ├
                         ┤  ├ 14
                      13 ┤  ├
  ─ 2.50           12 ┤  ├ 13                                        ┤15
                         ┤  ├ 12
                      11 ┤  ├ 11
  ─ 2.00           10 ┤  ├
                         ┤  ├ 10
                       9 ┤  ├ 9
  ─ 1.50            8 ┤  ├ 8                                         ┤10
                       7 ┤  ├ 7
                       6 ┤  ├ 6
  ─ 1.00            5 ┤  ├ 5
                       4 ┤  ┴ 4
  ─ .50                                                               5
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Figure 4.—A nomograph designed to compare the feed costs per 100 lb. gain of steer calves fed two levels (⅔ and ½ refer to corn silage level on air-dry basis) of corn silage in a corn silage-alfalfa hay roughage mixture.

Level of Corn Silage Calculations

T HE nomograph in Figure 4 compares the cost of 100 lb. gain of two groups of steer calves fed two levels of corn silage. One group received two-thirds of the dry matter of the roughage as corn silage. This gives a roughage combination of approximately 15 percent alfalfa hay and 85 percent corn silage as taken from the silo. The second group received one-half of the dry matter of the roughage as corn silage. The roughage mixture fed to the second group had approximately 25 percent alfalfa hay and 75 percent corn silage as taken from the silo. The corn silage moisture content averaged about 66 percent. Sixty-six was the factor used as the moisture of the silage and to convert the corn silage to the dry matter basis as indicated in Figure 4.

A steer feeder may determine the most profitable level of corn silage to feed through the use of the nomograph in Figure 4.

For example, assume that alfalfa hay is priced at $24.00 per ton and corn silage at $8.00 per ton, the total cost of a ton of roughage with 25 percent alfalfa hay and 75 percent corn silage (equivalent to one-half alfalfa hay and one-half corn silage-air-dry basis) would be (.25 x $24.00 = $6.00) + (.75 x $8.00 = $6.00) = $12.00. The cost of a ton of roughage with 15 percent alfalfa hay and 85 percent corn silage (equivalent to one-third alfalfa hay and two-thirds corn silage-air-dry basis) would be (.15 x $24.00 = $3.60) + (.85 x $8.00 = $6.80) = $10.40. Place a straight edge on the nomograph in Figure 4 at $3.00 on the concentrate mixture cost per 100 lb. (assuming that this is the cost of the concentrate mixture) and $12.00 on the roughage cost per ton, the cost of 100 lb. gain of those steers fed the roughage with one-half of the dry matter as corn silage is $14.40.

In a second example, assume that alfalfa hay is priced at $15.00 per ton and silage at $8.00 per ton. The cost of a ton of roughage with 25 percent alfalfa and 75 percent corn silage (equivalent to one-half alfalfa hay and one-half corn silage-air-dry basis) would be (.25 x $15.00 = $3.75) + (.75 x $8.00 = $6.00) = $9.75. The cost of a ton of roughage with 15 percent alfalfa hay and 85 percent corn silage (equivalent to one-third alfalfa hay and two-thirds corn silage-air-dry basis) would be (.15 x $15.00 = $2.25) + (.85 x $8.00 = $6.80) = $9.05. Place a straight edge on the nomograph in Figure 4 at $3.00 on the concentrate mixture cost per 100 lb. and $9.75 on the roughage cost per ton, the cost of 100 lb. gain of those steers fed the roughage with one-half of the dry matter as corn silage is $14.00. The cost of 100 lb. gain of those steers fed the roughage with two-thirds of the dry matter as corn silage is $13.60.

COST $ / 100 LB. GAIN
S.B.O.M. LEVEL

CONCENTRATE
COST $/C.W.T.   0   10   ROUGHAGE MIXTURE
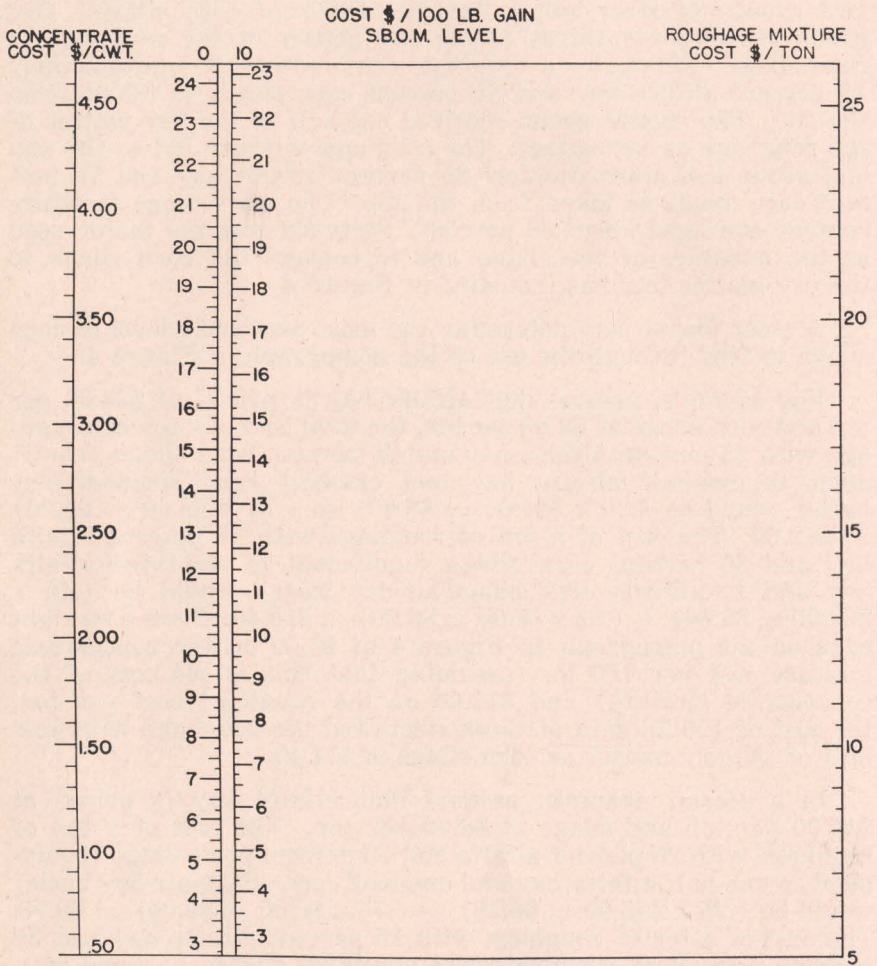   COST $/ TON

Figure 5.—A nomograph designed for rapid calculation of feed costs per 100 lb. gain of steer calves fed two levels of soybean oil meal with a corn silage-alfalfa hay roughage.

Calculation of Protein Needs as Determined By Soybean Oil Meal Level

A NOMOGRAPH is presented in Figure 5 to give the comparative costs of 100 lb. gain of steers fed two levels of soybean oil meal. Four levels of protein were studied by feeding four different percentages of soybean oil meal in the concentrate mixture. The percentages of soybean oil meal studied were 0, 10, 20 and 30. Since the 20 and 30 percentages of soybean oil meal gave the same returns as the 10 percent, they were not included in the nomograph of Figure 5. The comparative values of all four percentages are included in the histograms of Figures 6, 7, 8 and 9.

The histograms shown in Figures 6 and 8 indicate that no soybean oil meal is required by fattening steer calves when alfalfa hay is used as the sole roughage with either a concentrate-to-alfalfa hay ratio of 2 : 1 or 1 : 2. These differences are too small to be significant.

A roughage mixture of approximately 50 to 66 percent corn silage (air-dry basis, Figure 8) required a concentrate containing 10 percent soybean oil meal to meet the protein needs of fattening steer calves. The feeding of a 20 or 30 percent soybean oil meal in the concentrate mixture did not increase gains or feed efficiency over 10 percent soybean oil meal in the concentrate mixture. The inclusion of 10 percent soybean oil meal reduced the cost of 100 lb. gain from 25 cents to one dollar. If the roughage mixture is proportionally cheaper than the concentrate mixture (roughage mixture $15.00 per ton as compared to $3.00 per 100 lb. for concentrate mixture) the cost of 100 lb. of gain of those steers fed soybean oil meal will average $1.00 less than the steers fed the concentrate mixture without soybean oil meal.
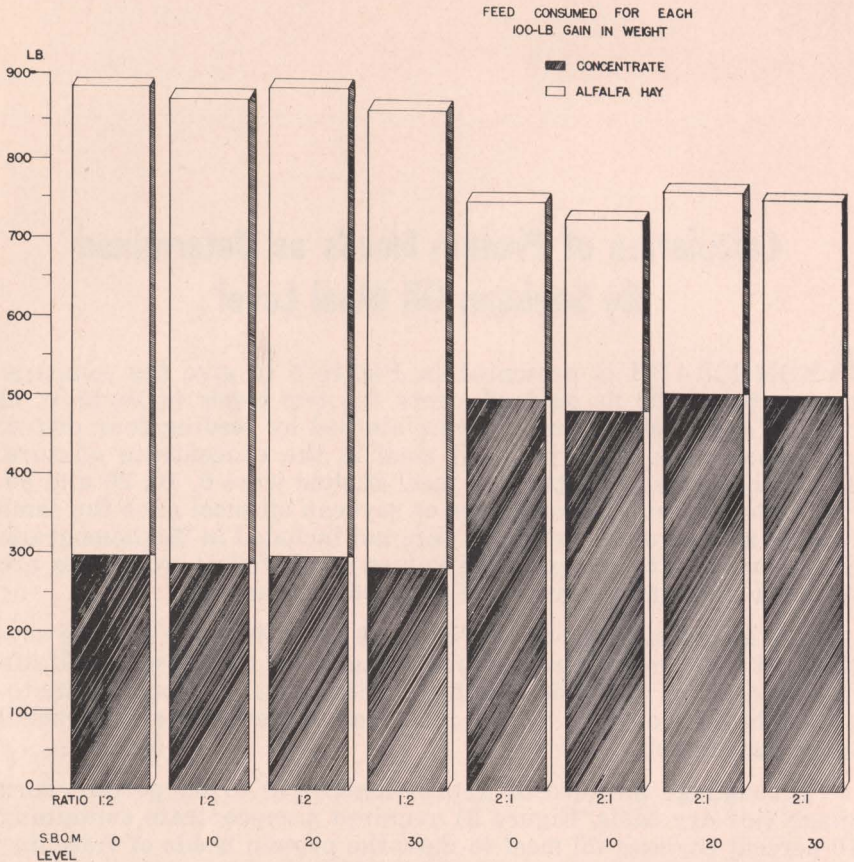
Figure 6.—Histograms designed to show the feed required for 100 lb. gain of steer calves each fed a soybean oil meal level with each ratio of concentrate to roughage of 1 : 2 and 2 : 1 when alfalfa hay was used for the roughage.

Soybean Oil Meal

THE total feed required for 100 lb. gain of the steers fed two ratios of concentrate to alfalfa hay and four levels of soybean oil meal is shown in Figure 6. The inclusion of 10, 20 or 30 percent soybean oil meal in a concentrate mixture of barley, oats and dried molasses beet pulp did not increase the efficiency of gains when alfalfa hay was used as the roughage.

Those steers fed the concentrate to alfalfa hay ratio of 2 : 1 required less total feed than those fed the ratio of concentrate to alfalfa hay 1 : 2.

Those steers fed the ratio of concentrate to alfalfa hay of 2 : 1 received a ration higher in total digestible nutrients than those fed the ratio of concentrate to alfalfa hay of 1 : 2.
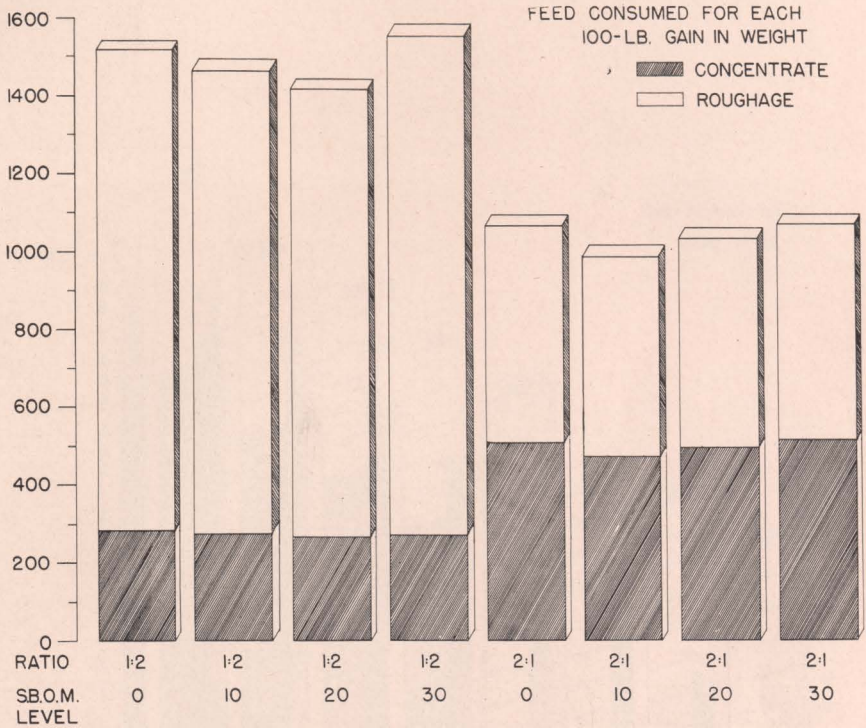
Figure 7.—Histograms designed to show the feed required for 100 lb. gain of steer calves fed each soybean oil meal level with ratios of concentrate to roughage of 1 : 2 and 2 : 1 when a corn silage-alfalfa hay mixture was used as the roughage.

Soybean Oil Meal-Corn Silage-Alfalfa

THE total feed required for each 100 lb. gain of the steers fed two ratios of concentrate to roughage and four levels of soybean oil meal is shown in Figure 7. The histograms show a lower total feed requirement for those steers receiving the 10 percent soybean oil meal concentrate mixture than those steers receiving no soybean oil meal in both ratios of concentrate to roughage. Those steers fed the 20 percent soybean oil meal concentrate mixture also required less total feed but this requirement was not great enough to be different than those fed the 10 percent soybean oil meal mixture.

Those steers fed the 10 percent soybean oil meal concentrate mixture required less total feed for 100 lb. gain in both levels of roughage intake than those fed the 0 and 30 percent soybean oil meal mixtures. Feed requirements of the steers fed the 20 percent soybean oil meal mixtures were not significantly different than the steers fed the 10 percent mixture for either level of roughage.
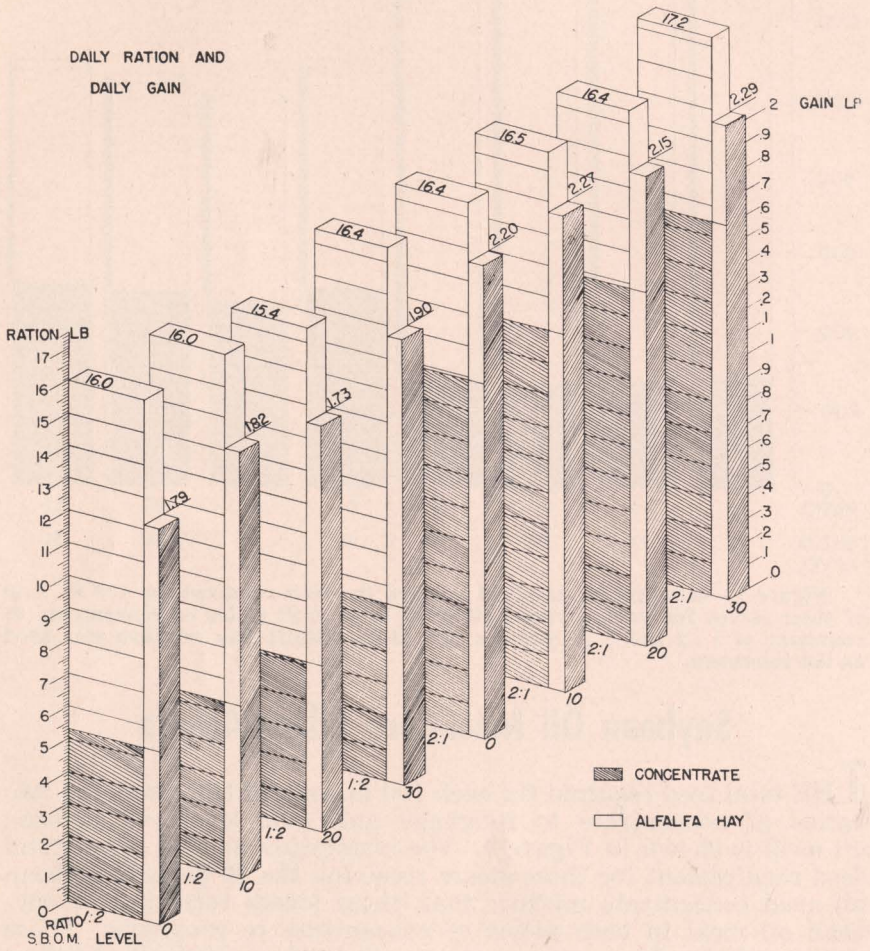
Figure 8.—Histograms designed to show the average daily ration and the average daily gain of steer calves fed each soybean oil meal level with ratios of concentrate to alfalfa of 1 : 2 and 2 : 1.

Alfalfa Hay Consumption

Table 1. Feed consumption of steers fed two ratios of concentrate to alfalfa hay, two soybean oil levels and four levels of soybean oil meal (1955-1956).

Ratio C : R	Oil level	SBOM* level	Concentrate mixture	Alfalfa hay
	percent	percent	lb.	lb.
1 : 2	0	0	5.2	10.5
2 : 1	0	0	10.8	5.4
1 : 2	2	0	5.4	10.8
2 : 1	2	0	11.0	5.5
1 : 2	0	10	5.3	10.6
2 : 1	0	10	11.2	5.6
1 : 2	2	10	4.9	9.8
2 : 1	2	10	10.8	5.4
1 : 2	0	20	5.1	10.2
2 : 1	0	20	10.8	5.4
1 : 2	2	20	5.2	10.4
2 : 1	2	20	11.0	5.5
1 : 2	0	30	5.4	10.8
2 : 1	0	30	11.4	5.7
1 : 2	2	30	5.5	11.0
2 : 1	2	30	11.4	5.7

*Soybean oil meal

THE average daily consumption of the concentrate mixture and the alfalfa hay of the steers fed the two ratios of concentrate to alfalfa hay, two levels of soybean oil and four levels of soybean oil meal is shown in Table 1. The comparative average total feed consumption, the average quantities of the concentrate mixture and alfalfa hay consumed are shown in the histograms of Figure 8.

Those steers fed the ratio of 2 parts concentrate to 1 part alfalfa hay had a consistently higher average daily gain when compared to those steers fed the ratio of 1 : 2 of concentrate to alfalfa hay. No other real differences in the performances of the steers fed each ration combination were indicated.
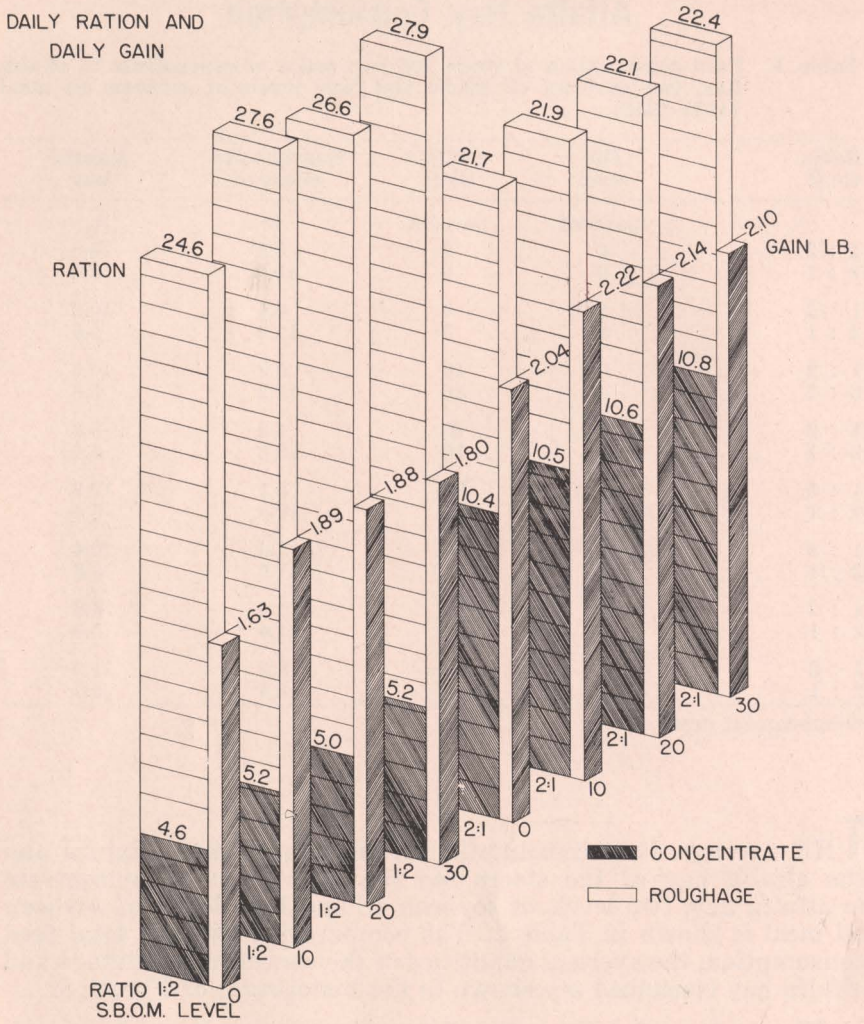
Figure 9.—Histograms designed to show the average daily ration and the average daily gain of steer calves fed each soybean oil meal level with ratios of concentrate to roughage of 1 : 2 and 2 : 1 when corn silage and alfalfa hay constituted the roughage.

Corn Silage-Alfalfa Hay Consumption

T HE average daily consumption of the concentrate mixture, alfalfa hay and corn silage of the steers fed the two ratios of concentrate to roughage, four levels of soybean oil meal and two levels of corn silage is shown in Table 2. The comparative total feed consumption, the quantities of the concentrate mixture and roughage consumed are shown in Figure 9. The roughage intake is given in total quantities instead of the air dry basis. This explains the difference in the ratio of concentrate to roughage shown in the graph as compared to the indicated ratio.

Table 2.—Feed consumption of steers fed two ratios of concentrate to roughage, four levels of soybean oil meal, and two levels of corn silage (1956-57).

Ratio C : R	Silage* level	SBOM**	Concentrate mixture	Alfalfa hay	Corn silage
		percent	lb.	lb.	lb.
1 : 2	½	0	4.7	4.7	14.2
2 : 1	½	0	9.9	2.5	7.4
1 : 2	⅔	0	4.5	3.0	18.1
2 : 1	⅔	0	10.9	1.8	10.9
1 : 2	½	10	5.0	5.0	14.9
2 : 1	½	10	10.0	2.5	7.5
1 : 2	⅔	10	5.4	3.6	21.4
2 : 1	⅔	10	11.0	1.8	11.0
1 : 2	½	20	5.1	5.1	15.4
2 : 1	½	20	10.9	2.7	8.2
1 : 2	⅔	20	4.8	3.2	19.4
2 : 1	⅔	20	10.4	1.7	10.4
1 : 2	½	30	5.3	5.3	16.0
2 : 1	½	30	10.5	2.6	7.9
1 : 2	⅔	30	5.1	3.4	20.5
2 : 1	⅔	30	11.0	1.8	11.0

* ½ and ⅔ refer to corn silage roughage on an air-dry basis.
** Soybean oil meal.

Other University of Idaho
Publications on Steer Feeding

The Optimum Ratio of Concentrate to Alfalfa Hay for Fattening Steers. Experiment Station Bulletin No. 290.

A System of Wintering, Pasturing and Finishing Beef Calves for Idaho. Experiment Station Bulletin No. 292.

Sun-dried Potatoes for Fattening Steers. Experiment Station Bulletin No. 201.

Potato Silage for Beef Steers. Experiment Station Bulletin No. 293.

Optimum Ratio of Concentrate to Alfalfa Hay for Steers as Affected by Protein Level and Method of Feeding. Research Bulletin No. 26.

Beef Cattle Feeding Experiments With Urea. Experiment Station Bulletin No. 225.

Optimum Ratio of Concentrate and Roughage for Steers as Affected by Corn Silage and Protein Level. Research Bulletin No. 32.

Delayed Concentrate Feeding of Steers—As Affected by Time and Type of Roughage. Experiment Station Bulletin No. 291.

Two Ratios of Concentrate to Roughage, Four Protein Levels, Two Corn Silage Levels, and Two Oil Levels for Steers. Research Bulletin No. 40.