Table 53 (Continued).

% roughage	29.5	30.0
Lbs. feed per cwt. of gain:		
Corn	553.2	
Cottonseed meal	42.6	
Molasses	42.6	
Alfalfa hay	267.8	78.3
Salt	.8	.9
Pellets		685.2
Total	907.0	764.4
Feed cost per cwt. of gain[1]	$ 22.62	$ 21.80
Initial cost of heifer @ $19	$134.90	$134.90
Feed cost per heifer	$ 68.10	$ 63.22
Heifer cost plus feed cost	$203.00	$198.12
Market wt., lbs.	987	995
Necessary selling price	$ 20.57	$ 19.91
Selling price per cwt.	$ 21.50	$ 21.50
Dressing %	61.8	60.8
Carcass grades:[2]		
Choice+	1	
Choice	6	3
Choice−	1	3
Good+	1	3
Good	1	
Marbling score:		
Moderate	6	2
Modest	2	3
Small	1	3
Slight	1	1

1. Feed prices: corn, $2.87 per cwt.; cottonseed meal, $72 per ton; alfalfa hay, $20 per ton; molasses, $2.20 per cwt.; salt, $15 per ton; preparation of pelleted ration (grinding, mixing, pelleting, and hauling), $12 per ton; preparation of coarse concentrate mixture (mixing and hauling), $5 per ton.

2. The carcass grade for one heifer from lot 2 was lost.

Sources of Phosphorus for Beef Cattle (Project 536[1]).

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

In a previous test it was found that phosphoric acid can be used as a source of phosphorus for beef heifer calves on dry bluestem pasture. A phosphorus balance study with lambs also indicated efficient use of phosphorus from phosphoric acid. This test was conducted to further evaluate phosphoric acid as a source of phosphorus in the wintering and fattening ration under dry-lot feeding conditions.

Experimental Procedure

Seventy-four Hereford heifer calves were divided into five lots as equally as possible on the basis of weight and type. Ten animals were placed in the control lot and 16 animals in each of the others.

The control ration consisted of ¾ pound of soybean oil meal, ½ pound of dehydrated alfalfa meal, 2 pounds of dehydrated ammoniated hydrol product (Dex-Mo-Lass made with ammoniated hydrol), and all of a corncob-blackstrap molasses mixture that the animals would clean up each day. The corncob-molasses mixtures contained approximately 22 percent molasses for the first 84 days. It was then increased to 40-45 percent molasses. When the molasses concentration was increased, 1½ percent each of ground limestone and salt was added to retard "setting up" of the mixture. The limestone was decreased to ¾ percent after about 30 days. The soybean oil meal and dehydrated alfalfa meal were made into pellets containing approximately 10 percent molasses. The added phosphorus was put in these pellets in the form of phosphoric acid or steamed bonemeal. Salt alone and a mixture of ground limestone and salt were available to all animals free choice.

1. This project was in cooperation with Westvaco Mineral Products Division, Food Machinery and Chemical Corporation, New York 17, N.Y.

The control ration supplied approximately 6 grams of phosphorus per head per day. This is one half the National Research Council recommendation of 12 grams per head per day. Source and amount of phosphorus in the ration were the only variations. The treatments were as follows, which indicate the amount of added phosphorus per head per day:

Lot 1—Control ration.
Lot 2—Control ration + 3 grams phosphorus from phosphoric acid.
Lot 3—Control ration + 6 grams phosphorus from phosphoric acid.
Lot 4—Control ration + 3 grams phosphorus from steamed bonemeal.
Lot 5—Control ration + 6 grams phosphorus from steamed bonemeal.

Blood samples were taken at the end of the wintering phase to determine serum phosphorus and calcium levels.

After the end of the wintering phase, approximately 30 days were used to adjust the animals to hay and grain before starting the fattening phase. At the beginning of the fattening phase, lots 2, 3, 4, and 5 were subdivided into two groups each, i.e., 2 and 2A. One group continued to receive supplemental phosphorus; the other group did not. This was to determine the value of supplemental phosphorus in the fattening ration. The control animals in lot 1 never got any supplemental phosphorus. Carcass data were obtained after slaughter. The shank bone from the right front leg was obtained for measurements and ash determination.

Results and Discussion

Wintering phase: Results are presented in Table 54. As the experimental ration used in this test was designed to be low in phosphorus, the roughage and source of energy had to be from ingredients low in phosphorus. Although there was considerable variation from time to time in consumption of the corncob-molasses mixture, no difficulty was experienced in keeping the animals on feed. After increasing the percentage of molasses, the animals were getting approximately 1 pound of molasses per 100 pounds bodyweight. Trouble with scouring was observed when the consumption of molasses exceeded that quantity.

Fattening phase: Feedlot, carcass, and bone data are shown in Table 55. It was discovered early in the fattening phase that four of the heifers were pregnant and they were removed from the test (3 from lot 2 and 1 from lot 3A). Two animals in lot 3A died but no reason for death was determined by postmortem examination. All animals went on feed without any trouble except the control lot. Some trouble was experienced in getting them on a full feed of grain. They would eat well for a time and then refuse to eat. This happened twice.

Supplemental phosphorus made no significant differences in rate of gain. Feed efficiency tended to be highest with animals that received phosphoric acid as a source of phosphorus. There were no significant differences in carcass grades, dressing percentage, degree of marbling, size of ribeye, or degree of firmness. Shank bones from animals that had received supplemental phosphorus tended to be longer and greater in diameter and thickness.

Observations

Wintering phase:

1. No harmful or ill effects of any kind were observed from feeding phosphoric acid as a source of phosphorus.

2. No deficiency symptoms, phosphorus, vitamin A, etc., were observed. Animals in all lots gnawed on the fence; however, there were no differences among lots.

3. Feed containing phosphoric acid was highly palatable and the total consumption tended to be greater.

4. Rate of gain and feed efficiency increased as the level of phosphorus was increased. There was no difference between steamed bonemeal and phosphoric acid at the higher level; however, phosphoric acid tended to be more efficient at the lower level.

5. Serum calcium levels were normal; however, they were highest in the phosphorus-deficient lot.

6. Serum phosphorus levels were all within normal range; however, lot 1 showed borderline deficiency.

Fattening phase:

1. Animals that received supplemental phosphorus during the wintering phase were easier to get on a full feed of grain.

2. Supplemental phosphorus was of no value in the fattening ration.

3. Shank bones from animals that had received phosphorus tended to be longer and greater in diameter and thickness. The average percentage of ash in the bones tended to be higher for animals that received supplemental phosphorus in the wintering ration except lot 3 (3 + 3A); however, there were no significant differences.

Table 54

Results of Wintering Phase, Including Blood Data, on Level and Source of Phosphorus with Beef Heifer Calves.

November 9, 1955, to April 11, 1956—154 days.

Lot number	1	2	3	4	5
Added phosphorus	none	3 gms. from phos. acid	6 gms. from phos. acid	3 gms. from steamed bonemeal	6 gms. from steamed bonemeal
Number heifers per lot	10	16	16	16	15[1]
Av. initial wt., lbs.	441	442	440	441	442
Av. final wt., lbs.	603	612	623	606	624
Av. total gain, lbs.	162	170	183	165	182
Av. daily gain, lbs.	1.05	1.11	1.18	1.07	1.18
Av. daily ration, lbs.:					
Corncob-molasses mixture	9.02	10.37	10.03	9.87	9.80
Soybean oil meal-dehydrated alfalfa pellets	1.30	1.30	1.30	1.30	1.30
Dehydrated amm. hydrol product	2.00	2.00	2.00	2.00	2.00
Limestone and salt	.03	.02	.02	.02	.02
Salt	.05	.04	.02	.04	.03
Lbs. feed per 100 lbs. gain:					
Corncob-molasses mixture	857.7	939.8	844.1	921.0	828.8
Soybean oil meal-dehydrated alfalfa pellets	123.5	118.8	110.4	122.4	111.0
Dehydrated amm. hydrol product	190.1	181.2	168.3	186.7	169.2
Limestone and salt	2.6	1.8	1.7	1.9	1.4
Salt	5.1	3.8	1.7	3.7	2.6
Av. serum calcium, mg. %[2]	12.23	11.41	11.41	11.30	11.19
Av. serum phosphorus, mg. %[2]	5.52	7.21	9.13	8.11	8.94

1. One sick animal removed.
2. Blood samples taken at end of wintering phase.

Table 55

Results of Fattening Phase, Including Carcass and Bone Data, on Levels and Source of Phosphorus in Beef Heifer Fattening Rations.

May 10 to August 20, 1956—103 days.

Lot number	1	2	2A	3	3A	4	4A	5	5A
Treatment	Control	No suppl. phosphorus	3 gms. phos. from phosphoric acid	No suppl. phosphorus	6 gms. phos. from phosphoric acid	No suppl. phosphorus	3 gms. phos. from steamed bonemeal	No suppl. phosphorus	6 gms. phos. from steamed bonemeal
Number heifers per lot	10	5	8	8	5	8	8	7	8
Av. initial wt., lbs.	634.5	644.0	634.0	646.0	653.0	640.0	641.0	651.0	648.0
Av. final wt., lbs.	831.8	860.6	840.2	886.6	869.8	844.5	842.0	860.4	865.4
Av. daily gain, lbs.	1.92	2.10	2.00	2.34	2.11	1.99	1.95	2.04	2.13
Av. daily ration, lbs.:									
Alfalfa hay	5.5	5.8	5.1	4.0	4.9	4.4	5.9	5.1	5.6
Milo grain	13.3	14.8	13.9	15.6	13.4	13.9	14.1	15.0	15.4
Pellets	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Av. lbs. feed per 100 lbs. gain:									
Alfalfa hay	286.0	274.0	257.0	172.0	234.0	222.0	301.0	253.0	264.0
Milo grain	693.0	696.0	696.0	666.0	639.0	699.0	722.0	734.0	728.0
Pellets	78.0	71.0	75.0	64.0	71.0	76.0	77.0	74.0	71.0
Feed cost per 100 lbs. gain[1]	$22.91	$22.63	$22.59	$20.61	$20.79	$22.35	$23.75	$23.47	$23.32
Carcass data:									
Av. dressing % (includes 3% cooler shrink)	59.4	61.1	61.4	60.9	61.6	61.1	59.8	61.2	60.3
Av. carcass grade[2]	11.2	13.6	13.0	10.5	11.2	12.5	13.5	10.9	11.5
Av. degree of marbling[3]	6.6	7.4	7.4	5.9	6.4	6.7	7.2	6.3	6.8
Av. size ribeye[4]	4.3	3.6	4.3	4.3	3.6	4.1	4.4	4.0	4.4
Av. firmness of carcass[5]	3.6	4.4	4.0	3.6	3.8	4.2	4.0	3.9	3.8
Data from front shank bone, M.M.:									
Av. length	190.0	194.6	189.0	193.0	194.8	193.5	195.4	195.1	194.0
Av. diameter	30.3	30.9	30.2	31.4	30.9	31.8	31.2	31.3	30.8
Av. thickness	7.1	8.2	7.7	7.7	7.8	9.1	8.9	8.2	7.8
Av. % ash (center of shank)	69.47	69.52	69.68	68.80	68.89	69.32	69.84	69.51	69.92

1. Alfalfa hay @ $20 per ton; milo grain @ $2.50 per 100 pounds; pellets @ $70 per ton.
2. Carcass grade based on top choice 8, average choice 10, low choice 12, top good 14, average good 16.
3. Based on slightly abundant 4, moderate 5, modest 6, small amount 7, slight amount 8.
4. Based on large 2, moderately large 3, modestly large 4, slightly small 5.
5. Based on firm 2, moderately firm 3, modestly firm 4, slightly soft 5.

Self-Feeding Molasses Mixed with Various Combinations of Urea or Ammonia with Phosphoric Acid and with or without Ethyl Alcohol in the Wintering Ration of Beef Heifer Calves (Projects 536[1] and 537[2 3]).

D. Richardson, Ed F. Smith, Berl A. Koch, and Rufus F. Cox

It has been shown that phosphoric acid is an excellent source of phosphorus and ammoniated hydrol (corn molasses) is a good source of protein equivalent when used in ruminant rations (Kansas Experiment Station Circulars 320 and 335). Urea, a nonprotein nitrogen compound, has long been recognized as a good source of protein equivalent for ruminants. Recently, the idea has been advanced that small amounts of ethyl alcohol would be beneficial in ruminant rations. Also, the practice of self-feeding liquid feed seems to be gaining in popularity. All of the above-mentioned ingredients can be mixed easily and thoroughly with molasses. This test was conducted to study the value of self-feeding molasses when mixed with several combinations of the above ingredients in a wintering ration with beef heifer calves.

Experimental Procedure

Sixty-six Hereford heifer calves averaging about 435 pounds each were divided on the basis of weight and conformation into 6 lots of 11 animals each. All lots received all of the sorghum silage the animals would clean up each day. The remainder of the ration was as follows:

Lot 7—Control, 1 pound soybean oil meal and 2 pounds milo grain.

Lot 8—Free-choice mixture, 77 percent blackstrap molasses, 3 percent phosphoric acid, 10 percent urea, and 10 percent water (30 percent protein equivalent).

Lot 9—Free-choice mixture, 71 percent blackstrap molasses, 3 percent phosphoric acid, 6 percent ethyl alcohol, 10 percent urea, and 10 percent water (30 percent protein equivalent).

Lot 10—Free-choice mixture, ammoniated blackstrap molasses with added phosphorus (15 percent protein equivalent).

Lot 11—Free-choice mixture, ammoniated blackstrap molasses with added phosphorus and 3 percent ethyl alcohol (15 percent protein equivalent).

Lot 12—0.5 pound soybean oil meal plus free-choice mixture of ammoniated hydrol with added phosphorus.

Lot 7 had salt and a mixture of 2 parts bonemeal 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 various molasses mixtures. All animals were weighed at 28-day intervals.

This test is being continued by adding grain to the ration for fattening. The various molasses mixtures will continue to be fed free choice. Carcass data will be obtained when the animals are marketed and slaughtered.

Results and Observations

The results of the wintering phase of this test are shown in Table 56.

1. It was the second day on test before the animals started consuming any of the molasses mixtures. There was no marked variation in consumption of the molasses in an individual lot throughout the test. Of course, there was a tendency toward increased consumption as the animals became larger.

2. The ammoniated blackstrap molasses appeared to be more palatable and was consumed in greater quantity than the other mixtures. In fact, it is believed that this product was too palatable. The large amount of molasses tended to cause looseness or borderline scouring. A condition of this kind does not promote best utilization of nutrients.

3. No unusual behavior or toxic effects were observed.

1. This project was in cooperation with Westvaco Mineral Products Division, Food Machinery and Chemical Corporation, New York 17, N.Y.

2. This project was in cooperation with Clinton Corn Processing Company, Clinton, Iowa.

3. Ingredients for the molasses mixture in lots 8 and 9 were supplied and mixed by Feed Service Corporation, Crete, Nebr.

4. Animals receiving molasses urinated more than those on the control ration. Increased urination tended to vary with the rate of molasses mixture consumption. This condition resulted in excessively wet and muddy lots.

5. Silage consumption decreased when molasses consumption increased.

6. Although satisfactory gains were made with the nonprotein-nitrogen sources of protein, they were not so good as those where natural protein was used.

7. Gains in lots 10 and 11 were very poor for the first 28 days; however, they were about the same as lots 8 and 9 for the remainder of the test. This indicates the possibility that a longer period is needed for the rumen microorganisms to adjust to utilization of ammonia nitrogen.

8. One half pound of soybean oil meal per head in lot 12 greatly improved gains. Thus, it is indicated that a combination of natural protein and nonprotein-nitrogen is better than nonprotein-nitrogen alone.

9. The addition of ethyl alcohol tended to increase consumption of the molasses mixtures and increase rate of gain.

10. Limestone consumption was lower than expected; however, the quantity consumed, plus the amount of calcium in the silage, meets the recommended nutrient allowances.

Table 56

Results of Self-Feeding Molasses Mixed with Various Combinations of Urea or Ammonia with Phosphoric Acid and with or without Ethyl Alcohol in the Wintering Ration of Beef Heifer Calves.

December 15, 1956, to April 6, 1957—112 days.

Lot number	7	8	9	10	11	12
Number heifers per lot	11	11	11	11	11	10[1]
Av. initial wt., lbs.	435.0	435.5	434.5	433.6	434.0	431.0
Av. final wt., lbs.	601.4	565.0	567.7	526.4	540.9	579.5
Av. daily gain per heifer, lbs.	1.49	1.16	1.19	.83	.95	1.33
Av. daily ration, lbs.:						
Sorghum silage	29.4	30.1	30.5	22.1	23.0	26.7
Soybean meal	1.0					0.5
Milo grain	2.0					
Urea-blackstrap molasses No. 1[2]		2.1				
Urea-blackstrap molasses No. 2[3]			2.3			
Ammoniated blackstrap molasses No. 1[4]				5.2		
Ammoniated blackstrap molasses No. 2[5]					5.9	
Ammoniated hydrol[6]						3.2
Bonemeal and salt, equal parts	0.10					
Salt	0.05	0.12	0.16	0.15	0.15	0.11
Limestone		0.02	0.04	0.05	0.04	0.02
Lbs. feed per 100 lbs. gain:						
Sorghum silage	1978.0	2600.0	2563.0	2666.0	2408.0	2015.0
Soybean meal	67.3					37.7
Milo grain	134.6					
Urea-blackstrap molasses No. 1		180.6				
Urea-blackstrap molasses No. 2			193.3			
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	10.0	13.2	17.5	15.7	8.2
Limestone		1.9	3.4	5.5	4.3	1.8

1. One sick heifer removed.
2. Mixture of 77 percent blackstrap molasses, 3 percent phosphoric acid, 10 percent urea and 10 percent water (30 percent protein equivalent).
3. Mixture of 71 percent blackstrap molasses, 3 percent phosphoric acid, 6 percent ethyl alcohol, 10 percent urea and 10 percent water (30 percent protein equivalent).
4. Ammoniated blackstrap molasses with added phosphorus (15 percent protein equivalent).
5. Ammoniated blackstrap molasses with added phosphorus and 3 percent ethyl alcohol (15 percent protein equivalent).
6. Ammoniated hydrol with added phosphorus (15 percent protein equivalent).

The Value of Ammoniated Hydrol in the Fattening Ration of Yearling Beef Heifers (with and without Stilbestrol Implants) (Project 537).

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

Ammoniated hydrol (ammoniated corn molasses) has been used successfully as a partial nitrogen source in the wintering rations of beef cattle. This trial was designed to determine the value of the product in fattening rations for yearling beef heifers. Part of the animals in each treatment group were also implanted with stilbestrol.

Experimental Procedure

Twenty-seven yearling Hereford heifers were used in this study. They were divided into three equal groups on the basis of weight and previous treatment. Six heifers in each lot were implanted with stilbestrol, three at the 24-mg. level, and three at the 36-mg. level. All animals had free access to a mixture of salt and ground limestone, salt alone, and water.

Each group was fed twice daily and the concentrates, molasses, and cottonseed hulls were mixed together when fed. The control lot, lot 1, received 1 pound of soybean meal per head daily. In lot 2, one half the soybean meal nitrogen was replaced by nitrogen from ammoniated hydrol, and in lot 3, by nitrogen from dehydrated ammoniated hydrol. Cane molasses was used to equalize the molasses intake in all lots.

At the conclusion of the feeding period the heifers were grouped according to stilbestrol treatment and sold on the Kansas City market.

Observations

1. Hydrol was apparently as palatable as cane molasses.
2. Rate of gain was essentially the same in all lots. Those cattle receiving the liquid ammoniated hydrol were less efficient than the other groups.
3. The stilbestrol implants did not increase the rate of gain of the heifers regardless of implant level.
4. Some of the implanted heifers showed evidence of so-called side effects (elongated teats, raised tailheads, looseness and swelling about the external genitalia). The side effects seemed to reach a maximum about 60 days after implanting and then regress somewhat.
5. Although heifers implanted at two levels were fed in the same lot with nonimplanted heifers, no excessive riding or other stimulatory symptoms were noted.
6. The implanted groups showed carcass grades somewhat lower than those of the control groups.

Table 57

Ammoniated Hydrol As a Partial Nitrogen Source in the Fattening Ration of Beef Heifers.

May 9, 1956, to September 6, 1956—120 days.

Treatment	Control	Liquid amm. hydrol	Dehydrated amm. hydrol
Number heifers	9	9	9
Av. initial wt., lbs.	667	671	671
Av. daily gain, lbs.	1.59±0.12[1]	1.55±0.06[1]	1.67±0.08[1]
Av. final wt., lbs.	858	857	872
Av. daily ration, lbs.:			
Milo grain	10.6	11.6	11.2
Soybean oil meal	1.0	0.5	0.5
Alfalfa pellets	1.0	1.0	1.0
Cottonseed hulls	3.4	3.4	3.4
Molasses	1.5	....	0.9
Dehyd. amm. hydrol	....	....	1.0
Amm. hydrol	....	1.5	....
Feed per cwt. gain, lbs.:			
Milo grain	667.9	752.8	673.3
Soybean oil meal	61.0	31.5	29.4
Alfalfa pellets	61.0	63.0	58.8

1. Standard error of mean.

Table 57 (Continued)

Cottonseed hulls	214.8	221.5	207.0
Molasses	91.4	....	53.5
Amm. hydrol	....	94.6	....
Dehyd. amm. hydrol	....	....	58.8
Carcass grades:			
choice+	1	3	1
choice	3	2	3
choice−	4	1	2
good+	....	3	1
good	....	....	2
good−	1	....	....

Table 58

Heifers Implanted with Two Levels of Stilbestrol at Beginning of the Fattening Period.

May 9, 1956, to September 6, 1956—120 days.

Implant level	0 mg.	24 mg.	36 mg.
Number heifers	9	9	9
Av. initial wt., lbs.	671	668	674
Av. daily gain, lbs.	1.59±0.08[1]	1.60±0.12[1]	1.62±0.07[1]
Av. final wt., lbs.	860	860	868
Carcass grades:			
choice+	2	2	1
choice	4	2	2
choice−	3	....	4
good+		3	1
good		1	1
good−		1	
Selling price ($/cwt.)			
25.25	9 head		
24.50			7 head
23.00		8 head	
20.00		1 head	2 head

1. Standard error of mean.

Nutritive Value of Forages as Affected by Soil and Climatic Differences (Project 430).

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

This report is a summary of progress to date in one phase of the study designed to determine differences in the results obtained when cattle consume forage grown on limestone or sandstone soils.

In any study of this sort there are many variables which cannot be completely controlled or eliminated. Regardless of the care used in selection, pastures and meadows will differ somewhat in type and yield of forage. Rainfall differs, even on pastures within a few miles of each other. And the previous histories of the pastures are somewhat different. All these and many other variables affect the results obtained. Therefore, several years of comparisons will be needed before definite conclusions can be drawn. Results obtained to date should be looked upon as suggestive rather than as final conclusions.

Experimental Procedure

Thirty-nine choice Hereford heifer calves purchased from the Williams Ranches in Lovington, N.M., are being used in this study. The heifers were spayed to eliminate the possibility of their being bred during the study. They were then divided into two lots of approximately the same average weight. Twenty of the heifers were wintered on native sandstone

pasture and 19 were wintered on native limestone pasture. The predominant species in both pastures was native bluestem grass. The pastures were located within 8 miles of each other in Ellsworth County. Both lots of heifers received 1½ pounds of cottonseed cake daily as protein supplement during the winter period.

At the end of the winter period it was necessary to place the cattle in different pastures. Pastures used during the grazing period were approximately 20 miles apart and were as similar as possible except that one was on limestone soil and one was on sandstone soil. Frequency and quantity of rainfall differed on the two pastures. Rainfall was inadequate on both pastures during the grazing period.

Due to the drouth conditions of the pastures, the cattle were returned to Manhattan at the end of the pasture season. During the past winter they received prairie hay grown on either limestone or sandstone soil in Woodson County. One half of the heifers in each group received 4 grams of supplemental phosphorus per day during the winter period. All of the cattle received 1½ pounds of soybean meal per day during this period.

During all phases of the study the animals were weighed periodically. Blood samples were collected from a representative group of the animals at indicated intervals. Soil, water, and forage samples were also collected periodically throughout the different phases of the study.

March 11, 1957, the animals were started on a full feed fattening ration. They will be fed to choice slaughter grade. Further blood and skeletal studies are planned at the time of slaughter.

Results of all phases of the study to date are summarized in the tables that follow.

Table 59

Average Weight Gain of Spayed Heifers Eating Forage Grown on Limestone or Sandstone Soils.

Soil type	Limestone	Sandstone
Number of animals	19	20
Av. initial wt., lbs.	553	558
Phase 1—December 5, 1955, to April 15, 1956 (131 days)	Pasture	Pasture
Av. total gain, lbs.	63±5.7[1]	6±5.1[1]
Phase 2—April 15, 1956, to October 8, 1956 (176 days)	Pasture	Pasture
Av. total gain, lbs.	180±5.6	193±6.2
Phase 3—October 8, 1956, to March 8, 1957 (151 days)	Dry lot	Dry lot
Av. total gain, lbs.	149±8.4	114±8.4
Av. total gain December 5, 1955, to March 8, 1957, lbs.	392	313
Av. wt., March 8, 1957, lbs.	945	871

1. Standard error of mean.

Table 60

Value of Added Phosphorus for Spayed Heifers Wintered on Prairie Hay from Limestone or Sandstone Soil Areas.

Soil type	Limestone		Sandstone	
Treatment	Control	+P	Control	+P
Number of animals	9	10	10	10
Av. initial wt., lbs.	861	869	787	798
Av. total gain, lbs., November 28, 1956, to March 8, 1957	74±7.1[1]	79±8.9[1]	80±5.0[1]	79±8.4[1]
Av. hay consumed per day, lbs.	17	18	17	17
Soybean meal per day, lbs.	1.5	1.5	1.5	1.5
P from H_3PO_4,[2] per day, gms.	0	4	0	4

1. Standard error of mean.
2. Phosphoric acid mixed in soybean meal.