Table 50 (Continued)

Salt	1.6	1.0	2.0
Limestone	....	1.3	2.7
Feed cost per 100 lbs. gain,[3] $	30.28	30.39	29.54
Summary—Wintering and fattening—December 15, 1956, to August 24, 1957—252 days.			
Lot number	1	2	3
Av. total gain, lbs.	407.3	410.4	426.0
Av. daily gain, lbs.	1.62	1.63	1.69
Av. feed cost per 100 lbs. gain,[3] $	24.47	27.64	27.22
Percent shrink to market	2.0	1.6	1.5
Av. dressing percent (includes 2% cooler shrink)	58.9	59.0	58.7
Av. carcass grade, before ribbing[6]	11.7	11.5	11.6
Av. carcass grade, after ribbing[6]	12.9	12.6	12.9
Av. fat thickness at 12th rib, visual est.[7]	3.6	3.4	3.6
Av. uniformity of fat distribution[8]	3.4	3.3	3.1
Av. degree of marbling[9]	6.2	7.2	6.5
Av. size rib eye, visual estimate[10]	3.9	3.8	3.9
Av. size rib eye, sq. in.	9.67	9.54	9.44
Av. degree of firmness[11]	3.3	3.6	3.2

3. Based on following prices: Silage, $10 per ton; prairie hay, $20 per ton; sorghum grain, $2.60 per cwt.; soybean oil meal, $70 per ton; urea-molasses mixtures, $95 per ton; bonemeal and salt mixture, $80 per ton; salt, $15 per ton; limestone, $15 per ton.

6. Based on: top choice 15; av. choice 14; low choice 13; top good 12; av. good 11; low good 10.

7. Based on thick 2; moderate 3; modest 4; slightly thin 5.

8. Based on uniform 2; moderate 3; modest 4; slightly uneven 5.

9. Based on slightly abundant 4; moderate 5; modest 6; small amount 7; slight amount 8.

10. Based on large 2; moderately large 3; modestly large 4; slightly small 5.

11. Based on firm 2; moderately firm 3; modestly firm 4; slightly firm 5.

Self-Feeding Molasses Mixed with Urea, Phosphoric Acid and Water with or without Ethyl Alcohol to Beef Heifers. II. Meat Evaluation Study (Project 536).

D. Richardson, D. L. Mackintosh and R. A. Merkel

The details of management and feeding of animals involved in this test are given in part I of this report. Five wholesale rib cuts from each lot were obtained at the time of slaughter for cooking, palatability, mechanical separation and chemical tests. These tests were conducted to determine the effect of the protein supplement upon the meat produced.

Results and Observations

The average results of this test are presented in Tables 51 and 52. These data show that no differences were produced in the meat by the protein supplements used in this test.

Table 51

Results of Cooking, Palatability, and Mechanical Separation Tests with Rib Roasts from Beef Heifers (Project 536, 1957).

Treatment	Control: Soybean oil meal supplement	Urea, phos. acid, molasses supplement	Urea, phos. acid, molasses, alcohol supplement
Lot number	1	2	3
Number of samples	5	5	5
Av. percent total loss	13.5	13.6	12.4
Av. percent volatile loss	10.1	10.2	10.2

Table 50 (Continued)

Av. percent drip loss	3.5	3.4	2.3
Av. cooking time, minutes per lb.	31.3	29.5	30.2
Av internal temp. from oven, degrees F.	140	138	139
Av. max. internal temp.	147	146	146
Av. palatability score[1]			
Aroma	5.9	5.8	5.8
Flavor:			
Lean	5.9	5.9	5.7
Fat	5.9	6.0	5.5
Tenderness	6.0	6.3	6.3
Juiciness	5.6	5.7	5.6
Av. shear value, lbs.	14.5	15.4	14.2
Av. press fluid, yield ml./25 gms.:			
Total	8.7	8.7	8.6
Serum	7.5	7.5	6.9
Fat	1.3	1.2	1.7
Mechanical analysis 9-11 rib (av. % of entire 9-11 rib cut):			
Av. percent eye muscle	18.42	17.84	17.64
Av. percent other lean	30.53	29.15	31.54
Av. percent fat	33.04	35.04	32.43
Av. percent bone	17.80	16.64	18.14

1. Range 1-7, higher figure = higher score.

Table 52
Chemical Analysis of Beef Samples (Project 536, 1957).

Grade	Degree marbling[1]	Shear value, lbs.	Other lean, % fat	Press fluid: Total volume, ml/25g	Press fluid: Fat volume, ml/25g	Press fluid: Total nitrogen, mg/ml	Rib eye: pH	Rib eye: Penetrometer scale[2]	Rib eye: Nitrogen %	Rib eye: Moisture %	Rib eye: Ash %	Rib eye: Fat %
Control:												
C	6	17.2	20.5	8.1	0	17.8	5.30	59	3.40	70.5	1.02	7.0
G−	9	11.6	11.8	9.1	0	15.0	5.41	62	3.40	74.8	1.04	2.2
Urea—Phosphoric Acid—Molasses Supplement												
G	8	18.4	14.6	8.2	0	17.6	5.38	57	3.41	72.3	1.05	5.3
C−	7	15.1	16.4	9.0	0	16.5	5.34	55	3.42	71.6	1.02	4.9
G+	8	13.6	14.0	8.2	0	16.5	5.36	57	3.51	72.2	1.04	3.7
G+	8	11.3	12.8	8.1	0	17.5	5.24	62	3.35	73.5	1.04	3.5
Urea—Phosphoric Acid—Molasses—Alcohol Supplement												
C	6	15.6	19.4	8.3	0	17.8	5.40	53	3.35	71.0	1.01	6.6
C−	7	15.0	17.8	10.8	0	16.1	5.29	57	3.33	72.6	1.03	5.2

1. The smaller the number the greater the degree of marbling.
2. Penetration of standard ASTM quarter scale cone into ground rib eye at 10°C. Average of 7 readings.

Self-Feeding Molasses Mixed with Urea, Phosphoric Acid and Water to Beef Heifers. Wintering Phase 1957-58 (Project 536).

D. Richardson, E. F. Smith, B. A. Koch, F. W. Boren and R. F. Cox

This is the second test to study the value of self-feeding a mixture of blackstrap molasses, urea, phosphoric acid and water as the protein supplement to beef cattle. The results of the wintering phase are given in this report.

Experimental Procedure

Thirty Hereford heifer calves from the same herd were divided as equally as possible on the basis of weight and conformation into three lots of 10 animals each. Animals in all lots received all of the sorghum silage they would clean up each day. The remainder of the ration was as follows:

Lot 7—Free-choice mixture, 77 percent blackstrap molasses, 3 percent phosphoric acid, 10 percent urea, and 10 percent water.

Lot 8—Free-choice mixture, 77 percent blackstrap molasses, 3 percent phosphoric acid, 10 percent urea, and 10 percent water plus .5 pound soybean oil meal, and 1.5 pounds sorghum grain.

Lot 9—Control, 1 pound soybean oil meal and 2 pounds sorghum grain.

Salt and a mixture of equal parts salt, steamed bonemeal, and limestone were fed free-choice to all lots. Water was supplied by electrically heated automatic fountains.

Results and Observations

Results of the wintering phase of this test are shown in Table 53. No toxic symptoms were observed from self-feeding the urea, phosphoric acid, water and molasses mixture. Satisfactory gains were obtained on the silage and molasses mixture; however, the rate of gain was increased by adding soybean oil meal and grain to the ration.

Table 53
Results of Self-Feeding a Mixture of Molasses, Urea, Phosphoric Acid and Water to Beef Heifer Calves. Wintering Phase.

December 12, 1957, to March 21, 1958—100 days.

Lot number	7	8	9
Number calves per lot	10	10	10
Av. initial wt., lbs.	441.5	441.5	441.0
Av. final wt., lbs.	560	590	585
Av. daily gain per calf, lbs.	1.18	1.48	1.44
Av. daily ration, lbs.:			
Sorghum silage	27.6	25.9	25.9
Sorghum grain	....	1.5	2.0
Soybean oil meal	....	0.5	1.0
Molasses mixture[1]	2.15	2.39	....
Salt	.07	.04	.09
Mineral mixture[2]	.09	.11	.12
Lbs. feed per cwt. gain:			
Sorghum silage	2333	1747	1799
Sorghum grain	....	101	138.9
Soybean oil meal	....	33.7	69.4
Molasses mixture[1]	181.4	160.7	....
Salt	5.6	2.4	6.1
Mineral mixture	7.8	5.7	8.7
Cost per cwt. gain, $[3]	15.71	15.88	11.71

1. Mixture contained 77 percent blackstrap molasses, 3 percent phosphoric acid, 10 percent urea, and 10 percent water.
2. Equal parts of limestone, steamed bonemeal, and salt.
3. Based on ingredient prices given on inside of back cover.

Self-Feeding Ammoniated Blackstrap Molasses with or without Ethyl Alcohol and Ammoniated Hydrol to Beef Heifers (Project 537).[1]

D. Richardson, Ed F. Smith, B. A. Koch and R. F. Cox

Previous work has shown that ammonia added to hydrol (corn molasses) can serve as a source of non-protein-nitrogen for ruminants (Kansas Agr. Exp. Sta. Cirs. 320, 335 and 349). The practice of self-feeding liquid supplements seems to be increasing in popularity. This test was conducted to study the value of self-feeding ammoniated blackstrap molasses and ammoniated hydrol as a source of protein equivalent in the wintering and fattening ration of beef heifers.

Experimental Procedure

Forty-four Hereford heifer calves from the same herd averaging about 435 pounds were divided as equally as possible on the basis of weight and conformation into four lots of 11 animals each. All lots received all of the sorghum silage that the animals would clean up during the wintering phase. The remainder of the ration was as follows:

Lot 1—Control, 1 pound soybean oil meal and 2 pounds sorghum grain.

Lot 2—Free choice mixture of ammoniated blackstrap molasses (15 percent protein equivalent).

Lot 3—Free choice mixture of ammoniated blackstrap molasses containing 3 percent ethyl alcohol (15 percent protein equivalent).

Lot 4—Free choice mixture of ammoniated hydrol (15 percent protein equivalent) plus 0.5 pound soybean oil meal.

Lot 1 had salt and a mixture of 2 parts steamed bone meal and 1 part salt fed free choice. The other lots had salt and a mixture of equal parts limestone and salt fed free choice. Electrically heated automatic water fountains provided drinking water at all times. The calves were started on test without any preliminary feeding of the molasses mixtures. Weights were obtained on individual animals each 28 days.

At the end of the wintering phase, grain was added to the ration in all lots. An average daily consumption of 22 to 23 pounds of grain was reached before the animals were on full feed. This was an unusually high consumption for this weight animal; however, consumption became normal after self-feeding of grain was started. It was necessary to change the roughage from silage to prairie hay after 34 days of the fattening phase. The source of protein remained the same throughout the test.

Results and Observations

The results of this test are shown in Table 54.

1. This project was in cooperation with Clinton Corn Processing Co., Clinton, Iowa.

Table 54

Results of Self-Feeding Ammoniated Blackstrap Molasses with or without Ethyl Alcohol, and Ammoniated Hydrol to Beef Heifers.

Wintering phase—December 15, 1956, to April 6, 1957—112 days.				
Lot number	1	2	3	4
Number heifers per lot	11	11	11	10[1]
Av. initial wt., lbs.	435.0	433.6	434.0	431.0
Av. final wt., lbs.	601.4	526.4	540.9	579.5
Av. daily gain per heifer, lbs.	1.49	.83	.95	1.33
Av. daily ration, lbs.:				
Sorghum silage	29.4	22.1	23.0	26.7
Soybean meal	1.0	....	....	0.5
Sorghum grain	2.0	....	....	....
Ammoniated blackstrap molasses No. 1[2]	....	5.2	....	....
Ammoniated blackstrap molasses No. 2[3]	....	....	5.6	....
Ammoniated hydrol[4]	....	....	....	3.2
Bonemeal and salt, equal parts	0.10	....	....	....
Salt	0.05	0.15	0.15	0.11
Limestone	....	0.05	0.04	0.02
Lbs. feed per cwt. gain:				
Sorghum silage	1978.0	2666.0	2408.0	2015.0
Soybean meal	67.3	....	....	37.7
Sorghum grain	134.6	....	....	....
Ammoniated blackstrap molasses No. 1	....	633.4	....	....
Ammoniated blackstrap molasses No. 2	....	....	617.5	....
Ammoniated hydrol	....	....	....	241.8
Bonemeal and salt, equal parts	7.0	....	....	....
Salt	3.4	17.5	15.7	8.2
Limestone	....	5.5	4.3	1.8
Av. feed cost per cwt. gain,[5] $	16.06	32.50	30.71	18.71
Fattening phase—April 6, 1957, to August 24, 1957—140 days.				
Lot number	1	2	3	4
Number heifers per lot	11	11	11	10
Av. initial wt., lbs.	601.4	526.4	540.9	579.5
Av. final wt., lbs.	842.3	774.5	796.4	847.0
Av. daily gain per heifer, lbs.	1.72	1.77	1.83	1.91
Av. daily ration, lbs.:				
Sorghum silage[6]	27.9	21.3	21.7	22.9
Prairie hay[7]	4.7	3.5	4.2	3.7
Sorghum grain	16.0	16.8	16.5	16.8
Soybean oil meal	1.0	....	....	.5
Ammoniated blackstrap molasses No. 1	....	1.8	....	....
Ammoniated blackstrap molasses No. 2	....	....	1.8	....
Ammoniated hydrol[4]	....	....	....	1.1
Bonemeal and salt, equal parts	0.03	....	....	....
Salt	0.02	0.08	0.10	0.03
Limestone	....	.05	.04	.02
Lbs. feed per cwt. gain:				
Sorghum silage	394	291	288	292
Prairie hay	206	149	134	147
Sorghum grain	930	949	902	882
Soybean oil meal	58	....	....	....
Ammoniated blackstrap molasses No. 1	....	102	....	....
Ammoniated blackstrap molasses No. 2	....	....	99	....
Ammoniated hydrol	....	....	....	55
Bonemeal and salt, equal parts	1.2	....	....	....
Salt	1.6	4.8	5.3	1.7
Limestone	....	2.9	2.0	1.1
Av. feed cost per cwt. gain,[5] $	30.28	30.74	29.25	28.44

1. One sick heifer removed.

2. Ammoniated blackstrap molasses (15 percent protein equivalent).

3. Ammoniated blackstrap molasses with 3 percent ethyl alcohol (15 percent protein equivalent).

4. Ammoniated hydrol (15 percent protein equivalent).

5. Based on following prices: Silage, $10 per ton; prairie hay, $20 per ton; sorghum grain, $2.60 per cwt.; soybean oil meal, $70 per ton; ammoniated molasses mixtures, $60 per ton; bonemeal and salt mixture, $80 per ton; salt, $15 per ton; limestone, $15 per ton.

6. Sorghum silage fed only first 34 days.

7. Prairie hay fed last 106 days.

Table 54 (Continued)

Summary—Wintering and fattening—December 15, 1956, to August 24, 1957—252 days.

Lot number	1	2	3	4
Av. total gain, lbs.	407.3	340.9	362.4	416.0
Av. daily gain, lbs.	1.62	1.35	1.44	1.65
Av. feed cost per cwt. gain, $	24.47	30.80	29.68	24.97
% shrink to market	2.0	1.7	1.7	1.5
Av. dressing % (includes 2% cooler shrink)	58.9	56.8	56.1	58.0
Av. carcass grade, before ribbing[8]	11.7	10.6	11.1	11.3
Av. carcass grade, after ribbing[8]	12.9	12.5	12.0	13.6
Av. fat thickness at 12th rib, visual estimate[9]	3.6	3.9	3.9	3.4
Av. uniformity of fat distribution[10]	3.4	4.0	4.2	3.4
Av. degree of marbling[11]	6.2	6.9	7.2	5.8
Av. size rib eye, visual estimate[12]	3.9	4.9	4.9	4.1
Av. size rib eye, sq. in.	9.67	8.93	8.81	9.45
Av. degree of firmness[13]	3.3	4.0	3.9	3.6

8. Based on top choice 15, av. choice 14, low choice 13, top good 12, av. good 11, low good 10.
9. Based on thick 2, moderate 3, modest 4, slightly thin 5.
10. Based on uniform 2, moderate 3, modest 4, slightly uneven 5.
11. Based on slightly abundant 4, moderate 5, modest 6, small amount 7, slight amount 8.
12. Based on large 2, moderately large 3, modestly large 4, slightly small 5.
13. Based on firm 2, moderately firm 3, modestly firm 4, slightly firm 5.

Wintering phase. The ammoniated blackstrap molasses mixtures were very palatable. In fact, the large amount consumed by animals in lots 2 and 3 tended to cause looseness or borderline scouring. Rate of gain was very poor for the first 28 days in these lots. It is believed that this was caused by the looseness plus a greater length of time than normal for microorganisms to adapt themselves to utilization of ammonia nitrogen. Satisfactory gains were made after the first 28 days; however, they were not so good as those in lots 1 and 4. The increased rate of gain in lot 4 over lots 2 and 3 illustrates the value of a small amount of natural protein concentrate in the ration when the principal source of protein equivalent is non-protein-nitrogen. A smaller molasses consumption may also have been a factor. A lower rate of gain and high molasses consumption caused lots 2 and 3 to have a high feed cost per cwt. gain. The results indicate that the ethyl alcohol may have been slightly beneficial.

Fattening phase. The high grain consumption at the beginning of the fattening phase was probably responsible for the founder of two animals in lot 1. One animal went off feed in lot 2; however, it recovered without any noticeable effect. There was a substantial drop in rate of molasses consumption after the animals were on a full feed of grain. In fact, the rate of consumption was probably less than 1 pound per head daily for the last 40 to 50 days of the test. Considering the size of animal and extremely hot weather, the rate of gain was satisfactory in all lots.

The rate and efficiency of gain was best in lot 4, which resulted in the lowest cost per cwt. gain. There were no practical differences in dressing percentage, carcass grade, amount of fat, degree of marbling, size of rib eye or degree of firmness between lots 1 and 4. Even though the rate of gain was similar in lots 2 and 3, they were thinner at the beginning of the fattening phase and consequently were not as well finished at the time of slaughter. As a result, the above values were not quite so good for lots 2 and 3 as for lots 1 and 4. Ethyl alcohol was apparently of no value in the fattening phase.

Summary. Ammonia nitrogen, self-fed as ammoniated molasses, can be used as the source of protein equivalent to ruminants when fed a non-legume roughage; however, results are vastly improved when a small amount of natural protein concentrate is added to the ration. These results indicate that ethyl alcohol is of very little, if any, value in the ration of ruminants.

Self-Feeding Ammoniated Blackstrap Molasses to Beef Heifers. Wintering Phase 1957-58 (Project 537).

D. Richardson, E. F. Smith, B. A. Koch, F. W. Boren and R. F. Cox

This is the second test to study the value of ammoniated blackstrap molasses in beef cattle rations. This report gives the results of the wintering phase.

Experimental Procedure

Forty Hereford heifer calves from one herd were divided as equally as possible on the basis of weight and conformation into four lots of 10 animals each. The animals received all of the sorghum silage they would clean up in all lots. The remainder of the ration was as follows:

Lot 9—Control, 1 pound soybean oil meal and 2 pounds sorghum grain.

Lot 10—Free-choice ammoniated blackstrap molasses (16 percent protein equivalent) and .5 pound soybean oil meal.

Lot 11—Free-choice ammoniated blackstrap molasses (16 percent protein equivalent), .5 pound soybean oil meal, and 1.5 pounds sorghum grain.

Lot 12—Free-choice ammoniated blackstrap molasses (16 percent protein equivalent) and 2 pounds sorghum grain.

Salt and a mineral mixture of equal parts limestone, steamed bonemeal, and salt were fed free-choice to all animals. Water was provided by electrically heated water fountains.

Results and Observations

The results of the wintering phase of this test are shown in Table 55. No unusual behavior or toxic effects were observed even though the rate of consumption of the ammoniated molasses would be considered high. Rate of gain was satisfactory in all lots. Gains were better than those produced in the wintering phase of the previous test. It is believed that the addition of .5 pound natural protein concentrate to the ration is largely responsible for the improved results. The addition of grain alone seemed to be beneficial but not so much as the protein concentrate.

Table 55

Results of Self-Feeding Ammoniated Blackstrap Molasses to Beef Heifer Calves.

December 12, 1957, to March 21, 1958—100 days.

Lot number	9	10	11	12
Number calves per lot	10	10	10	10
Av. initial wt., lbs.	441	441.5	442.5	440.5
Av. final wt., lbs.	585	574	591	567
Av. daily gain, lbs.	1.44	1.32	1.48	1.26
Av. daily ration, lbs.:				
Sorghum silage	25.9	24.5	23.3	23.2
Sorghum grain	2.0	....	1.5	2.0
Soybean oil meal	1.0	0.5	0.5	....
Amm. blackstrap molasses (16% protein equiv.)	....	4.58	5.11	5.09
Salt	.09	.07	.07	.12
Mineral mixture[1]	.12	.09	.08	.08
Lbs. feed per cwt. gain:				
Sorghum silage	1799	1851	1569	1832
Sorghum grain	138.9	....	101	158.1
Soybean oil meal	69.4	37.7	33.7	....
Amm. blackstrap molasses (16% protein equiv.)	....	345.4	344.1	402.7
Salt	6.1	5.5	4.5	9.2
Mineral mixture	8.7	6.9	4.4	6.6
Cost per cwt. gain, $[2]	11.71	15.77	16.55	18.92

1. Equal parts steamed bonemeal, limestone, and salt.
2. Based on ingredient prices given on inside back cover.

The Effect of Implanting Beef Heifers on a Fattening Ration with Hormones or Hormonelike Substances.[1]

D. Richardson, Ed F. Smith, B. A. Koch and F. W. Boren

The response from feeding stilbestrol to heifers is not so good as that obtained with steers. Implanting heifers with levels of stilbestrol recommended for steers produces many undesirable side effects, including prolapse of the vagina in many instances. This test was designed to study the effect of low level (12 mgs.) implanting of stilbestrol and a combination of testosterone (100 mgs.) and estradiol benzoate (20 mgs.) on heifers being fattened for slaughter.

Experimental Procedure

Sixty-five Hereford heifers averaging slightly over 600 pounds were being fattened in Projects 536 and 537. There were six lots of animals. Three animals in each of the lots were each implanted with one 12-mg. pellet of stilbestrol and three with Synovex-heifer-7 implant. The remaining animals served as controls. Thus, there were 29 control animals and 18 on each of the two kinds of implants. Carcess data were obtained at the time of slaughter.

Results and Observations

Results of this test are shown in Table 56. There were no noticeable side effects from either of the implants. Neither was there any unusual behavior on the part of any of the heifers. Animals receiving the stilbestrol implant gained an average of .27 pound faster than the controls, while the ones receiving Synovex-heifer-7 gained .13 pound faster. There were no significant differences in carcass grade, fat thickness, fat distribution, degree of marbling, or degree of firmness. However, size of rib eye was larger with both implants, and those from heifers receiving stilbestrol were the largest. It should be observed that size of rib eye increased as weight of animal increased.

1. Stilbestrol supplied by Chas. Pfizer & Co., Terre Haute, Ind. Synovex-heifer-7 supplied by E. R. Squibb & Son, New Brunswick, N.J.

Table 56

Results of Implanting Stilbestrol and Synovex-Heifer-7 in Beef Heifers on Fattening Ration.

May 4 to August 24—112 days.

Treatment	Control	12 mgs. stilbestrol implant	Synovex heifer-7 implant[1]
Number heifers per treatment	29	18	18
Av. initial wt., lbs.	618.8	618.9	615.3
Av. final wt., lbs.	815.9	846.7	826.9
Av. daily gain per heifer, lbs.	1.76	2.03	1.89
Av. carcass grade before ribbing[2]	11.2	11.6	11.0
Av. carcass grade after ribbing[2]	12.8	12.4	12.8
Av. fat thickness at 12th rib, visual estimate[3]	3.6	3.6	3.8
Av. uniformity of fat distribution[4]	3.4	3.6	3.7
Av. degree of marbling[5]	6.6	7.0	6.4
Av. size rib eye, visual estimate[6]	4.4	4.1	4.3
Av. size rib eye, sq. in.	9.00	9.71	9.39
Av. degree of firmness[7]	3.4	3.7	3.6

1. 100 mgs. testosterone and 20 mgs. estradiol benzoate.
2. Based on top choice 15, av. choice 14, low choice 13, top good 12, av. good 11, low good 10.
3. Based on thick 2, moderate 3, modest 4, slightly thin 5.
4. Based on uniform 2, moderate 3, modest 4, slightly uneven 5.
5. Based on slightly abundant 4, moderate 5, modest 6, small amount 7, slight amount 8.
6. Based on large 2, moderately large 3, modestly large 4, slightly small 5.
7. Based on firm 2, moderately firm 3, modestly firm 4, slightly firm 5.

Improvement of Beef Cattle Through Breeding Methods (Project 286).

W. H. Smith, L. A. Holland and J. D. Wheat

The purebred Shorthorn cattle breeding project was continued during 1957 and thus far in 1958 according to the plans and breeding programs which were established in 1949. Two inbred lines have been established. These are referred to as the Wernacre Premier and the Mercury lines with reference to the foundation sires which were used initially for the development of the two lines. The Wernacre Premier line is entering the fourth generation of inbreeding, while the Mercury line is now in the third. The basic inbreeding plan has been the continued mating of half-brothers to half-sisters during the progress of the study.

The experiment was initiated to study the inheritance of beef cattle production traits and to evaluate the effects of inbreeding upon production. The lines will be crossed at some time in the future to study the feasibility of utilizing inbred lines of beef cattle for the breeding improvement of productivity. To date, no extensive line crossing has been introduced in the breeding program; however, a Mercury line bull was used on some Wernacre Premier line females during the 1956 and 1957 breeding seasons because of the fact that one of the Wernacre Premier bulls possessed low fertility and was necessarily removed from the breeding herd. In view of the fact that the data are limited, no conclusions regarding line crossing can be made at this time. Most of the line-cross calves produced to date have been from two-year-old heifers.

Birth weight of calves and the weight of each cow are taken at the time of calving. The calves are routinely born in the spring as the result of summer pasture breeding. The calves are not creep fed during the suckling period while the cows are on grass. Calves are weaned at approximately 6 months of age at which time they are scored for type and conformation and weighed. After a three-week adjustment period, the calves are placed on individual feeding trials or record-of-performance tests for a 182-day period. Weight gain and feed consumption records are maintained on each calf.

The full feed ration for the steers and bulls consists of 75 percent cracked corn and 25 percent chopped alfalfa hay; that for the heifers, 55 percent cracked corn and 45 percent chopped alfalfa hay.

Approximately one-half of the bull calves are castrated each year immediately after the calves are weaned.

Upon the termination of the feeding trials, the calves are weighed and scored individually and a series of body measurements are taken on each. Since the project started, a total of 83 heifers, 36 bulls, and 37 steers have been individually fed. This does not include the 37 calves produced in 1957 which have not completed their individual feeding trials at this date. Thus far in the study the Wernacre Premier calves have been more highly inbred than the Mercury calves. The Wernacre Premier calves have made slightly greater gains but have required more feed per 100 pounds of live body weight gain than have the Mercury calves.

To date no abnormalities which can be attributed to inbreeding have occurred in either of the two inbred lines. Analyses of the data indicate that inbreeding has lowered the weaning weights of the calves. Initial weight and average daily gain have appeared to be related to feed efficiency. The calves possessing lighter initial weights and those making higher average daily gains within each line tend to be more efficient in feed utilization. Inbreeding has not appeared to be related to gaining ability or feed efficiency in either of the two lines.

The data for the 1956 Shorthorn calves are summarizd in Table 57 and a partial summary of the 1957 calves appears in Table 58. The data on the 1957 calves are incomplete because these will not complete their feeding trials until the summer of 1958.

Table 57
Summary of the 1956 Shorthorn Calves of the Wernacre Premier and Mercury Lines.

Tag number	Coefficient of inbreeding[1]	Birth weight	Weaning weight	Weaning score	Days fed	Initial weight	Final weight	Total gain	Average daily gain, lbs.	Final score	Pounds corn per cwt. gain	Pounds alfalfa per cwt. gain
Wernacre Premier Line												
Bulls												
56	32.03	71	406	2—	182	450	917	467	2.56	2	405	202
31	23.74	59	405	3+	182	417	876	459	2.52	3—	406	203
Av.	27.89	65	406	2—	182	434	897	463	2.54	3+	406	203
Steers												
82	32.03	68	380	4	182	360	854	494	2.72	2—	538	238
Heifers												
30	23.56	78	430	2	182	440	795	355	1.95	2	397	349
68	32.03	70	395	2	182	406	650	244	1.34	2	430	393
173	15.36	69	395	2—	182	416	750	334	1.84	2—	407	365
108	30.20	69	340	3+	182	350	667	317	1.74	2+	337	303
38	15.09	74	305	2—	182	350	640	290	1.59	3+	366	334
Av.	23.25	72	373	2—	182	392	700	308	1.69	2	387	349
Mercury Line												
Bulls												
189	14.19	61	365	1—	182	400	835	435	2.39	1—	391	205
105	15.72	56	412	1—	182	455	933	478	2.63	1	350	182
7	25.00	62	409	2	182	427	886	459	2.52	2+	393	189
154	3.37	71	457	2—	182	500	950	450	2.49	3+	422	214
Av.	14.57	63	411	2+	182	446	901	456	2.50	2+	389	198
Steers												
11	13.48	65	312	2+	182	371	795	424	2.33	3	355	191
8	3.61	58	355	3+	182	355	752	397	2.18	2	373	183
36	12.92	65	370	2	182	391	660	269	1.48	3	520	266
Av.	10.00	63	346	2	182	372	736	363	2.00	3+	416	213
Heifers												
13	11.23	54	315	2	182	312	620	308	1.69	1—	383	344
760	3.91	58	360	1—	182	365	590	225	1.24	1—	433	391
12	6.45	66	380	1—	182	405	691	286	1.57	1+	395	364
184	13.48	51	352	2+	182	378	655	277	1.52	1—	406	368
10	14.26	55	345	1	182	350	622	272	1.49	1+	397	360
58	14.46	65	365	1—	182	388	640	252	1.38	1+	474	437
15	8.01	62	372	1—	182	395	705	310	1.70	1	411	368
103	14.31	63	315	3+	182	355	665	310	1.70	2—	401	365
Av.	10.76	59	351	2+	182	369	649	280	1.54	1	413	375

1. The coefficient of inbreeding means the percentage of inbreeding. Individuals from full brother-sister matings are 25 percent inbred and individuals from mating half-brothers to half-sisters are 12.5 percent inbred.

Table 58

Partial Summary of the 1957 Shorthorn Calves of the Wernacre Premier and Mercury Lines and Line Crosses.

Tag number	Coefficient of inbreeding[1]	Birth weight	Weaning weight	Weaning score	Initial weight	Weight on 3-20-58	Days on trial	Daily gain during trial
				Wernacre Premier Line				
				Bulls				
56	10.94	69	410	2—	460	830	142	2.61
				Steers				
105	27.97	55	375	3	390	660	142	1.90
				Heifers				
12	23.47	73	435	3+	430	700	142	1.90
103	32.03	87	240	3	255	510	142	1.80
52	32.03	58	254	2—	275	450	87	2.00
Av.	29.18	73	310	3+	320	.....	.....	1.90
				Mercury Line				
				Bulls				
189	16.50	70	365	1	380	775	142	2.78
61	13.28	65	420	2+	495	912	142	2.94
13	11.23	58	360	2+	415	765	142	2.46
10A	14.46	67	376	1—	416	630	87	2.46
15	6.44	65	368	2+	402	577	87	2.01
6	13.48	68	291	1—	341	525	87	2.11
5	14.18	64	412	1	450	695	87	2.82
1	15.72	67	312	1—	339	580	87	2.77
Av.	13.16	66	363	1—	405	.....	.....	2.54
				Steers				
8	6.25	70	320	2—	360	715	142	2.50
68	8.01	59	260	3	275	540	142	1.87
36	3.91	81	300	2—	320	670	142	2.46
7	14.26	69	410	2	472	760	142	2.03
10	3.61	70	410	1—	540	853	142	2.20
Av.	7.21	70	340	2—	393	.....	.....	2.21
				Heifers				
58	13.97	63	305	1—	335	575	142	1.69
106	9.37	56	435	1	477	720	142	1.71
31	13.48	55	390	1	400	605	142	1.44
11	9.03	56	380	2+	430	670	142	1.69
82	25.00	57	305	2+	310	564	142	1.79
173	3.61	57	270	3	300	555	142	1.80
9	6.25	70	228	2—	252	406	87	1.77
146	12.91	64	325	2+	330	490	87	1.84
2	15.72	74	305	1—	323	477	87	1.77
38	7.03	58	271	2	296	430	87	1.54
68A	12.50	61	216	3	220	270	37	1.35
49	6.25	62	282	2	280	315	37	.95
Av.	11.26	61	309	2+	329	.....	.....	1.61
				Line Crosses				
				Bulls				
30	.....	72	314	2—	346	575	87	2.63
				Steers				
3	.....	65	266	3	307	495	87	2.16
87	.....	80	354	3+	365	400	37	.95
Av.	.....	73	310	3+	336	.....	.....	1.56
				Heifers				
72	.....	80	311	2	334	505	87	1.97
4	.....	62	236	2	267	435	87	1.93
120	.....	75	320	1—	330	372	37	1.14
81	.....	64	300	2—	300	370	37	1.89
Av.	.....	70	292	2	308	.....	.....	1.73

1. The coefficient of inbreeding means the percentage of inbreeding. Individuals from brother-sister matings are 25% inbred and individuals from mating half-brother to half-sister are 12.5% inbred. The line cross calves are not inbred.

The Value of Shade for Beef Cattle, 1957 (Project 430 B.J.9, 2).

F. W. Boren, B. A. Koch, E. F. Smith, D. Richardson, R. F. Cox

This is the first year of a study designed to investigate the economic value of providing shade for beef cattle kept under Kansas environmental conditions. Because the practice of year-around fattening of cattle in the dry-lot is becoming increasingly popular, it was decided that the beginning phase of this study should be a preliminary dry-lot fattening trial with heifers. This experiment was conducted during the summer of 1957 for a period of 140 days.

Experimental Procedure

Thirty head of Hereford heifers weighing an average of 530 pounds per head were used in this study. They were placed in three lots, 10 head per lot, on the basis of live weight and grade.

The heifers were on test from June 26, 1957, to November 13, 1957, a total of 140 days. At the beginning of the experiment, the heifers were consuming 8 pounds of coarse ground sorghum grain, 1 pound of soybean oil meal, and 6 pounds of alfalfa hay per head daily. They were rapidly brought up to a daily ration composed of all the sorghum grain they would consume plus 1 pound of soybean oil meal and 5 pounds of alfalfa hay. At the termination of the test the heifers were sold on the central market at St. Joseph.

The experimental treatment for each lot was as follows: lot 1, control (sun); lot 2, control (sun); lot 3, shade.

The shade provided the heifers in lot 3 was from two trees located in the experimental pen. These trees supplied approximately 50 square feet of shade per animal. The lot was not completely shaded and the heifers could go into the shade cast by the trees, as they desired. Feed and water were in the sun.

Five heifers in each lot were randomly selected and implanted with Synovex (R) Heifer hormone implant. This implant was composed of 20 mg. of estradiol benzoate and 100 mg. of testosterone.

Results and Observations

Table 59 shows the results of this preliminary test designed to measure the effects of shade upon the feed lot performance and carcass characteristics of yearling heifers.

1. The heifers having access to shade (lot 3) made an average daily gain of .16 pound per head daily more than heifers in lots 1 or 2.
2. Shaded heifers were more efficient in feed utilization, requiring less feed per cwt. gain.
3. The heifers in lot 3 produced higher grading carcasses and sold for more on the market.
4. The percent shrink to market was essentially the same for all lots. However, the heifers from the sun lots had a slightly higher dressing percentage than those which had had access to the shade.
5. During the summer days when the temperature was high, the heifers in the sun lots appeared to be extremely uncomfortable. They were very slow to consume their daily ration and were continually going off feed. In contrast, the shaded heifers appeared comfortable and contented, consumed their daily ration readily, and did not go off feed during the experiment.
6. Based on the results of this preliminary experiment, the shade in lot 3 was worth about $5.00 per animal.

Table 60 illustrates the effect of certain climatic factors on the period average daily gains of yearling heifers. Again, it should be emphasized that this is only a preliminary trial, and the data presented and observations made are not conclusive. Trials will be continued during future summer seasons and more conclusive results presented.

It appears that increased temperature, sunshine, and radiation had a depressing effect upon the period average daily gains regardless of whether or not shade was provided. Also, the heifers responded to a moderation of temperature, sunshine, and radiation as indicated by the daily gains during periods 3 and 4.

Table 59

The Value of Shade for Beef Cattle—Shade versus No Shade—Fattening Yearling Heifers.

June 26, 1957, to November 13, 1957—140 days.

Lot number	1	2	3
Number heifers per lot	10	10	10
Management	No shade	No shade	Shade
Av. initial wt. per heifer, lbs.	530	530	530
Av. final wt. per heifer, lbs.	795	805	822
Av. gain per heifer, lbs.	266	275	292
Av. daily gain per heifer, lbs.	1.90	1.96	2.09
Av. daily ration per heifer, lbs.:			
Ground sorghum grain	12.9	12.8	13.4
Soybean oil meal	1.0	1.0	1.0
Alfalfa hay	6.0	6.3	6.1
Lbs. feed per cwt. gain:			
Ground sorghum grain	676	650	640
Soybean oil meal	53	51	48
Alfalfa hay	323	321	298
Feed cost per cwt. gain,[1] $	18.39	17.94	17.01
Selling price per cwt. at market	22.50	22.80	22.95
Percent shrink to market	3	3	3
Dressing percent	58.4	58.2	58.0
Carcass Data			
Carcass grades, USDA:			
Av. choice	1	..	..
Low choice	..	4	6
High good	1	..	1
Av. good	2	2	..
Low good	6	4	3
Av. carcass grade[2]	16.8	17.4	18.4
Av. size of rib eye[3]	4.2	4.4	4.1
Av. size of rib eye, sq. in.[4]	9.95	9.98	10.27
Av. fat thickness at 12th rib[5]	3.9	4.1	3.4
Av. fat thickness at 12th rib, in.[6]	.45	.55	.56
Av. degree of marbling[7]	8.2	7.5	7.4
Av. degree of firmness[8]	4.2	4.3	3.4

1. Price of feed per cwt.: Ground sorghum grain, $2.50; soybean oil meal, $3.50; alfalfa hay, $1.25.
2. Average choice, 20; low choice, 19; high good, 18; average good, 17; low good, 16.
3. Very large, 1; large, 2; moderately large, 3; modestly large, 4; slightly small, 5. Visual estimate.
4. Planimeter reading of rib eye muscle.
5. Very thick, 1; thick, 2; moderately thick, 3; modestly thick, 4; slightly thin, 5. Visual estimate.
6. Reciprocal Meat Conference Standards—1952.
7. Modest, 6; small amount, 7; slight amount, 8; traces, 9. Visual estimate.
8. Very firm, 1; firm, 2; moderately firm, 3; modestly firm, 4; slightly soft, 5; soft, 6. Visual estimate.

Table 60

Effect of Certain Climatic Factors on the Period Average Daily Gains of Yearling Heifers.

Dry-Lot Fattening Period—June 26, 1957, to November 13, 1957—140 days.

Period	1	2	3	4	5
Date	6/26–7/24	7/25–8/21	8/22–9/18	9/19–10/16	10/17–11/13
Av. maximum temp.[1]	92.8	97.4	84.0	73.3	56.6
Av. minutes of sunshine[2]	599.2	665.8	516.2	397.1	234.1
Av. radiation[3]	526.4	578.3	434.0	318.8	191.7
Av. wind movement[4]	141.0	145.3	131.3	133.4	141.3
Av. relative humidity[5]	47.6	46.3	52.0	56.5	56.5
Av. daily gain:					
Lot 1 (sun)	1.89	1.16	2.79	2.07	1.57
Lot 2 (sun)	1.84	1.11	2.27	2.79	1.82
Lot 3 (shade)	2.29	1.36	2.59	2.21	1.96

1. Reading made daily at 7 p.m.; thus maximum temperature will have occurred. Thermometer in standard thermometer shelter.

2. Number of minutes the sun shone during the day. Period midnight to midnight.

3. Reading in langleys. Langleys × 3.69 = BTU's per square foot.

4. Wind movement is miles past the station.

5. Read from an autographic hygrograph exposed in thermometer shelter.

The Effect of Shade and Hormone Implant on Fattening Yearling Heifers.

June 26, 1957, to November 13, 1957—140 days.

F. W. Boren, B. A. Koch, E. F. Smith, D. Richardson, R. F. Cox

Five heifers in lots 1, 2 and 3 of the shade vs. no shade study were randomly selected to receive an implant composed of 20 mg. of estradiol benzoate and 100 mg. of testosterone. Since they were fed along with the non-implanted heifers in each lot, no feed efficiency data is available.

Table 61 shows the results of this phase of the study. Although the numbers are small, some general observations can be made. These are as follows:

1. Shade exerted a definite influence upon the average daily gains. The implanted heifers in the shade gained .12 pound more per head daily than the implanted heifers in the sun. Heifers receiving no hormone implant in the shade gained .16 pound more per head daily than the non-implanted heifers in the sun. Thus shade increased gains an average of .14 pound per head per day regardless of hormone implant.

The hormone implant increased average daily gains .30 pound in the sun lots and .26 pound in the shade. Thus the implant increased average daily gain per head .28 pound.

The combined influence of shade and implant was .42 pound increase in average daily gain per head.

2. The implanted heifers had a slightly higher dressing percentage than did the non-implanted heifers.

3. Shade influenced carcass grade. The average carcass grade of the heifers in the sun lots was just slightly over average good, whereas the shaded lot heifer carcasses graded high good.

4. The average square inches of rib eye muscle were greater in the implanted heifers. Shade apparently had no influence upon the size of rib eye muscle.

5. The implant caused no excessive development of teats and udder, raised tail heads or depressed loins.

Table 61

The Effect of Shade and Hormone Implant[1] on Fattening Yearling Heifers.

June 26, 1957, to November 13, 1957—140 days.

	No shade		Shade	
	No implant	Implant	No implant	Implant
Number of heifers	10	10	5	5
Initial wt. per heifer, lbs.	535	524	532	528
Final wt. per heifer, lbs.	786	816	805	838
Av. gain per heifer, lbs.	251	292	273	310
Av. daily gain per heifer, lbs.	1.79	2.09	1.95	2.21
Dressing percent	58.1	58.5	57.8	58.2
Carcass Data				
Carcass grades, USDA:				
Av. choice	..	1	..	..
Low choice	2	2	4	2
High good	..	1	..	1
Av. good	3	1	..	..
Low good	5	5	1	2
Av. carcass grade[2]	17.2	17.4	18.4	17.6
Av. size of rib eye[3]	4.3	4.3	4.4	3.8
Av. size of rib eye, sq. in.[4]	9.8	10.3	9.8	10.7
Av. thickness of fat at 12th rib[5]	4.1	4.0	3.4	3.8
Av. thickness of fat at 12th rib, in.[6]	.51	.55	.59	.53
Av. degree of marbling[7]	8.0	7.2	7.4	8.0
Av. degree of firmness[8]	4.3	3.7	3.2	3.6

1. 20 mgs. estradiol benzoate plus 100 mgs. testosterone supplied by Squibb and Sons.

2. Av. choice, 20; low choice, 19; high good, 18; av. good, 17; low good, 16.

3. Very large, 1; large, 2; moderately large, 3; modestly large, 4; slightly small, 5. Visual estimate.

4. Planimeter reading of rib eye muscle.

5. Very thick, 1; thick, 2; moderately thick, 3; modestly thick, 4; slightly thin, 5. Visual estimate.

6. Reciprocal Meat Conference Standards—1952.

7. Modest, 6; small amount, 7; slight amount, 8; traces, 9. Visual estimate.

8. Very firm, 1; firm, 2; moderately firm, 3; modestly firm, 4; slightly soft, 5; soft, 6. Visual estimate.

Adapting Roughages Varying in Quality and Curing Processes to the Nutrition of Beef Cattle (Project 370—1957-58).

Combinations of Wheat Straw and Alfalfa Hay in the Winter Ration of Beef Heifers.

F. W. Boren, B. A. Koch, E. F. Smith, D. Richardson and R. F. Cox

Previous work at this station (Circular 297, p. 45-47) and at the Fort Hays Branch Experiment Station (Circular 322, p. 1-6) indicates that beef calves wintered on a daily ration of 1.75-2 pounds of ground sorghum grain, 1.25-2 pounds of protein concentrate and wheat straw fed free-choice made average daily gains of only .3 to .6 pound. One pound of molasses substituted for 1 pound of grain and sprinkled on wheat straw increased consumption only .22 pound per head daily but decreased gains .08 pound per head daily. Also 1 pound of molasses had slightly less feeding value than 1 pound of grain in a wintering ration for steer calves with wheat straw roughage. The addition of 1 pound of dehydrated alfalfa pellets increased the rate of gain and feed efficiency. Calves receiving dehydrated alfalfa pellets also consumed more straw.

Although wheat straw is considered a very poor roughage and under normal conditions should not be used as the only roughage for cattle, there are times when it can be used as a major part of the roughage. The