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The Value of Water Sprinklers for Cooling Pregnant Sows During the Summer

J. A. WHATLEY, JR., J. B. PALMER, DOYLE CHAMBERS AND D. F. STEPHENS

An experiment was conducted at the Fort Reno Experiment Station in the summer of 1956 to determine the effect of water sprinklers on the body temperatures of pregnant sows and their subsequent reproductive performance.

Procedure

In June, 41 gilts and yearling sows consisting of 17 Hampshires, 22 Duroc x Beltsville No. 1 crossbreds and 2 Durocs were divided into four lots for this test. The 28 gilts were divided into 2 equal lots on the basis of line of breeding and stage of gestation (the breeding season was from April 23rd to May 29th). The 13 yearling sows were also divided into two lots on the same basis.

Each of the four alfalfa pasture lots contained a 12 x 24 foot open shade with a galvanized iron roof six feet above the ground. The ground under the shades was covered with 6 to 8 inches of river sand. A single nozzle water sprinkler was installed under the shades for one gilt lot and one sow lot. Beginning June 15 these sprinklers were turned on about 8:00 a.m. each morning and turned off about 5:00 p.m. each afternoon.

Gilts and sows under the two treatments were hand fed equal quantities of the same ration twice a day. The sprinkled sows and gilts readily consumed the morning and afternoon feed immediately after it was placed before them. The non-sprinkled sows and gilts sometimes left the morning feed and frequently left the afternoon feed until sometime during the night. Their day's feed was always consumed prior to the next morning's feeding.

Rectal temperatures were taken on samples of 8 females from each of the two treatments at four weekly intervals beginning July 24th. Temperatures were taken between 1:00 and 3:00 p.m. and air temperatures under the shades were recorded at the same time. The air temperatures on these days ranged from 96 to 108 degrees F. (Table 1). The average body temperature for the sprinkled sows was 101.0 degrees (Table 2). It was rather consistent even with a 12 degree range in air temperature. The average temperature for the non-sprinkled sows was 103.8 degrees. The difference between sows on the two treatments was 2.8 degrees and highly significant. The body temperatures of the non-sprinkled sows and gilts tended to increase as the air temperature increased. There was no significant difference in the body temperatures of the gilts and yearling sows.

Table 1.—Air temperatures under shades when rectal temperatures were recorded.

Treatment	Date			
	July 24	July 31	Aug. 7	Aug. 14
No sprinklers	96.0	100.0	104.0	108.5
Sprinklers	96.0	100.0	101.5	104.5

Table 2.—Rectal temperatures of sows with access to shades with and without water sprinklers.

Treatment	No. sows	July 24	July 31	August 7	August 14	Av.
No sprinklers	8	102.7	104.2	103.9	104.6	103.8
Sprinklers	8	101.2	101.1	101.1	100.7	101.0
Difference		1.5	3.1	2.8	3.9	2.8[1]

[1] P is less than .01.
Day difference is significant at the .05 level.

Results

As the individual sows in the different lots were due to farrow in August and September, they were taken to the central farrowing barn and all were treated alike after that time. There were no sprinklers in the farrowing barn but on hot days all sows were sprinkled several times during the day with a hose. Five sows and 12 gilts from the sprinkled lots and similar numbers from the non-sprinkled lots farrowed fall litters. Reproductive failures in the two treatments were approximately equal (4 and 3 in the sprinkled and non-sprinkled groups respectively).

One gilt from the sprinkled lot aborted on June 29th and one sow from the non-sprinkled lot aborted August 12th. One gilt and two sows from the sprinkled lots and two gilts from the non-sprinkled lots failed to farrow. These individuals were tested for Brucellosis and Leptospirosis and found to be negative.

The production of the 34 females (24 gilts and 10 yearling sows) is summarized in Table 3. The sows and gilts sprinkled during pregnancy farrowed 10.06 live pigs per litter as compared to 7.71 for the non-sprinkled sows and gilts. The difference of 2.35 live pigs was significant. The sprinkled sows and gilts also farrowed more total pigs per litter and their litters were heavier at birth but these differences were not statistically significant. The non-sprinkled sows and gilts averaged 1.53 stillborn pigs and .65 decomposed embryos as compared to .82 stillborn pigs and .06 decomposed embryos per litter for the sprinkled sows and gilts.

The sprinkled sows and gilts weaned 7.76 pigs per litter as compared to 5.71 for the non-sprinkled sows and gilts. The difference of 2.05 pigs per litter was highly significant. Similarly the difference of 85 pounds

Table 3.—Reproductive performance of sows that had access to shades with and without water sprinklers during pregnancy, 1956 summer.

Treatment of Bred Sows	Sprinklers	No Sprinklers	Difference
No. of sows	17	17	
Farrowing Data:			
Total pigs farrowed per litter	10.88	9.24	1.64
Live pigs farrowed per litter	10.06	7.71	2.35[1]
Stillborn pigs per litter	.82	1.53	— .71
Decomposed embryos per litter	.06	.65	— .59
Litter birth weight, total pigs, lbs.	27.90	24.90	3.00
Litter birth weight, live pigs, lbs.	26.20	21.20	5.00
Weaning Data:			
Pigs weaned per litter	7.76	5.71	2.05[2]
Litter 56 day weight, lbs.	306.76	221.35	85.41[2]

[1] P is less than .05.
[2] P is less than .01.

in average litter weaning weight in favor of the sprinkled sows and gilts was also highly significant.

Other studies have demonstrated the value of cooling devices in promoting more rapid and efficient gains of growing pigs during the summer. The present experiment indicates that cooling the pregnant sow during the hot summer months may be even more important economically than cooling the growing pig. In hot weather the pregnant sow likely has more difficulty dissipating heat than a growing pig or an open sow. Therefore the benefits derived from cooling bred sows might be expected to be greater than from cooling fattening pigs. The differences in productivity of the sprinkled and non-sprinkled sows certainly support this view.

Cooling devices for sows and fattening pigs need not be expensive. Adequate shade over sand that can be wet down several times on hot days can be used to cool hogs. A fine mist spray nozzle over sand or concrete to prevent the formation of mud holes is a more satisfactory cooling device and is less time consuming than the procedure of sprinkling hogs under a shade several times each day.

During June, July and August maximum daily temperatures at El Reno averaged 96.3 degrees. During this period of 92 days the maximum temperature was above 90 degrees on 77 days. It is probable that the observed difference in the production of the sprinkled and non-sprinkled sows would not have been as great after a cool summer, but additional tests under different summer conditions are needed to determine the effect on production.

Effect of Three Levels of Carotene Intake During Lactation on the Performance of Beef Cows

O. G. DANIEL, L. S. POPE, R. W. MacVICAR AND W. D. CAMPBELL

The importance of vitamin A for beef cattle has been recognized for some time. In "normal" seasons, the carotene (provitamin A) requirement of beef cattle may be met by range grass and the ability of mature cattle to accumulate large body stores for use during the winter. However, the prolonged drouth in the southwest has intensified the vitamin A problem.

Previous work at this station has shown that deficiency symptoms can develop in young, suckling calves even though their dams appeared normal and that carotene supplementation of the dam during gestation is apparently not necessary unless the cows have been off green feed for long periods prior to calving.

With cow-calf operations, supplying the beef cow with carotene during lactation in order to protect her calf may be a critical item. The purpose of this experiment was to study the effect of feeding three levels of carotene during lactation on the vitamin A nutrition of the cow and her calf.

Procedure

Twenty-one, bred, two-year-old Hereford heifers were selected from the Experiment Station herd in December, 1955. Initial blood and liver levels of vitamin A and carotene were determined at this time. During gestation, the cows were fed weathered, range-grass hay, cut in December and devoid of carotene, plus 2½ pounds of cottonseed meal and 2 pounds of cracked milo per head daily. In addition, they had access to a mineral mixture of 2 parts salt and 1 part steamed bone meal. This ration was believed adequate with the exception of carotene. None of the cows received any supplemental carotene until after calving.

At parturition, blood and liver samples were taken and the cows were assigned to one of three lots. During the first 3 months of lactation, the cows of lots 1, 2 and 3 received 70, 140 and 210 mg. of carotene per head daily or 10, 20 and 30 mg./cwt., respectively.[1] The carotene was a carrot oil concentrate and was fed individually. In addition, they were continued on the winter-cut hay (free choice), plus 5 pounds of cracked milo and 3 pounds of cottonseed meal per head daily. The 3 levels of carotene were chosen in order to determine the optimum daily allowance that would maintain the liver stores of the lactating cow and protect her calf from vitamin A deficiencies. The calves had access to creep-feed composed of oats, milo and cottonseed meal.

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[1] Carotene used in these studies was supplied by Nutritional Research Associates Inc. of South Whitley, Ind.

The calves were removed from experiment at 3 months of age, at which time data were obtained on weight gains and blood and liver levels of vitamin A and carotene for the cows and calves.

Results

Changes in body weight of the cows and gains of the calves to 3 months of age are shown in Table 1. The vitamin A blood and liver data are contained in Table 2.

Table 1.—Average weight gains of beef cows and their calves.

	Lot number and level of carotene during lactation		
	Lot 1 70 mg.	Lot 2 140 mg.	Lot 3 210 mg.
Number of cows per treatment	5	6	7
Average cow weights (lbs.)			
Initial	711	756	726
Parturition	666	738	694
At 3rd mo. lactation	770	803	775
Gain, parturition to 3rd mo.	104	65	81
Average calf weights (lbs.)			
Birth	58	57	58
At 3 months	166	151	148
Total gain	108	94	90

Table 2.—Average vitamin A contents of blood and liver samples of beef cows and their calves.

	Lot number and level of carotene during lactation		
	Lot 1 70 mg.	Lot 2 140 mg.	Lot 3 210 mg.
Cows			
Blood Vitamin A (mg./100 ml.)			
Initial-Dec., 1956	34.47	34.01	34.89
Parturition	9.83	8.76	7.15
3rd mo. lactation	20.03	23.86	26.76
Liver Vitamin A (mcg./gram DM)			
Initial-Dec., 1956	243.94	271.86	225.95
Parturition	21.62	24.73	21.69
3 months	17.74	30.20	35.27
Calves			
Blood Vitamin A (mcg./100 ml.)			
Parturition	3.80	5.70	4.47
3 months	5.47	8.79	8.32
Liver Vitamin A (mcg./gram DM)			
3 months	2.60	3.66	5.20

The weight gains for the cows, from parturition to three months post-partum were 104, 65 and 81 lbs. for lots 1, 2 and 3, respectively. In the same order, calf gains from birth to three months of age were

108, 94 and 90 lbs. There was no consistent effect of varying levels of carotene intake on cow or calf weights.

Most of the calves were weak at birth and susceptible to scours for the first few weeks. Diarrhea was very noticeable in calves of lots 1 and 2 throughout the trial where the cows received 10 and 20 mg. of carotene per cwt. daily.

Two calves were lost in lot 1, and one in lot 2. Severe diarrhea was noted in these calves shortly before death.

The cows of lot 1 were not able to maintain liver vitamin A stores during lactation. In contrast, the liver stores of the cows in lots 2 and 3 had increased by the time the calves were 3 months old. Hence a carotene intake of 20 mg./cwt. appears necessary to maintain body vitamin A stores in the lactating beef cow. Slight differences in blood vitamin A levels in the cows, and liver and blood levels of their calves, reflected the greater carotene intake of lots 2 and 3.

Summary

Three levels of carotene were fed beef cows during early lactation and their effects on the performance of the cows and their calves were studied. The cows were depleted of body stores of vitamin A during gestation and received supplemental carotene to supply 10, 20 or 30 mg./cwt. after parturition. No deficiency symptoms appeared in the cows, and the different levels of carotene intake after calving had no consistent effect on calf weights at three months. Rate of survival was greater in calves from cows receiving the 20 and 30 mg./cwt. levels of carotene intake. It appears that beef cows may use body stores of Vitamin A to maintain health for long periods, but must receive relatively large amounts in the feed in order to protect their calves against a deficiency. Under range conditions, it may be more profitable to give the calves carotene or vitamin A directly (such as in the creep feed) than to feed high levels to their dams.

The Effect of Stilbestrol Implantation on Gains of Steers Grazing Native Grass

A. B. NELSON and W. D. CAMPBELL

Both the feeding and implanting of stilbestrol have greatly increased the gains of fattening cattle. The degree of response is apparently related to the level of energy in the ration. Experiments have indicated that the greatest response to stilbestrol implantation occurs when cattle are full-fed for rapid fattening with lesser or no response when cattle are "wintered" on a ration of relatively low energy content.

Results of tests with grazing cattle have been quite variable but apparently related to the type of pasture. In tests in other areas of the country, stilbestrol implantation has resulted in increased gains of cattle grazing high quality pastures such as legumes or legume and grass mixtures. During the summer of 1956 a test was conducted by the Oklahoma Agricultural Experiment Station to determine the value of implanting with stilbestrol steers grazing native grass pastures.

Procedure

The 56 steers used in this test had been used in previous experiments at the Lake Carl Blackwell experimental range area. They were choice-quality grade Hereford yearlings and two-year-olds which were divided into 4 lots of 14 head each. There were 7 yearlings and 7 two-year-olds in each lot. The test was started on June 8, 1956 at which time the steers were hauled in a truck for approximately 5 miles prior to weighing. Thus, the initial weight was a partially shrunk weight. The steers of Lots 2 and 4 were implanted with three 15 mg. pellets of stilbestrol at the base of the right ear.

All cattle were allowed to graze the native grass pastures (Bluestem and associated grasses). The steers in Lots 1 and 2 were allowed grazing plus salt, free choice. Those in Lot 2 were implanted with 45 mg. of stilbestrol. Because stilbestrol administration has been most beneficial in fattening rations this study included the feeding of a limited amount of ground milo to the steers in Lots 3 and 4. These steers were self-fed a mixture of salt and ground milo with the salt serving as a regulator of consumption. The salt content of the mixture was either 10 or 15 percent at various periods of the test. The average salt content was 13.2 percent and the average milo consumption was approximately 4.5 lbs. per head daily. In addition to self-feeding salt-milo to Lots 3 and 4, the steers in Lot 4 were implanted with 45 mg. of stilbestrol.

Results

A summary of the weight gains and milo consumption is presented in Table 1. The gains of the two groups of cattle allowed grazing only (Lots 1 and 2) were nearly equal. The stilbestrol implanted in the steers

Table 1.—The effect of stilbestrol implantation on gains of steers grazing native grass.

	Lot number/Supplemental feed/Stilbestrol			
	1 None[1] None	2 None[1] 45 mg. implant	3 Salt-milo[2] None	4 Salt-milo[2] 45 mg. implant
Number of steers per lot	14	14	14	14
Average weights per steer (lbs.)				
Initial 6-8-56	704	708	701	714
Final 9-6-56	840	845	858	872
Gain	136	137	157	158
Daily gain	1.51	1.52	1.74	1.76
Average supplemental milo (lbs.)	None	None	4.65	4.43
Cost of milo per steer ($)	None	None	8.58	8.17

[1] Salt was available free-choice.
[2] Self-fed a mixture of salt and ground milo. The mixture contained either 10 or 15 percent salt with an average salt content of 13.2 percent for the 90-day test.

of Lot 2 had no effect on gains. Also, the gains of the steers in Lots 3 and 4 were nearly equal. Thus, stilbestrol did not affect gains in either comparison (with and without milo).

The steers fed milo gained 21 lbs. more per head than those not fed milo. The value of the increased gain was not equal to the cost of the milo fed.

There were noticeable differences in the behavior of the steers implanted with stilbestrol and those not implanted. The implanted steers appeared to be more nervous and when confined to the corral for weighing would paw the ground excessively with more than usual bellowing. Their behavior was quite similar to that of an active bull. Most of the implanted steers had noticeably higher tail-heads. When some of these steers were marketed the buyers purchased them at $1-$2 per cwt. less than the control steers. This change in conformation and the behavior on test suggest that the implanted dosage (45 mg.) of stilbestrol may have been too high.

This test was conducted during a season of abnormally low rainfall, therefore, both the quantity and quality of grass in the pastures should be considered abnormal.

At the end of this experiment many of the steers were used in a test to determine the value of various supplements to high-silage rations for fattening two-year-old steers. All steers were fed stilbestrol in the dry-lot fattening phase and they were allotted in a manner which would allow a study of the carry-over effect of the stilbestrol implant during the summer. The summer treatment (implant or no implant, feeding milo) apparently had no effect on subsequent gains of fattening cattle.

Summary

Implantation of 45 mg. stilbestrol did not increase the gains of yearling and two-year-old steers grazing native grass with and without supplemental feed.

Nutritive Value of Various Protein Supplements for Lambs

WALTER R. WOODS, WILLIS D. GALLUP & ALLEN D. TILLMAN

Many feeders show a preference for one protein supplement over another in rations for cattle and sheep. The opinion generally held among research workers is that protein supplements when compared at equal protein intake are about the same in nutritive value for ruminants, although they may differ widely for non-ruminants, such as swine. A series of feeding and digestion trials with lambs were initiated in the Spring of 1955 to study differences in protein quality which might be the basis for the above preference. The limitations of this study in matters of final choice of supplements for lambs are recognized.

Procedure

Rations were formulated so that 67% of the total protein was furnished by the supplements to be tested. Among the supplements tested were two samples of cottonseed meal, one was of low nitrogen solubility (39.6%) and the other of high nitrogen solubility (70.1%). These were specially prepared products furnished by National Cottonseed Products Association, Inc. The solubility of the nitrogen indicated a reasonable difference in protein quality. Sesame meal was tested in a third ration, and a combination of two-thirds soybean meal and one-third sesame meal was tested in a fourth ration. All rations contained, in percent: cottonseed hulls, 50; blackstrap molasses, 20; corn oil, 0.2; salt, 0.5; and the protein supplement, 12.3 to 13.6, depending on its protein content. Cerelose (sugar) was added in amounts to bring the total to 100 percent. The rations were equalized in calcium and phosphorus content by adding $CaCO_3$ and $CaHPO_4$. Vitamin A and D were added in the form of Quadrex "10" Type IV. These rations contained approximately 8 percent protein.

The first test consisted of a growth trial using 24 wether lambs as the experimental animals. The lambs were kept in individual pens and were fed all they would consume daily for a period of 56 days. Following the growth trial two digestion trials were conducted with the lambs using essentially the same rations.

Results

The average daily gain, feed efficiency and crude protein digestibility are shown in Table 1. Lambs fed the special cottonseed meals gained less than the lambs fed either sesame meal or a combination of soybean and sesame meal. However, neither this difference nor the difference in gains made by the lambs fed the two cottonseed meals was statistically significant. Thus, nitrogen solubility did not appear to be an important contributing factor in the outcome of these results. On the basis of feed efficiency, the lambs fed the sesame meal ration or a combination of soybean and sesame meal were significantly more

Table 1.—Average daily gain, feed efficiency and crude protein digestibility for lambs fed various protein supplements

	Daily gain lb.	Feed per lb. gain	Crude Protein Digestibility, %
Cottonseed Meal—LNS	0.26	13.90	29.0
Cottonseed Meal—HNS	0.30	12.58	27.6
Sesame Meal	0.34	10.32	36.6
Soybean—Sesame Meal	0.36	10.65	37.5

efficient than those fed the two cottonseed meal rations. The digestibility of the protein was significantly lower in the two cottonseed meal rations than in the soybean-sesame meal combination or sesame meal ration. This difference in digestibility is believed to be one reason for the difference obtained in feed efficiency. However, other ration factors very likely are involved, and it is the purpose of experimentation of this type with simplified rations to sort out those factors and their influences and bring them under control in practical feeding operations. With this in mind, further tests are being made with these and other supplements which will lead to practical recommendations in selecting protein sources for sheep and cattle. As a brief summary of these initial results it may be said that in a single trial with simplified rations, lambs fed sesame meal or a combination of soybean and sesame meal made more efficient use of their feed than lambs fed two specially prepared cottonseed meals of low and high nitrogen solubility. The protein in the cottonseed meal rations was low in digestibility.

The Effect of Level of Wintering Upon the Production of Two-Year-Old Slaughter Steers

By A. B. NELSON and GLEN BRATCHER

For several years the Oklahoma Agricultural Experiment Station has conducted studies on the effect of level of wintering steer calves upon their subsequent performance as yearlings, two-year-olds, and three-year-olds. The best level of wintering apparently depends upon the management system used during the summer and the age at which the steers are sold. Should steers which are to be sold as two-year-olds be wintered at a "high" or a "low" level?

The most recent study relating to this problem was started in 1954 and completed during the summer of 1956. This test was part of an experiment initiated in 1952 with the following objectives:

1. To determine the effect of level of wintering for two successive winters upon the performance of two-year-old steers fed corn on grass during the second summer grazing season.

2. To compare two levels of feeding corn on grass to two-year-old steers which have been wintered at the same level of nutrition.

3. To compare the management systems of producing two-year-old feeder and slaughter steers.

The first two trials of this experiment were completed in the summer of 1954 and 1955 and the results were summarized in Oklahoma Agricultural Experiment Station MP-43 and MP-45, respectively. The results of the third and last trial are reported here.

Procedure

Fifty head of choice-quality grade Hereford steer calves were divided into two groups on October 30, 1954 (30 in one group and 20 in the other). Each group was confined in a 2-acre trap and fed prairie hay and 1.25 pounds of pelleted cottonseed meal per head daily during the winter months. In addition, the steers in the second group were fed 3 pounds of ground yellow corn per head daily. The ration containing corn has been designated as the "high" level of wintering and the ration without corn has been designated as the "low" level. At the end of the wintering period all calves were allowed to graze the native grass pastures at the Lake Carl Blackwell experimental range area.

At the end of the first summer grazing period the 30 yearling steers which were in the "low" level group as calves were divided into 3 lots (lots 1, 2, and 3) of 10 head each on the basis of initial weight and yearly gain. Also, the 20 head fed on the "high" level were divided into 2 lots of 10 head (lots 4 and 5). The steers were divided after having been in the experiment for one year instead of at the beginning of the test in order that gains for the first year within the two levels of wintering would be approximately equal.

During the winters the yearling steers were returned to the small traps and fed prairie hay and 1.25 pounds of pelleted cottonseed meal. In addition, some of the steers were fed corn. Those in lots 1 and 2 were continued on the "low" level of wintering. Those in lot 3 were fed at the "low" level as calves but changed to the "high" level as yearlings. Those in lots 4 and 5 were fed on the "high" level for both seasons.

As two-year-olds, all steers were allowed to graze native grass pastures. Those in lot 1 were sold on August 4, which was thought to be the most desirable time for selling two-year-old feeder steers in that particular season. The steers in the other four lots were fed 3 pounds of ground yellow corn per head daily while on grass. This was continued until late June at which time the amount of corn fed to the steers in lots 2, 3, and 4 was gradually increased until they were on a full-feed of corn. The steers of lot 5 continued to be fed 3 pounds of corn per head daily. Those in lots 2, 3, 4, and 5 were sold when it was estimated that their carcasses would grade approximately U. S. Choice when slaughtered.

A mineral mixture composed of 2 parts ground rock salt and 1 part steamed bone meal was available in all lots.

Results

A summary of the results is given in Table 1. The chemical composition of feeds and grasses is given in Table 2.

The gains during the winter as calves and during the following summer as yearlings are in agreement with previous results which indicate that cattle which gain the most during the winter will gain the least during the following summer.

Table 1.—The effect of level of wintering on the production of two-year-old steers.

Lot number[1]	1	2	3	4	5
Level of feeding, Winter I	Low	Low	Low	High	High
Level of feeding, Winter II	Low	Low	High	High	High
Level summer suppl. feed	None	High	High	High	Low
WINTER 1954-55 as calves (170 days)					
Average weight per steer (lbs.)					
Initial 10-30-54	430	440	434	439	440
Final 4-19-55	567	575	556	630	616
Gain in winter	137	135	122	191	176
Daily gain	0.81	0.79	0.72	1.12	1.04
Financial (dollars)					
Feed cost[2]	29.21	29.21	29.21	42.26	42.26
Initial cost @ $21.50 per cwt.	92.45	94.60	93.31	94.38	94.60
Value per steer[3]	121.00	122.76	118.58	131.36	128.57
Return per steer in winter	—0.66	—1.05	—3.94	—5.28	—8.29
SUMMER 1955 as yearlings (197 days)					
Average weight per steer (lbs.)					
Initial 4-19-55	567	575	556	630	616
Final 11-2-55	807	808	807	840	830
Gain in summer	240	233	251	210	214
Daily gain in summer	1.22	1.18	1.27	1.07	1.09
Total gain to date	377	368	373	401	390
Financial (dollars)					
Cost of grass and mineral	14.12	14.12	14.12	14.12	14.12
Value per steer[4]	140.94	141.12	140.94	146.70	144.90
Return in summer	5.82	4.24	8.24	1.22	2.21
Return to date	5.16	3.19	4.30	—4.06	—6.08
WINTER 1955-56 as yearlings (182 days)					
Average weight per steer (lbs.)					
Initial 11-2-55	807	808	807	840	830
Final 5-2-56	942	944	970	969	963
Gain in winter	135	136	163	129	133
Daily gain in winter	0.74	0.75	0.90	0.71	0.73
Total gain to date	512	504	536	530	523
Financial (dollars)					
Feed cost[5]	43.97	43.97	55.50	55.50	55.50
Value per steer[6]	155.38	155.72	159.97	159.80	158.78
Return in winter	—29.53	—29.37	—36.47	—42.40	—41.62
Return to date	—24.37	—26.18	—32.17	—46.46	—47.70
SUMMER 1956 as two-year-olds					
Average weight per steer (lbs.)					
Initial 5-2-56	942	944	970	969	963
Final 8-4-56 (94 days)	1126	1152	1175	1176	1175
Final 8-18-56 (108 days)	—	1178	1202	1204	1193
Gain to 8-4-56	184	208	205	207	212
Gain to 8-18-56	—	234	232	235	230
Daily gain to selling	1.96	2.17	2.15	2.18	2.13
Financial (dollars)					
Feed cost to 8-4-56[7]	17.61	38.96	38.76	38.76	25.23
Feed cost to 8-18-56[7]	—	43.13	43.13	43.13	26.36
Value per cwt. 8-4-56[8]	18.93	20.60	20.60	20.60	20.60
Value per cwt. 8-18-56[9]	—	21.84	21.84	21.50	20.50
Return per steer 8-4-56	29.56	30.88	31.17	31.54	45.89
Return per steer 8-18-56	—	45.54	46.31	43.03	47.12
Return to date 8-4-56	5.19	4.70	—1.00	—14.92	—1.81
Return to date 8-18-56	—	19.36	14.14	—3.43	—0.58

Table 1.—The effect of level of wintering on the production of two-year-old steers. (Continued)

Lot number[1]	1	2	3	4	5
Level of feeding, Winter I	Low	Low	Low	High	High
Level of feeding, Winter II	Low	Low	High	High	High
Level summer suppl. feed	None	High	High	High	Low
Summary 10-30-54 to Selling in Summer 1956					
Days on experiment	643	657	657	657	657
Average weight per steers (lbs.)					
Initial	430	440	434	439	440
Final	1126	1178	1202	1204	1193
Gain to selling	696	738	768	765	753
Financial (dollars)					
Initial cost @ $21.50 per cwt.	92.45	94.60	93.31	94.38	94.60
Total feed cost[10]	104.91	130.43	141.96	155.01	138.24
Selling price per cwt.	18.93	21.84	21.84	21.50	20.50
Value per steer (5% shrink)	202.55	244.39	249.41	245.96	232.26
Return per steer	5.19	19.36	14.14	—3.43	—0.58
Dressing percentage[11]	60.3	60.7	60.3	60.5	60.3
Carcass grade					
Low choice	0	0	1	0	0
High good	3	4	2	1	2
Average good	1	4	5	2	3
Low good	4	0	1	6	4
High standard	1	2	1	1	1
Low standard	1	0	0	0	0
Total feed					
Corn (lbs.)	0	945	1491	2001	1380
Cottonseed meal (lbs.)	440	440	440	440	440
Pasture (summer)	ad lib	ad lib	ad lib	ad lib	ad lib
Prairie hay (winter, lbs.)	5702	5702	5384	5146	5146

[1] Ten steers per lot.

[2] During the winter of 1954-55 as calves the average feed consumption per head in lots 1, 2 and 3 was prairie hay, 12.1 lbs. and cottonseed cake, 1.25 lbs. The steers in lots 4 and 5 were fed 10.7 lbs. of prairie hay, 1.25 lbs. cottonseed cake, and 3 lbs. ground yellow corn per head daily.

[3] Based on appraised price of $22 per cwt. in lots 1, 2, and 3 and $21.50 in lots 4 and 5 with 3% shrink.

[4] Based on appraised price of $18 per cwt. and 3% shrink.

[5] Average daily feed consumption was: Prairie hay, 20 lbs. in lots 1 and 2 and 18.3 lbs. in lots 3, 4, 5; and cottonseed meal, 1.25 lbs. In addition, the steers in lots 3, 4, and 5 were fed 3 lbs. of ground yellow corn.

[6] Based on appraised price of $17 per cwt. and 3% shrink.

[7] Cost of pasture and mineral in lot 1 and corn, in addition, for the remaining lots. The lot 5 steers were fed 3 lbs. ground yellow corn per head daily. The consumption of corn by the steers in lots 2, 3, and 4 was gradually increased to 21 lbs. for the last 3 weeks of the test. Total consumption of corn during the summer was 945 lbs. in lots 2, 3, and 4 and 324 lbs. in lot. 5.

[8] Selling price for slaughter in lot 1. Appraised price for these steers as feeders was $18.50. Appraised price per cwt. as slaughter steers for lots 2, 3, 4, and 5.

[9] Selling price as slaughter steers.

[10] Based on prices prevailing during the test (See Okla. Agr. Expt. Sta. MP-43 and MP-45).

[11] Based on market weight and cold carcass weight.

Lot 1 (grazing only) vs. Lot 2 (corn on grass).

The steers in both lots 1 and 2 were wintered on the "low" level for both winters. The two-year-olds grazing native grass without supplemental corn (lot 1) were sold for slaughter on August 4, 1956 at an average price of $18.93 per cwt. At this time they were valued at $18.50 per cwt. as feeders. During the two previous years the value of steers for slaughter was the same as their value as feeders.

The steers of lot 2 were sold August 18, 1956. This selling was approximately two months earlier than in preceding years because the cattle appeared to be in higher condition than previously. The

Table 2.—Chemical composition of feeds and grasses.

	Percent dry matter	Percentage composition of dry matter: Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Ca	P
1954-55								
Prairie hay	94.11	7.94	4.80	3.05	32.19	52.02	.46	.05
Cottonseed meal	94.76	6.81	41.30	7.59	8.21	36.09	.20	1.03
Corn	91.24	1.59	9.37	4.08	2.06	82.90	.03	.23
Native grass[1]								
May		8.60	11.42	2.92	29.16	48.23	.30	.18
August		7.65	3.47	3.54	32.66	53.92	.34	.04
1955-56								
Prairie hay	94.96	6.56	5.33	2.88	33.60	51.63	.45	.05
Cottonseed meal	93.18	7.42	42.73	5.99	12.51	31.35	.20	1.20
Corn	90.72	1.44	10.78	4.65	1.90	81.23	.03	.32
Native grass[1]								
May		7.44	13.17	2.96	29.20	47.23	.32	.15
August		6.83	3.66	2.33	34.41	52.77	.42	.06

[1] Average by species of four predominant grasses: big bluestem, little bluestem, switch, and Indian.

selling price was $21.84 per cwt. At the time of selling the average daily corn intake was 21 lbs. per head daily. The total amount of corn consumed during the summer was 945 lbs. Because of this consumption of corn the total feed cost in lot 2 was $25.52 greater than in lot 1 ($104.91 vs. $130.43). The selling value minus feed cost (return) was $5.19 and $19.36 for lots 1 and 2, respectively. Thus, it was more profitable to sell two-year-olds that had been fed corn on grass.

These results are not in agreement with those obtained in 1954 and 1955 when it was less profitable to feed corn on grass. The increased net return in lot 2 was due mainly to the increase in price level of slaughter cattle in mid-August. If the lot 2 steers had been sold on August 4 the return would have been $4.70 which was slightly less than the return in lot 1. Selling 2 weeks later resulted in an increased return of $14.66 ($4.70 vs. $19.36) per head.

The steers of lot 1 were in the experiment for 643 days and gained 696 lbs. Those of lot 2 gained 738 lbs. in 657 days.

Level of Wintering with Full-Feeding on Grass (lots 2, 3, and 4)

A comparison of the results in lots 2, 3, and 4 allows an evaluation of the effect of 3 levels of wintering on the production of two-year-old slaughter steers which were full-fed corn on grass. The steers of lot 2 were not fed corn in either winter. Those of lot 4 were fed corn for both winters. Those of lot 3 were not fed corn the first winter but were fed corn the second winter (designated the "low-high" level of wintering) to determine whether or not feeding corn during the second winter only was as satisfactory as feeding corn both winters. The total gain to selling was 738, 768, and 765 lbs. for lots 2, 3, and 4, respectively. They were sold on August 18 when it was estimated that their carcasses would grade U. S. Choice. However, the grades were over estimated because the carcass grade was approximately high good.

The carcass grades of the lot 3 steers were slightly lower than the grades in the other lots but this difference was not reflected in dressing percentage.

The return was related to the level of wintering in that the steers fed corn both winters (lot 4) lost $3.43 per head, those fed corn the second winter only (lot 3) returned $14.14, and those not fed corn returned $19.36. These results are in agreement with results of the 1955 test but not the 1954 test. Although there were only small differences in return during the 1956 summer period only, differences in previous wintering costs resulted in greater return for the lower levels of wintering.

The average consumption of corn during the entire test was 945, 1491, and 2001 lbs. for the steers in lots 2, 3, and 4, respectively.

Lot 4 (full-fed on grass) vs. Lot 5 (3 lbs. corn on grass).

It was more profitable (although the difference was only $2.85 per head) to feed 3 lbs. of corn per head daily than to full-feed corn on grass to steers that had been fed at a "high" level for two winters. This is in agreement with the 1955 test, but in 1954 the results were in favor of full-feeding. The lot 5 steers had gained only 12 lbs. less in the 657 days than those in lot 4. The packer buyers preferred the lot 4 cattle as indicated by the $1 per cwt. difference in selling price but this was not reflected in differences in carcass grades and dressing percentage.

Summary

In this test it was most profitable to winter two successive winters at a "low" level and sell two-year-old steers after full-feeding on grass during the summer. When steers were sold after full-feeding corn on grass the return was related to the level of wintering in that the least profit was realized when steers had been wintered at the high level, the greatest profit resulted from the low level of wintering, and the return from wintering at the "low" level the first year and "high" level during the second year was intermediate. Limited feeding on grass after wintering at a high level was more profitable than full-feeding similar cattle on grass. It was more profitable to full-feed corn on grass than to allow grazing only after wintering at the "low" level.

Phosphorus Supplements for Beef Cattle

S. A. EWING, A. B. NELSON, A. D. TILLMAN and W. D. GALLUP

Steamed bone meal is recognized as one of the chief sources of supplemental phosphorus for livestock. At present, however, the demand for supplemental phosphorus has far exceeded the supply of steamed bone meal. This has led to the use of inorganic sources, such as defluorinated rock phosphate, dicalcium phosphate, Curacao Island phosphate and colloidal clay. Of the latter three sources, only colloidal clay has failed to produce good results in recent tests at this station.

This experiment was designed to (1) compare the value of defluorinated rock phosphate and feeding grade dicalcium phosphate as sources of supplemental phosphorus for growing beef cattle and (2) compare these feed grade materials with two purified sources of phosphorus, reagent grade dicalcium phosphate and nomosodium phosphate.

Procedure

The experiment was divided into three periods. During Period 1 the experimental animals, 15 grade Hereford steers and 25 grade Hereford heifers, were self-fed the low-phosphorus basal ration shown in Table 1. At the end of this 56-day depletion period the animals were divided into five lots on the basis of sex and weight. During the second and third periods the cattle in Lot 1 were continued on the basal rations as a negative control. Lots 2, 3, 4 and 5 were self-fed the rations shown in Table 1, which contained supplemental phosphorus from reagent grade dicalcium phosphate, defluorinated rock phosphate, feed grade dicalcium phosphate and monosodium phosphate, respectively.

Table 1.—Composition of experimental rations (lbs.)

Ingredients[1]	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Cerelose[2]	22.10	22.10	22.10	22.10	22.10
Cottonseed hulls	37.48	37.48	37.48	37.48	37.48
Beet pulp	27.10	27.10	27.10	27.10	27.10
Alfalfa meal	9.10	9.10	9.10	9.10	9.10
Corn gluten meal	3.70	3.70	3.70	3.70	3.70
Urea	.35	.35	.35	.35	.35
A&D supplement[3]	.17	.17	.17	.17	.17
Reagent dicalcium phosphate	--	.18(.32)[4]	--	--	--
Deflourinated rock phosphate	--	--	.25(.44)	--	--
Feed grade dicalcium phosphate	--	--	--	.21(.37)	--
Monosodium phosphate	--	--	--	--	.17(.31)
Calcium carbonate[5]	--	.34(.56)	.25(.41)	.31(.51)	.47(.79)
P from supplement %	--	.04(.07)	.04(.07)	.04(.07)	.04(.07)
P from basal %	.08	.08	.08	.08	.08

[1] In addition, salt was fed free-choice.
[2] Corn sugar.
[3] Supplied 2724 I. U. of vitamin A and 340 I. U. of vitamin D per lb. of ration. Trade name is "Quadrex"—Supplied gratis by Nopco Chemical Co., Harrison, N. J.
[4] Figures in parenthesis indicate amount of supplemental phosphorus added during Phase 3.
[5] Calcium carbonate was added to maintain a constant Ca:P ratio in all rations.

Blood samples for the determination of plasma inorganic phosphorus were taken by jugular puncture at 14-day intervals. The animals were weighed and feed consumption was determined at the end of each 14-day period.

During Periods 2 (56 days) and 3 (56 days) the level of supplemental phosphorus was .04 percent and .07 percent, respectively. The level of supplemental phosphorus was increased to .07 percent at the end of the first 56 days because the weight gains and plasma phosphorus values were not as great as in previous tests. Also, some stiffness and lameness was observed indicating that the level of supplemental phosphorus may have been too low. Measures of the value of the various supplements were weight gain, plasma inorganic phosphorus and feed consumption.

Results

Weight Gain:

As shown in Table 2, the basal ration containing .08 percent phosphorus did not support normal growth. The provision of supplemental phosphorus resulted in greater gains. However, the cattle fed .04 percent additional phosphorus from monosodium phosphate (Lot 5) did not gain as much as the other supplemented cattle in Period 2. The gains in Lot 5 were considerably greater during Period 3 and when Periods 2 and 3 were combined the gains of all supplemented cattle were considerably greater than those fed the basal ration. The low gain in Lot 5 during Period 2 is probably related to the low feed consumption until near the end of the period. At this time feed consumption started to increase and continued to increase throughout Period 3.

Table 2.—Weight gain of cattle fed different amounts and sources of phosphorus (lbs.)

Lot number	1	8	3	4	5
Animals per lot	8	2	8	7[1]	8
Source of supplemental phosphorus	None	Reagent grade dicalcium PO_4	Deflourinated rock PO_4	Feed grade dicalcium PO_4	Monosodium PO_4
Period 2 (56 days)					
Initial wt.	455	475	469	467	465
Final wt.	478	537	528	510	493
Gain	23	62	59	43	28
Period 3 (56 days)					
Initial wt.	478	537	528	510	493
Final wt.	478	568	578	605	571
Gain	0	31	50	95	78
Periods 2 & 3 (112 days)					
Initial wt.	455	475	469	467	465
Final wt.	478	568	578	605	571
Gain	23	93	109	138	106

[1] One steer died, cause unknown.

No one supplement was consistently superior, although the total gain of cattle consuming feed grade dicalcium phosphate was considerably greater than the gains of any of the other lots. As measured by weight gain, defluorinated rock phosphate and the two relatively purified sources of phosphorus were approximately equal.

Plasma Inorganic Phosphorus:

During Period 2 the increase in plasma inorganic phosphorus values was approximately the same in Lots 2, 3 and 4 (Table 3). The reason for the failure of a similar increase from feeding monosodium phosphate (Lot 5) during this period may have been reduced feed consumption during much of the period. The greatest increase in plasma phosphorus values during Period 3 was in Lot 5, and when Periods 2 and 3 are combined the greatest increases occurred in Lots 4 and 5. Plasma inorganic phosphorus is apparently a satisfactory indicator of the state of nutrition of phosphorus in the animal body. In this test the inclusion of supplemental phosphorus in the ration increased plasma phosphorus levels. However, the smallest increase resulted from the feeding of reagent dicalcium phosphate.

Table 3.—Plasma inorganic phosphorus (mg/100 ml) of experimental cattle.

Lot number	1	2	3	4	5
Source of supplemental phosphorus	None	Reagent grade dicalcium PO_4	Deflourinated rock PO_4	Feed grade dicalcium PO_4	Monosodium PO_4
Period 2 (56 days)					
Initial phosphorus	2.70	2.74	2.83	2.89	2.75
Final phosphorus	2.05	3.28	3.36	3.40	2.39
Change	—.65	.54	.53	.51	.36
Period 3 (56 days)					
Initial phosphorus	2.05	3.28	3.36	3.40	2.39
Final phosphorus	1.96	3.62	4.26	4.64	4.49
Change	—.09	.34	.90	1.24	2.10
Periods 2 & 3 Combined (112 days)					
Initial phosphorus	2.70	2.74	2.83	2.89	2.75
Final phosphorus	1.96	3.62	4.26	4.64	4.49
Change	—.84	.88	1.43	1.75	1.74

Feed Consumption:

The average feed consumption for each lot during Periods 2 and 3 is shown in Table 4. During Period 2 feed consumption was approximately equal in Lots 1, 2, 3 and 4, but was considerably less in Lot 5.

In Period 3 feed consumption was greatly increased in all lots fed supplemental phosphorus. However, feed consumption decreased in the lot fed the basal ration. The feed consumption in Lot 5 remained

Table 4.—Feed consumption of experimental cattle (lbs.)

Lot number Source of supplement phosphorus	1 None	2 Reagent-grade dicalcium PO_4	3 Deflourinated rock PO_4	4 Feed grade dicalcium PO_4	5 Monosodium PO_4
Avg. daily feed consumption Period 2	9.1	9.2	9.6	9.4	7.8
Avg. daily feed consumption Period 3	8.5	14.4	14.9	15.0	13.8

below that in Lots 2, 3 and 4, but this lower intake was sufficient to promote apparently normal plasma inorganic phosphorus levels.

Summary

Feed grade dicalcium phosphate, deflourinated rock phosphate, reagent grade dicalcium phosphate and monosodium phosphate are apparently satisfactory sources of supplemental phosphorus for beef cattle as measured by weight gain, plasma inorganic phosphorus and feed consumption. The results indicated that the feed grade sources of phosphorus were equal or superior to the relatively purified sources of phosphorus.

Apparently rations containing .12 percent phosphorus are suboptimum with respect to this element and .15 percent phosphorus more nearly approached the minimum requirement of these animals.

Some Factors Influencing Ewe Conception During Late Spring

JOE V. WHITEMAN, RICHARD S. PITTMAN and K. I. BROWN

Much of the commercial sheep production in Oklahoma is unique because it involves breeding the ewes during an unnatural season (spring). Problems involved with breeding during spring, gestation during the summer, lambing during the fall and lactation during the winter have not been studied by experiment stations to an appreciable extent. The commercial breeding ewe project at Ft. Reno was started in order that we might study some of the problems inherent in this system of milk lamb production. Among these problems are the following:

1. What is the best kind of a ewe to buy?
2. How should ewe flocks be culled?
3. Should one buy or raise replacements?
4. What management practices will cause an increased lamb crop?

This study was started in April and May of 1955 with the purchase of two hundred yearling ewes from the Del Rio area of Texas. Therefore, at the present time the latter problem is the only one which has yielded reportable results. Certain management practices have consistently increased the percentage lamb crop produced under the conditions that have prevailed during the last two breeding seasons.

Management of the Flock

The ewe flock was composed of 100 grade Rambouillet and 100 ¼ Panama X ¾ Rambouillet (RPR) backcross ewes. All rams used have been good commercial grade yearling Dorsets. The breeding season was started about May 20 and lasted for 48 days. Ewes that have not conceived during this period have been considered as dry ewes. All breeding has been done at night with the flock managed in such a manner that the sire of most of the lambs is known.

The flock was handled as a commercial flock. During the late spring and summer Bermuda grass was the principal feed. Supplemental feed was added during the late gestation and early lactation periods. The lactating ewes grazed on wheat pasture during the winter and were moved to cheat grass pastures in early March. Dry ewes and rams were wintered on winter grass (principally cheat grass) in the small lots and paddocks around the Ft. Reno headquarters. The lambs were creep fed a mixture of one part chopped alfalfa hay and two parts of cracked kafir grain. Lamb weights were taken every two weeks starting when the first lambs born were about six weeks old. When lambs reached a weight of 90 pounds, they were sold on the Oklahoma City market and carcass weights and grades were obtained.

Procedure and Results

Rams used in the study were purchased in pairs from one to three months prior to the breeding season. The rams of a pair were half brothers or closer in relationship and as much alike in age, size, and type as could be obtained. A proportionate number of the ewes were mated to each pair of rams. One ram of each pair was used for four nights then the other ram was used for a like length of time.

To study the effect of temperature on ram performance, one ram of each pair was maintained in a cooled room from 8:00 a.m. until 5:00 p.m. daily whereas the other ram of each pair was kept in a stall of the same size. Feed and water were available to the rams during the day. In 1955 an evaporative cooler was used which lowered the temperature only 3 to 8°F. Maximum temperatures in the stall reached 88 to 93°F. and the temperatures were 83 to 86° in the cooled room while outside temperatures were 97 to 103°F. during the latter part of the season. In 1956 a half ton refrigerated cooler was used which succeeded in keeping the cooled room 10 to 20 degrees cooler than the stall. Maximum temperatures in the stall were 94 to 96°F. while those in the cooled room were 82 to 83° F. during the hot spells in June and July. Table 1 gives a summary of the breeding performance of the rams during these two breeding seasons.

Table 1.—The breeding performance of cooled and non-cooled rams during the 1955 and 1956 breeding seasons.

	Cooled		Uncooled
		1955 results	
Effective matings	68		58
Known conceptions	43		32
Percent conception	63		55
		1956 results	
Effective matings	129		111
Known conceptions	89		72
Percent conception	69		65
No. twin births	33		19

It is usually believed by sheepmen that sheep do better immediately after being shorn. To determine if shearing the ewes just before the breeding period would improve their performance, a test was conducted in the spring of 1956. One half of the ewes were shorn on April 7 and the other half shorn on May 12. Table 2 shows the results of this study.

Table 2.—The performance of ewes shorn 10 days prior to breeding as compared to those shorn six weeks before the breeding season.

	Shorn 4/7	Shorn 5/12
Number of ewes	97	98
Number of ewes that conceived	78	84
Number of ewes that twinned	16	36
Percent ewes lambing that twinned	20	43

As indicated before, one half of the ewe flock is of Rambouillet breeding and the other one half are of ¼ Panama breeding. Many sheepmen prefer ewes of part Panama or Columbia breeding because they are usually larger and more open faced. The lambing performance of the two kinds of ewes has not been adequately tested under spring breeding conditions. The two groups of ewes in the breeding flock are from different flocks in the same area of Texas. The Rambouillet ewes have consistently out performed the part Panama ewes under the conditions of this experiment as shown in Table 3.

Discussion and Summary

The two years results obtained to date represent findings which certainly do not represent all conditions. During each of the breeding seasons the average temperatures have been high during the latter part of the period. The results represented here indicate rather conclusively that under conditions of heat during the breeding season, management practices to prevent the rams from getting too hot will improve their performance. Likewise, delayed shearing of the ewes caused a significant

Table 3.—The performance of two groups of ewes of different breeding and origin.

	RXPR Backcross	Grade Rambouillet
1955 results		
Number of ewes	98	100
Number of ewes mated	80	96
Number of ewes that lambed	57	80
Number of lambs born	73	91
Number of lambs 20 days of age	47	77
Percent lambs born dead or lost	36	15
Percent lamb crop	48	77
1956 results		
Number of ewes	97	98
Number of ewes mated	92	94
Number of ewes that lambed	78	84
Number of lambs born	99	115
Number of lambs at 20 days of age	77	104
Percent lambs born dead or lost	22	10
Percent lamb crop	79	106

increase in the percentage of multiple births. The results obtained in the comparison of the part Panama ewes with the grade Rambouillet ewes is more difficult to interpret. The difference in performance may be due to the breeding of the sheep or it may be due to the way the sheep were handled before they were obtained for the experiment. A conclusion can be drawn however, i.e., different groups of ewes perform quite differently under the same conditions. Therefore, it is imperative that the cause or causes of these differences in performances be determined.

Reproductive Efficiency of Range Beef Cows

DOYLE CHAMBERS, GARY O. CONLEY and J. A. WHATLEY, Jr.

The number of beef cows two years of age and older in Oklahoma on January 1, 1957 was estimated by the United States Department of Agriculture to be more than one and one-fourth million head. These cows are being kept for the production of beef calves, most of which are marketed at weaning time either as feeder calves or as fat slaughter calves. In this system of production the success of the operation depends greatly upon the costs of maintaining the cow herd and the productivity of the individual cows in the herd.

In a recent survey conducted by the Research Committee of the American National Cattlemen's Association it was reported that only 79 per cent of the beef cows and heifers bred for 1954 calving actually dropped live calves and that only 63 percent of them raised calves to weaning. Other estimates by the United States Department of Agriculture indicate that, for the ten years 1945-54, 84 percent of cows on hand on January first calved. This was somewhat higher than the 1954 survey estimate.

Oklahoma calf crop percentage for the above ten-year period was estimated at 86 percent which was a bit higher than the national average and was considerably above some of the states in the Western and Southern regions. No reliable estimates of the percentage of cows actually weaning calves are available for Oklahoma, but it is probable that no more than 75 to 80 percent of them raise calves. If we could assume that it costs $64.00 per year to maintain a brood cow, and that an eighty percent calf crop is weaned, this would mean that the cost of each calf is $80.00. This does not include costs of producing replacement females which is related to the length of productive life of the brood cow. It is quite obvious, however, that factors of major importance in cow productivity would include regularity of reproduction, length of productive life, and the mothering ability of the brood cow including milking capacity.

According to the 1954 survey, referred to above, more than one-half of the cows culled from breeding herds were removed because of age and nearly one-third of the cows culled were removed because the cows were "dry" at weaning time. This indicates that little opportunity exists for selection of cows for other productive traits.

It is obvious that a high percentage calf crop is an essential feature of any successful cow-calf system of beef production. It is also highly desirable that these calves be dropped in the shortest possible period of time to simplify management of the herd and aid in marketing of the calves. Because of the importance of reproductive regularity to the beef cattle breeder, information is needed upon the influence of heredity and various environmental factors upon this particular factor of cow productivity.

Before one can conduct studies of factors influencing the reproductive efficiency of beef cows, he must devise methods for measuring differences among individuals. Calf crop percentage is a measure which can be used in the evaluation of the influence of certain environmental factors upon groups of cows, but is of much less value when trying to determine the influence of hereditary factors upon reproductive efficiency.

If individual selection is to be effective there must be heritable individual differences which one can detect by some means. This presents a problem to beef cattle producers because most beef cattle are pasture-mated during a restricted breeding season with very little information upon the breeding behavior of individual animals. One knows the period during which the cow was exposed to a bull and the date upon which she calves each year. He does not often know the reasons for her failure to conceive if she does not produce a full-term calf each year.

Nature of This Study

During the past year a study of the reproductive performance of some 325 beef cows which had been in the various herds of the Oklahoma

Agricultural Experiment Station during the past four to nine years was conducted to determine the repeatability of two different measures of reproductive efficiency. Two of the herds were located at the Ft. Reno Livestock Experiment Station; one of the herds was at the Lake Carl Blackwell Range area; and the other herd was maintained at a substation near Wilburton.

The experimental treatments differed from herd to herd and from one group to another within each of the herds, but all of the cows in this study were pasture-mated during a limited breeding season. The breeding season began about the first of May and ended during the early part of August each year. Fifteen to twenty cows and one bull was the usual size of the breeding group. Cows which failed to conceive during the breeding season were not exposed to a bull again until the following year.

Herd A was located at Ft. Reno and it contained three lines of registered Herefords and one line of registered Angus. These cows were treated alike so far as nutritional and management practices were concerned, but two of the lines were being developed by inbreeding while the other two lines were being developed by outbreeding. The two inbred lines contained cows which varied in ages while the two outbred lines contained cows all of which calved first in 1952 at three years of age.

Herd B was a high grade Hereford herd located also at Ft. Reno. These cows were all dropped in 1948 and half of the cows on each of the three different levels of supplemental winter feeding was bred to calve first at two years of age and half was bred to calve first at three years of age.

Herd C at the Lake Carl Blackwell area and Herd D at the Wilburton Station contained cows which were on various mineral supplementation treatments. These studies were initiated with pregnant high grade Hereford heifers to calve first at three years of age.

The two measures of reproductive performances studied in these data were calving intervals and successful exposures.

A calving interval is the length of time in days between consecutive calves from the same cow. In this particular study because of the restricted breeding season, calving intervals which were extended to near two years because of the failure of a cow to calve one year were eliminated from the analysis because it was assumed that, if year long breeding had been followed, these cows could have had calving intervals much shorter than the two-year intervals imposed by the short breeding season.

A successful exposure was a period of time in days from the time the open cow was exposed to a bull until she calved the next year. It was assumed that the more efficient reproducers would conceive more quickly after they were put into the breeding herds and that they would consequently calve earlier the following year. The distribution of the data in this study is given in Table 1.

The number of cows and the number of calving intervals were fewer than the number of cows with successful exposures. A cow and her records could be used if she had as many as two calves in her lifetime in the case of successful exposures, but she must have had at least three calves in three consecutive years to have the minimum of two calving intervals required for a study of repeatability for that trait.

Table 1.—Number of records in this study.

		Calving Intervals[1]		Successful Exposure[2]	
Herd	No. of Years	No. of Cows	No. of Intervals	No. of Cows	No. of Calves
A	5	61	175	99	351
B	6	94	411	109	558
C	9	42	238	58	372
D	4	54	157	59	211
Total		251	981	325	1,492

[1] A calving interval is the length of time between consecutive calves of a cow.
[2] A successful exposure refers to the interval of time from the date upon which the breeding season began to the date upon which the cow calved.

Results of the Study

The average length of the 981 calving intervals of the 251 cows included in this study was 364 days with a standard deviation of 28 days. This short interval and its small variability were due to the limited breeding season and to the elimination of records of two year intervals which resulted when a cow failed to calve during a year. If the cows had been bred year long, there would have been a longer average calving interval and the intervals would have been more variable than these.

Among the cows whose records are included in this study there was an average calf crop of 94 percent. Only 12 percent of the cows which failed to calve once failed to calve a second time during the period of these records. These excellent results are biased upward by the initial selection of pregnant heifers for the initiation of two of the herds, by the selection of some of the data imposed by the nature of the study, and by the good management practices to which the cows were exposed.

The calving intervals were analyzed by an analysis of variance and the intraclass correlations were obtained. The repeatability of calving interval derived in this manner was —.09 with a 95 percent confidence interval of —.02 to —.16. This estimate is in line with other estimates in the literature and indicates that, under conditions of a limited breeding season, calving interval is not likely to be of any use to breeders as a measure of reproductive performance for which they may effectively select brood cow replacements. It might perhaps be of more value in herds where year-long breeding is a practice, but data of that kind need to be studied.

It was thought that the period of time from the first exposure of an open cow to a bull until she calved might be a more refined measure of breeding efficiency for cows bred in a restricted season than was calving interval. The 1492 such intervals from successful exposure until calving averaged 309 days with a standard deviation of 27 days. Analysis of the variance of these intervals was calculated for each herd separately. The repeatability estimates obtained from the intraclass correlations ranged from +.06 to +.22 among the four herds with the pooled estimate of +.14 (Table 2a). When the analysis was made on an intra-season, intra-lot (treatment or line) basis, the repeatability estimates ranged from +.10 to +.30 with a pooled estimate of +.25 (Table 2b). This increased repeatability indicated that the environmental sources of variation associated with the different seasons and treatments were exerting a significant effect upon the interval from exposure to calving.

It was thought that perhaps the first record of a heifer might be a less accurate predictor of future performance than later records. The data were analyzed again after removing the first interval from the records of each cow. It will be noted from Table 2c that the repeatability of the interval from exposure to calving was estimated at +.38 by cause it would be expected that cows which have been open for the longer period of time before being put with a bull would more likely be bred earlier than one calving nearer the time of first exposure to the breeding pen, it was decided to adjust the records of all cows for differences among them for days from calving to first exposure. The average number of days from calving until exposure to the bull was 56 days in this study. This adjustment resulted in a repeatability estimate of +.33 which is shown in Table 2d.

Although the repeatability estimates for the interval from exposure to the bull until calving were not extremely high in these data, they were positive and they were large enough that one might expect to considering only records produced subsequent to the first record. Be-

Table 2.—Repeatability estimates of the interval from exposure to calving.

Method[1]	Herd A	Herd B	Herd C	Herd D	All Herds Pooled
(a)	.20	.12	.06	.22	.14
(b)	.25	.30	.10	.27	.25
(c)	.44	.26	.26	.65	.38
(d)	.40	.20	.20	.59	.33

[1] (a) Intra-class correlation uncorrected for temporary environmental variance.
(b) Intra-class correlation corrected for temporary environmental variance.
(c) Intra-class correlation corrected for temporary environmental variance, omitting the first record.
(d) Intra-class correlation corrected for temporary environmental variance, omitting the first record and corrected for days calving to exposure.

be able to select effectively for earlier calving cows. This would result in a more uniform group of calves so far as age is concerned and would perhaps be to the advantage of the breeder in the management of his cow herd and in the marketing of his calves.

These data were not suitable for a study of factors which might be responsible for "skip-breeders" because so few animals of that kind were available for observation. There is a real need for information of that type. Until suitable measures of reproductive efficiency are developed and until the importance of genetic and environmental factors has been determined, one cannot intelligently determine the amount of emphasis which should be placed upon reproductive performance in a selection program.

Genetic Aspects of Cancer Eye in Cattle[1,2]

DAVID E. ANDERSON[3] and DOYLE CHAMBERS

Cancer eye in cattle results in a significant economic loss each year to the livestock producer. The disease reduces productivity by shortening the life span of an animal. Diseased animals may die, may require treatment, or may need to be removed from the herd before their productive lives are completed, thus lowering the efficiency of production. It has been estimated that animals with cancer eye leave the herd about one year earlier than unaffected animals; and that in the southwestern states about 3 to 10 percent of the animals are removed from the herd each year because of the disease.

The salvage value of these culled animals and possibly of treated ones is reduced because entire carcasses or parts of carcasses may be condemned at slaughter, depending upon the extent of the disease and condition of the affected animal. The average annual loss from such condemnations alone is in excess of one million dollars. A reduction in the incidence of the disease obviously would be of economic concern to the livestock industry.

Materials and Methods

The animals included in this study were grade and purebred Hereford cattle from Oklahoma, Texas and New Mexico. A total of 2613 animals from seven herds were involved in the different phases of study.[4]

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[1] Publication No. 4 of the Cancer Eye Study Section of The University of Texas M. D. Anderson Hospital and Tumor Institute, Houston, Texas.

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The eyes of the animals in three of the herds were routinely examined in the spring and fall of each year. The period of observation for these three herds was from 1946 to 1954. One other herd has been examined twice each year since 1954. The remaining herds have been examined annually since 1954. Calves were observed for eyelid pigmentation. Animals in the breeding herds were observed for eyelid pigmentation and eye lesions. Any lesion on the eye which appeared to be cancer, or an advanced cancer precursor was usually removed by surgery. The practice in one of the herds was to dispose of such animals soon after the lesion was first observed.

Cancer may develop in any part of the eye and may develop simultaneously in both eyes. A common place for it is at the lateral portion of the eyeball where the white of the eye and dark cornea join. Other places where it is commonly seen include the inner or medial junction of the cornea and white of the eye, the region of the "third eyelid" or nictitating membrane, and the eyelids themselves. The disease usually develops after four or five years of age, and seems most frequent around eight years of age.

Some Herefords have brownish-red pigment on the skin of the eyelids which differs in shade of color, pattern, and amount between eyes on the same animal, and from animal to animal. In the present case, lid pigmentation was considered as an **amount**. The amount was measured as a percentage of the entire lid length covered by pigment; thus, the values could range from zero for complete lack of pigment to 100 percent for completely pigmented lids.

Results

Since the absence of eyelid pigmentation has been thought to be an important contributing factor in the occurrence of cancer eye in cattle, the first objective was to provide information on this relationship. All animals used in this particular phase of study were in the age range (over 4 years of age) in which the preponderance of cancer eye lesions occurs. Records of eyelid pigmentation were available on 842 animals, among which 338 had eye lesions which included cancer and other precursor lesions. The relationship between eye lesions and eyelid pigmentation is summarized in Table 1.

By comparing the expected values with the ones actually observed, the difference can be studied to determine the importance of the relationship between pigmentation and lesions. If there is little difference, it means there is probably little relationship between lesions and pigmentation. If the difference is large, the relationship is probably large.

There is little difference between the expected incidence and actual incidence of lesions on the eyeball within each of the pigmentation classes. There is only the slightest indication that more lesions occurred on the eyeball of eyes with zero lid pigmentation and correspondingly fewer lesions occurred in eyes completely surrounded by pigmentation than would be expected if there really were no relation between

Table 1.—The incidence[1] of cancer eye lesions among eyes with varying amounts of pigmentation on the lids.

Location of lesion		Percent pigmentation on the lids			
		Zero	Less than 50	50 or more	100
Eyeball	Observed	32	26	26	22
	Expected	(28)	(27)	(28)	(26)
Lids	Observed	18	9	5	0
	Expected	(10)	(10)	(10)	(10)
Nictitating Membrane	Observed	3	3	2	0
	Expected	(3)	(3)	(2)	(3)

[1] Each of the values represents the observed percentage of all animals within each of the pigmentation classes that had a lesion on the eyeball, lids, or area of the nictitating membrane. The numbers in parentheses are the values that would be expected *if* pigmentation and lesions were not related in any way.

lesions and pigmentation. The difference is small enough that it could easily have occurred by chance about 30 percent of the time. In other words, the incidence of lesions on the eyeball is about the same in eyes surrounded by a lot of lid pigmentation as it is in eyes surrounded by little or no lid pigmentation, meaning there is little, if any, relationship between lesions on the eyeball and lid pigmentation.

Likewise, there is little relationship between lesions developing in the area of the nictitating membrane and amount of lid pigmentation. In Table 1 the actual incidence of these lesions within the different pigmentation classes is almost identical to the expected incidence. Such a small difference would be expected by chance about 40 percent of the time.

There is, however, a highly significant relationship between cancer eye lesions on the lids and amount of lid pigmentation. In Table 1 the incidence of lid lesions in the zero pigmentation class exceeds the expected value by 8 percent. The incidence of lid lesions within each of the partially pigmented classes is correspondingly lower than expected, while no lesions were observed to develop on lids completely covered by pigment, although many more were expected. In fact, no lid lesions were ever observed to develop on any pigmented portion of the lids. It is evident that as the amount of lid pigmentation increases, the actual incidence of lid lesions decreases. Pigment on the skin of the lids seems to protect against the development of cancer eye lesions on the lids. Such differences as were found would occur by chance only once in a thousand times.

In view of this, the incidence of cancer eye lesions on the lids could be reduced by selection for an increased amount of pigmentation on the skin of the lids. The heritability of lid pigmentation was studied in a sample of 1117 animals. These were by 116 identifiable sires and from 513 dams.

Heritability is a measure of the extent to which the differences among animals are due to differences in the genes they have which act in an additive manner. Heritability can be determined from resemblances between relatives, that is, between mother and offspring, sire and offspring, paternal half-sibs, or maternal half-sibs. In the present case, the method amounts to dividing the parents into those which have pigmentation and those that do not, and then studying the pigmentation in the progeny of the two groups of parents. This method gives an estimate of the fraction of the differences in amount of pigmentation selected for in the parents that would be expected in the progeny. A low estimate of this fraction would mean that a selection program other than on the animal itself would be needed to change the average amount of pigmentation in the herd in succeeding generations. Information on the pigmentation of ancestors, parents, sibs or progeny would also be needed. On the other hand, a high fraction, or high heritability, would mean that direct selection for animals with large amounts of lid pigmentation would suffice in effectively increasing the average amount of pigmentation in the herd.

By studying resemblances in amount of pigmentation between mother and offspring, an estimate of heritability of .44 was found. This estimate is sufficiently high to indicate that the animal itself should be the most important criterion in selecting for an increased amount of pigmentation. Such selection, while increasing the average amount of lid pigmentation, would also be expected to reduce the incidence of lesions such as develop on the lids. It is unlikely that it would have much effect on the incidence of lesions on the eyeball or area of the nictitating membrane because the relationship between these lesions and eyelid pigmentation appears to be small. It is also unlikely that such selection would result in more than a slight reduction in the general incidence of cancer eye lesions because lesions on the lids are only a small proportion of the total number. Lesions on the eyeball and area of the nictitating membrane were about three times more frequent than those on the lids for animals in this study. Therefore, in a herd in which lid lesions account for a third of all eye lesions, selection for an increased amount of lid pigmentation might reduce the general incidence of lesions only about a third. The effect of selection for pigmentation on the general incidence of lesions will become smaller as the incidence of lid lesions becomes smaller. The general incidence of eye lesions might be more effectively reduced by selecting for increased resistance to the disease, since there appears to be a genetic basis for differences among animals in their susceptibility to cancer eye.

Table 2 shows the important effect inheritance has on the occurrence of the disease. The results are from a purebred herd in Oklahoma.

The incidence in the progeny of susceptible sires and resistant dams was 15 percent higher than the incidence in the progeny of two resistant parents. When the dam was the susceptible parent, the incidence was

Table 2.—The incidence of cancer eye in the progeny of susceptible parents with the disease and resistant parents without the disease.

Condition of parent Sire x Dam	Number of matings	Percent incidence in progeny (over 4 yrs. of age)
Resistant x Resistant	56	8.8
Susceptible x Resistant	13	23.7
Resistant x Susceptible	15	26.7
Susceptible x Susceptible	9	44.4

18 percent higher than that in the progeny of two resistant parents. The incidence in the progeny of two susceptible parents was 36 percent higher than that in the progeny of two resistant parents. Hence, one susceptible parent has increased the incidence about 17 percent and two susceptible parents have increased it 36 percent compared to resistant parents. This indicates the cumulative or additive effect of the genes affecting differences in cancer eye susceptibility.

Additional information on the importance of hereditary differences was had from study of mother-daughter resemblances in susceptibility to cancer eye. Susceptibility was determined by the age at which cancer eye lesions occurred. It was assumed that an animal developing the disease early in life is usually more susceptible than one developing the disease later in life. Among normal animals, the older ones are scored as being more resistant than the younger ones, because among the young ones some probably would have developed lesions if other causes had permitted them to remain in the herd to older ages. The heritability of susceptibility to cancer eye was .41, as measured by this age-score. This indicates that 41 percent of the differences in susceptibility selected for in the mothers would be expected in the progeny. Or, as the susceptibility score of the mothers increases, that is, the earlier they develop the disease, the susceptibility score of the progeny also increases, meaning they also tend to develop it earlier. Conversely this indicates again that resistant parents tend to have resistant progeny.

The incidence of cancer eye could be effectively reduced by selecting animals for the breeding herd from aged resistant animals. Since cancer eye appears in animals over four years of age and mostly in those about eight years of age, animals should be kept to 8, 9 or more years of age to be certain that they are resistant to cancer eye. If lid lesions are a problem, an increased amount of pigmentation on the skin of the lids should also serve as a criterion for some mild early selection.

Breeders are probably already practicing some selection against the disease, because animals with cancer eye are usually removed from the herd shortly after cancer is first recognized. Since an animal with cancer early in life is considered more susceptible than one in which it occurs later, the more susceptible animals leave fewer offspring in the herd before their removal. Thus, they have less opportunity of transmitting a high degree of susceptibility. This practice results in some automatic selection against the inheritance of susceptibilty. It should be remembered that this selection does not of itself lead to discarding the offspring the susceptible animals had produced before they were removed from the herd.

The automatic selection would not apply if eyes or lesions were treated or removed by surgery because the inherent susceptibility to the disease would still remain. Treatment or surgery can be used to prevent the spread of the disease and thereby increase the salvage value of an animal, or it can be used to allow an animal to remain in the herd until its calf is weaned.

Summary

A total of 2613 grade and purebred Hereford cattle were used to study (1) the relationship between amount of pigmentation on the skin of the eyelids and the occurence of cancer eye lesions; (2) the inheritance of amount of lid pigmentation, and (3) the inheritance of susceptibility to cancer eye.

A real relationship was found between lid pigmentation and lid lesions. Many more such lesions occurred on non-pigmented lids than would be expected if lesions and pigmentation were not related. Correspondingly fewer lesions occurred on partially pigmented lids than expected, while none was observed to develop on lids completely covered by pigment. No lid lesions were ever observed to develop on a pigmented area of the lids. There was little, if any, relationship between amount of lid pigmentation and cancer eye lesions occurring on the eyeball or area of the nictitating membrane.

Amount of lid pigmentation was found to be highly heritable. Selection for an increased amount of pigmentation would be expected to reduce the incidence of lid lesions, but would have little effect on the incidence of lesions on the eyeball or area of the nictitating membrane.

The general incidence of cancer eye lesions could be more effectively reduced by direct selection for increased resistance to the disease since susceptibility was found to have a genetic basis.

Radiographs of the Lumbar Vertebrae of Beef Calves and their Association with the Snorter Dwarf Gene

E. J. TURMAN, R. D. HUMPHREY, DOYLE CHAMBERS and DWIGHT STEPHENS

One of the important problems facing the beef cattle industry in recent years has been the occurence of dwarf calves among the progeny of phenotypically normal parents. Although conflicting opinions as to the cause of this condition have been advanced, it appears almost certain that it is hereditary.

Evidence collected to date indicates the inheritance of this abnormality is due to a single pair of autosomal recessive genes. Dwarf calves are homozygous for the recessive dwarf gene, while non-dwarf calves have at least one dominant non-dwarf gene. Thus normal calves may be either of two genotypes: homozygous for the dominant gene, and free of dwarfism: or heterozygous, and a carrier of dwarfism. The problem that faces the breeder in his efforts to eliminate dwarfism is to identify the normal animals that are carriers.

A large amount of research has been directed towards developing a method that will accurately distinguish carrier animals from clean. One such method was suggested by workers at Iowa State College, who observed marked differences in the lumbar vertebrae of dwarf and non-dwarf calves that were free of the dwarf gene. The abnormalities seen in dwarf vertebrae were also present, to a lesser degree, in the vertebrae of calves which were known to be carriers.

Examples of these characteristic differences, as seen in radiographs of the lumbar vertebrae, are presented in Figure I. The most noticeable differences are seen in the lateral profile of the body of the lumbar vertebrae. The vertebrae of animals believed to be free of the dwarf gene appear rectangular in outline and have a smooth ventral surface, which is arched dorsally (example C). In the dwarf (example A) there are marked undulations of the ventral profile, so that the ventral surface of the vertebrae protrudes downward. In addition the ventral edge of the lumbar vertebrae of the dwarf is usually shortened, resulting in a somewhat triangular, rather than rectangular, outline. The degree of abnormality observed in the vertebrae of dwarf-carrier calves varies considerably, from very slightly abnormal to very definitely abnormal. The radiograph labeled B in Figure I is a typical example of this type.

On the basis of these observations it was suggested that differences observed in the radiographs of the lumbar vertebrae of very young calves might permit the identification of animals that were carriers of the dwarf gene. Calves with normal vertebrae (C of Figure I) would be predicted clean, while calves with abnormal radiographs (similar to B of Figure I) would be predicted carriers of the dwarf gene.

To test this theory the present study was conducted at the Ft. Reno Station during 1955 and 1956. An x-ray machine was installed late in 1954, and a tester herd of approximately 100 cows known to be carriers of the dwarf gene were purchased to progeny test bulls whose genotypes for the dwarf gene were predicted on the basis of their x-rays.

Procedure

All calves produced in three projects in 1955 and 1956 at the Ft. Reno Station were x-rayed as soon as possible after birth. It is very

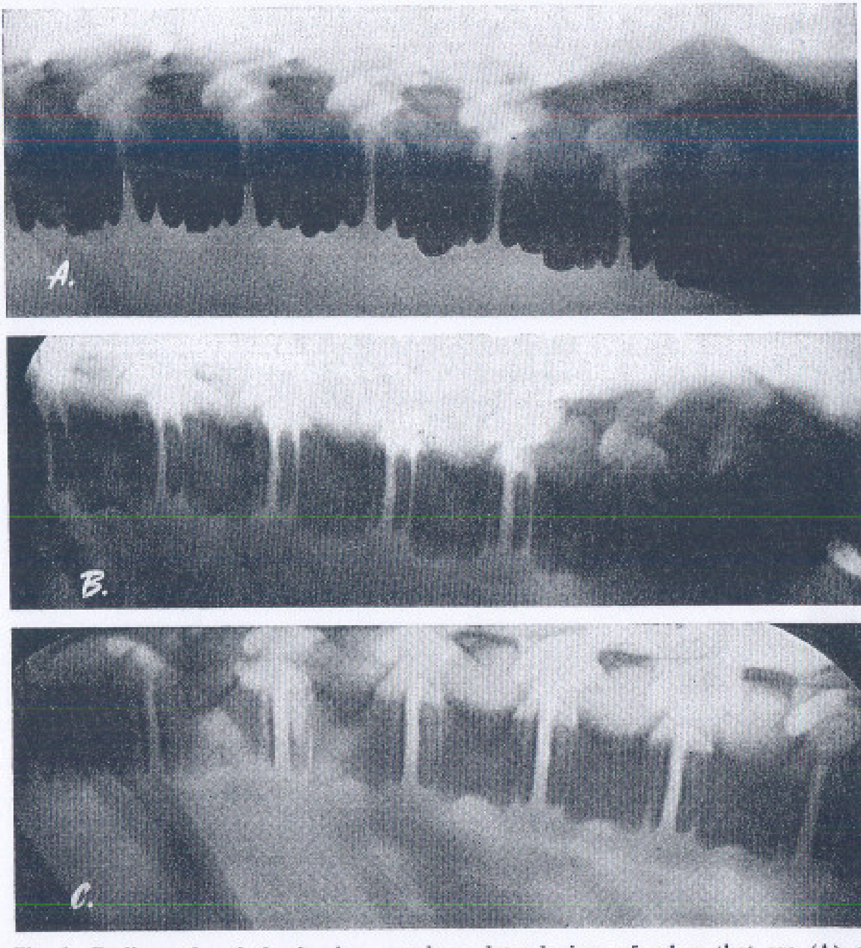

Fig. 1 Radiographs of the lumbar vertebrae, lateral view, of calves that are (A) a snorter dwarf, (B) predicted carrier of the dwarf gene, and (C) predicted free of the dwarf gene.

important that the calves be x-rayed by the time they are one week of age, primarily because the characteristic defects tend to be partially corrected as the animal grows older. There are also further advantages: the very young calves are easier to handle; their digestive tracts have not yet filled with gas and ingesta which tends to obscure the radiograph; and there is less tissue that the x-rays must penetrate.

On the basis of the radiographs of their lumbar vertebrae the calves were classified as A (dwarf), B (carrier), and C (clean) Calves with B x-rays were further classified as to degree of abnormality as MB (mild B, only slightly abnormal), IB (intermediate B, definitely abnormal), or

XB (extreme B, extremely abnormal). However, calves with any of these three classifications of B x-rays were predicted carriers.

The carrier cow herd now consists of 64 Herefords, 41 Angus and 1 Shorthorn. Except for 20 grade Herefords purchased in 1954, the cows were purchased in 1955 from cooperating breeders in four states. Many of the cows were with calf when purchased which prevented their immediate utilization in the progeny testing program.

Forty-three cows, bred to five half-brother pairs of bulls, calved in the Spring of 1956, and thirty-two cows bred to three pairs of bulls calved in the Fall of 1956. Except for one pair of bulls, both of which were predicted carriers, one bull of each pair was predicted clean, and the other a carrier. The bulls were selected from all of the purebred lines at the Ft. Reno Station as well as three pairs of Hereford bulls from the Iowa Experiment Station herd.

In the first test each bull was mated to six cows. In subsequent tests, each bull was mated to more than 6 cows to insure each bull siring at least 6 calves. Siring six calves would not test any individual bull to a very high level of probability, but 80% of the carrier bulls should sire at least one dwarf. The accuracy of the x-ray technique would be determined by whether dwarf calves were produced only by cows mated to bulls that were predicted to be carriers.

Results and Discussion

Data are presented on a total of 602 calves, of which 48 have a known genotype for the dwarf gene. Table 1 presents the x-ray classifications of all animals of known genotype.

Table 1.—Summary of x-ray classifications of animals of known genotype—data on all breeds combined

Description of Animals	No. Animals	No. Animals in Each X-Ray Classification				
		C	MB	IB	XB	A
Homozygous Recessive (Dwarf)	37	0	0	0	2	35
Heterozygous:						
By progeny test	4	1	0	1	2	0
One parent dwarf	7	1	1	3	2	0

All dwarf calves are known to be homozygous for the recessive dwarf gene. Ninety-five percent of the 37 dwarf calves x-rayed had the lumbar vertebral abnormalities that are characteristic of the dwarf. The two dwarf x-rays that were not classified A were classified as a very extreme B. Very few lumbar x-rays of non-dwarf calves have had abnormalities as extreme, and no x-ray from a non-dwarf calf has ever been classified as A. It should be noted that the two calves that were exceptions were of comprest breeding, although the calves were typical snorter dwarfs.

These data indicate that x-rays of the lumbar vertebrae are a very reliable means of identifying a dwarf calf. Although most breeders have very little trouble in recognizing a dwarf calf, there are some cases in which positive identification is difficult, especially when the calves are born dead or short term. In such cases an x-ray prediction could be extremely valuable to the owner of the sire of the doubtful calf.

Four animals, proven heterozygous on progeny test were x-rayed as baby calves. Three had the expected B type x-ray, but one bull with a C x-ray, and thus predicted clean, sired two dwarf calves in the comprest line. The bull was not of comprest breeding. Although there is evidence that animals of comprest breeding also carry a dwarf gene other than the snorter dwarf gene, these calves appeared to be of the typical snorter dwarf type.

Seven calves were known to be heterozygous because they were sired by a dwarf bull, and thus received a recessive dwarf gene from their sire. All were produced by Hereford heifers, one sired by a dwarf Hereford, and six sired by a dwarf Angus. Although all of the heterozygotes should have had x-rays with a B classification, one of the crossbred heterozygotes had a x-ray that was classified C.

The limited data available from known heterozygous animals indicates that the accuracy of the x-ray as a means of detecting carriers is not too high. Although it is dangerous to draw too many conclusions from the small number of animals in this study, 18% of the animals known to be heterozygous were, or would have been, predicted dwarf free on the basis of their x-rays. However, it may be very important to consider that the exceptions, in both the heterozygous and homozygous recessive groups involved either comprest breeding, or crossbred matings.

A summary of the offspring sired by 16 x-rayed bulls in the tester herd is presented in Table 2. Two of the nine bulls that were predicted carrier sired dwarf calves, while no dwarfs were sired by the seven bulls that were predicted clean. It will be noted in Table 2 that a number of the bulls were bred to fewer than six cows, largely due to the lack of knowledge about the cow herd. Most of the cows were purchased just prior to the start of, or during the breeding season. Many that were thought to be open, and which were allotted to bulls, were subsequently found to have been bred when purchased. There were a few instances in which the cows allotted to a bull were found to be non-breeders. In Table 2 the number of cows listed as having been bred to a bull include all open, fertile cows exposed to that bull. The number listed as having been settled by the bull were the cows bred to the bull that were diagnosed as pregnant by a veterinarian who examined the cows approximately three months after the end of the breeding season.

Although the progeny test data do not permit predictions as to the accuracy of the x-ray technique, the results are encouraging. Only bulls

Table 2.—Summary of x-ray classifications of calves sired by x-rayed bulls in tester herd

Sire	X-Ray of Sire	Dwarfism Status of Sire	Number of Cows Bred	Number of Cows Settled	Number of Cows Calved	No. Calves in Each X-Ray Classification C	MB	IB	XB	A
Hereford										
4-68	B	Predicted Carrier—Clean Pedigree	5	5	4	2	2	0	0	0
4-07	B	" " —Carrier Pedigree	6	4	3	0	0	2	1	0
1354	B	" " —Carrier Parent	3	3	2	0	0	1	1	0
1434	B	" " —Carrier Parent	4	4	2	1	0	0	0	1
1584	B	" " —Carrier Parent	6	6	6	0	0	2	1	3
1524	B	" " —Carrier Parent	6	4	4*	1	0	1	1	0
4-26	C	Predicted Clean —Clean Pedigree	6	6	6	2	0	1	3	0
4-38	C	" " —Carrier Pedigree	4	4	4	1	1	2	0	0
1044	C	" " —Carrier Parent	5	5	5	4	0	1	0	0
1154	C	" " —Carrier Parent	6	6	6	3	2	1	0	0
Angus										
304	B	Predicted Carrier—Carrier Pedigree	5	4	4	1	1	1	1	0
154	B	" " —Carrier Pedigree	6	4	2	1	0	1	0	0
455	B	" " —Carrier Pedigree	6	6	6	1	1	4	0	0
114	C	Predicted Clean —Carrier Pedigree	6	5	5*	4	0	0	0	0
104	C	" " —Carrier Parent	8	8	8	5	1	2	0	0
456	C	" " —Carrier Parent	8	8	8	6	1	1	0	0
Totals for 9 sires predicted carrier			47	40	33	7	4	12	5	4
Totals for 7 sires predicted clean			43	42	42	25	5	8	3	0

* Includes one calf for which x-ray classification was not made.

that were predicted to be carriers sired dwarf calves. It would be expected that if any carriers were included in the groups of bulls predicted clean, at least one would have sired a dwarf, since five of the seven bulls sired six or more calves. It is important to consider that four of these five bulls had a carrier parent, and by chance alone one-half of the sons of a carrier would also be expected to be a carrier. Thus the data obtained by the use of bulls with a C classification indicates the x-ray technique is fairly accurate. However, before any estimate of accuracy can be made many test matings such as this must be made. It will be important to know not only what percentage of the animals with C x-rays are carriers, but also, if possible, what percentage of the animals with B x-rays are clean.

It is very interesting to compare the breeding record of the two groups of bulls. The bulls predicted carrier settled 85% of the cows allotted to them, compared to 98% settled by the bulls that were predicted clean. Perhaps of even more importance is that all the cows calved that were diagnosed as settled to the predicted clean bulls, while only 83% of the cows diagnosed as settled by the predicted carrier bulls calved. In one instance a cow was known to have aborted, but the fetus was too premature to determine whether it was a dwarf. In the remainder of the cases the fetus either was resorbed or was aborted at a very early stage and was not detected. The significance of these observations is not known, but it seems more than coincidental that all cases of apparent fetal death occurred in matings involving bulls that were predicted carriers. It also suggests that care should be exercised in interpreting progeny test matings in which no dwarf calves were produced, but several cows bred to the bull under test aborted.

The Hereford heifers mated to the dwarf Angus bull provided some further progeny test information. Since the heifers were mated to a dwarf, one-half of the carrier heifers would be expected to produce a dwarf calf. Four of the seven heifers were predicted clean, and all produced normal calves. Three of the heifers were predicted carriers, and one heifer produced a crossbred dwarf. These results were as near the expected as could be obtained.

The data presented in Table 3 is a summary of the distribution of x-ray classifications among the calves produced in the three projects included in this study. Most of these calves were produced by animals whose genotype for the dwarf gene was not definitely known, but which could be predicted from pedigree and known breeding history. For example the animals in the grade Hereford herd of Project 650, and the purebred Herefords of Line 3 of Project 670 were believed to be clean on pedigree and no dwarf calves have been produced in these lines. The other purebred lines of Project 670 could be carriers on pedigree, but only a few dwarf calves have been produced, and the known carrier animals have been largely eliminated. All cows in the Project 873 herd are known to be carriers of the dwarf gene.

Table 3.—Summary of x-ray classifications of calves produced in three projects at Ft. Reno in 1955 and 1956.

Description of Cows	Dwarfism Status of Cows	No. Sires	No. Calves	No. Calves in Each X-Ray Classification				
				C	MB	IB	XB	A
Grade Hereford (Proj. 650)	Probably Clean	12	235	181	39	15	0	0
Purebred Hereford (Proj. 670)								
Line 2	Carriers in Pedigrees	7	64	34	12	16	1	0
Line 3	Pedigree Clean	3	54	39	4	11	0	0
Purebred Angus (Proj. 670)	Carriers in Pedigrees	4	64	41	11	8	2	2
Tester Hereford (Proj. 873)	Known Carriers	?	96	36	11	26	17	6
Tester Angus (Proj. 873)	Known Carriers	?	54	25	8	15	3	3

If a herd includes only clean animals, all calves should be dwarf-free and have x-rays classified as C. However, it will be noted in Table 3 that approximately one-fourth of the calves produced in the lines believed to be dwarf-free had B type x-rays, although none had extremely abnormal vertebrae. These observations suggest that these lines may include some dwarf carriers that have never been detected, or the abnormalities of the lumbar vertebrae are independent of the dwarf gene. However, this latter conclusion is not supported by the data from lines with a dwarfism history.

The two lines of Project 670 that have carriers in their pedigrees produced a higher percentage of x-rays classified as B than did the clean lines. Forty-seven percent of the Line 2 Herefords, and 33% of the purebred Angus calves were classified B and predicted heterozygous. Since the frequency of the gene in these lines is not known, although it is believed to be low, the expected percentages of each genotype cannot be determined.

If only the data from the known carrier cows of Project 873 are considered, the observed distribution of genotypes as predicted from the x-ray classifications closely fits the expected. If carrier cows were mated to clean bulls, 50% of the offspring should be clean and 50% should be carrier. If the carrier cows were mated to carrier bulls, 25% of the offspring should be clean, 50% carrier, and 25% dwarf. If both clean and carrier bulls were used the percentage of clean offspring would be somewhere between 25% and 50%, there would be 50% carriers, and less than 25% would be dwarf.

The genotypes of all the bulls to which the Project 873 cows were mated was not known, but it was evident that some were carriers and it was believed that some were clean. If the data for both breeds is combined, 40% of the calves had C x-rays, and thus were predicted clean, 54% had B, or predicted carrier, x-rays, and 6% were dwarf calves.

A comparison of the x-ray classifications of calves in Table 2 reveals striking differences in the progeny of the two groups of bulls. Sixty percent of the calves sired by the bulls predicted to be clean had x-rays classified as C, with 40% classified as B. In the group of calves sired by the bulls that were predicted carrier there were 22% classified C, 66% classified B, and 12% classified A. If we assume that the genotypes predicted for the sires on the basis of their x-rays were correct, these observed ratios were very close to what would be expected. It is evident, in any event, that bulls with B type x-rays sire a much higher percentage of calves with B x-rays, while bulls with C type x-rays sire a much higher percentage of calves with C x-rays.

While no definite conclusions as to the accuracy of the x-ray technique can be drawn from these distributions, the evidence suggests that the x-ray may be very useful in herds that have a dwarfism problem. It seems more than a coincidence that the observed distributions of enotypes as predicted by the x-ray fits so closely the expected distribu-ion of genotypes in the lines with known dwarfism history. However, he occurrence of calves which must be predicted carrier on the basis of heir x-ray in lines believed to be clean indicates that more study is ıeeded.

The results obtained in this study to date are too inclusive to justify . critical evaluation of the technique at this time. Although it is ap-›arent that occasionally an erroneous diagnosis is made, it may well ›e that the technique may prove accurate enough to be of real value n problem herds. Certainly further study to attempt to determine the ıccuracy of the test is justified, and is under way at the present time. Recommendation as to the possible use of this technique by breeders :annot be made until further information has been obtained.

Summary

Data are presented on two years study of a technique for detecting beef calves that are carriers of the snorter dwarf gene, based on abnormalities observed in radiographs of the lumbar vertebrate of very young calves. Snorter dwarf calves have very characteristic abnormalities which have never been observed in x-rays of non-dwarf calves. Lumbar x-rays accurately identify a dwarf calf, and may be very useful to breeders in determining the dwarfism status of a doubtful calf.

The accuracy of the method as a means of detecting carriers of the dwarf gene could not be determined from the limited number of animals of known genotype included in the study. However, the results obtained to date are promising enough to justify further study.

Effect of Feeding Different Levels of Winter Supplement and Age of First Calving on the Performance of Range Beef Cows and Replacement Heifers

J. E. ZIMMERMAN, L. S. POPE, DWIGHT STEPHENS and GEORGE WALLER

The most common system of cow herd management in the south-west is to graze year-long and supplement during the winter to make up for the lack of protein, phosphorus or carotene in the weathered range forage. Previous tests have shown that this is the most economical and profitable method of maintaining brood cows, particularly under a spring calving program.

However, the question often raised is: How much supplemental feed should a cow receive during the winter months? Obviously, this may depend on several factors such as calving date or length of the lactation period before spring grass appears, the type and amount of native grass available, and the protein content of the supplement fed. Since supplemental feed during the winter represents the largest out-of-pocket cost in a cow-calf operation, it is necessary to study the effect of feeding different amounts or levels to cows wintering on native grass. It is particularly desirable to conduct long-time studies in which the accumulative effect of high or low levels of supplemental feed may express themselves.

In the fall of 1948, a long-time experiment was initiated at this station with 90 weanling Hereford heifer calves. These calves were started on feed in October, 1948, and in the design of the project were to be wintered at three levels of supplemental feed each year throughout their productive life. In addition, one-half of the heifers within each level of wintering were bred as yearlings and calved first as two-year-olds; their mates were first exposed as two-year-olds and calved first as three's. In this way the effect of different levels of supplemental winter feed and age at first calving on life-time performance could be studied. This report gives the results of the eighth year (1955-56) of the project and contains a summary of all results obtained to the fall of 1956.

During the experiment, it has become apparent that more carefully controlled studies are necessary to evaluate the effects of different levels of supplemental winter feed, particularly on the growing and developing heifer. Further, it is desirable to repeat range trials several years in order to minimize the variation in climate and range conditions occurring from year to year. Thus, in the fall of 1954 a series of repetitions was initiated with weanling heifer calves from the experiment station herd. The majority of these calves were from the original cows used in the experiment. From the records available, it was possible to allot the calves according to age, sire, dam's average productivity, body weight, and grade. The heifers used in the first repetition are now calving for the second time (spring of 1957) and since data on this calf crop is incomplete, the results through the first 1½ years of the project (including the first calf crop) are summarized in this report.

In the fall of 1955, and again in 1956, two further repetitions of the experimental treatments were started, again using heifers from the experiment station herd. Results obtained up to March 5, 1957, including the calving performance of the majority of the heifers, are given in this report.

I. Studies with Mature Cows Wintered at Different Levels.

In the fall of 1948, six lots of 15 heifer calves each were placed on experiment at the Lake Carl Blackwell range west of Stillwater. In the summer of 1949 they were moved to the Fort Reno station and the study has continued at this location since that time. The cattle were grazed year-long on native grass consisting mostly of big and little bluestem, Indian, switch, side oats grama and less desirable annual grasses. The cows were given sufficient pasture to assure an ample amount of grass throughout the year. A stocking rate of approximately eight acres per cow has been maintained. The cows grazed together during the summer, and were divided into their respective groups about November 1, each year to receive their respective levels of winter supplement (November to mid-April). They were rotated among the native grass pastures during the winter at monthly intervals to minimize pasture differences.

The winter supplement was fed on alternate days, twice the daily allowance at each feeding. A mineral mix of 2 parts salt and 1 part steamed bone meal, free choice, was available to the cows in all lots throughout the test. The average daily supplements fed per head each winter since 1948 follows:

> Low Level (Lots 1 and 2)—1 lb. cottonseed meal pellets
> Medium Level (Lots 3 and 4)—2½ lbs. cottonseed meal pellets.
> High Level (Lots 5 and 6)—2½ lbs. cottonseed meal pellets + 3 lbs. of oats.

In establishing these levels, consideration was given to the prevailing practices of many ranchers in the state, and to the available information on the requirements of beef cows. It was believed that the low level would supply about two-thirds of the digestible protein needed by range beef cows; whereas, the high level would not only supply ample protein but additional energy. One-half of the heifers in each nutritional treatment (Lots 1, 3 and 5) were pasture bred during the early summer of 1949 and dropped their first calves as two-year-olds in the spring of 1950. Their mates (Lots 2, 4 and 6) were pasture bred for the first time as two-year-olds in the summer of 1950 and calved first in the spring of 1951.

To date, the original cows have been subjected to their respective winter treatments for nine consecutive years. Data obtained includes the seventh and eighth calf crops, depending on age at first calving. Since the data for the winter of 1956-57 is incomplete, this report deals with cow performance during the 1955-56 season, and will summarize the results obtained up to the fall of 1956 (first eight years on test).*

Results of the 1955-56 Test

The results of the 1955-56 test with the original cows are shown in Table 1, and a summary of the results obtained up to the fall of 1956 are given in Table 2.

The difference in winter weight loss, considering only the cows which calved, was surprisingly small in view of the differences in amount of supplemental feed consumed. This has been the tendency since the cows reached maturity (last five winters) and is in contrast to the rather severe weight losses suffered by the low level heifers when they calved for the first or second times during the winters of 1949-50 and 1950-51.

Winter gain up to calving following a rather definite trend proportional to the level of supplement fed. From calving to mid-April, body weight losses followed an inconsistent pattern. It has been a consistent

* Detailed data for other years may be found in Okla. Agr. Expt. Sta. Misc. Publ. MP-19, -22-27-31-34-43-45 (1948-56).

Table 1.—Weight Data, Feed Costs, and Calf Production Records for Cows Wintered at Low, Medium and High Levels of Supplemental Feed (1955-56).

Age at first calving	2-Year-Olds			3-Year-Olds		
Lot Number	1	3	5	2	4	6
Level of Supplement fed	Low	Med.	High	Low	Med.	High
Winter Phase (167 days)						
No. of cows/lot 1955[1]	14	14	10	14	13	13
Average cow weights (lbs.)						
Fall 11/4/55	1144	1190	1240	1225	1220	1263
Gain to calving 2/16/56[2]	— 8	+39	+60	— 5	+53	+65
Loss from calving to 4/20/56[3]	—139	—171	—148	—101	—193	—163
Spring weight 4/20/56	1025	1081	1152	1135	1069[4]	1191
Cost of winter feed/cow ($)	10.39	17.87	28.75	10.39	17.87	28.75
Summer Phase (193 days)						
Average cow weights (lbs.)						
Spring 4/20/56	1025	1081	1152	1135	1069	1191
Fall 10/30/56	1103	1165	1165	1182	1128	1223
Summer gain	78	84	13	47	59	32
Summer feed cost/cow ($)	17.79	17.79	17.79	17.79	17.79	17.79
Total yearly feed cost/cow ($)	28.28	35.66	46.54	28.28	35.66	46.54
Calf Production Records						
No. of calves born	14	13	10	13	13	13
No. of calves weaned[5]	12	12	10	13	12	12
Average calving date	3/22	3/24	3/26	4/1	3/15	3/21
Average calf weights (lbs.)						
At birth (corrected for sex)	78	76	82	81	82	81
At weaning (corrected for age and sex)	510	499	510	515	506	515

[1] The project was initiated in the fall of 1948 with 15 heifers per lot. As of November, 1955, a total of 12 cows had been removed.

[2] Includes only those cows which had not calved by February 16.

[3] Includes only those cows which had calved before April 20.

[4] One cow was removed from Lot 4 during the winter because of an infection that developed at calving time.

[5] Two calves in Lot 1 and one calf in Lot 4 died at calving; one cow in each of lots 2, 3 and 6 did not calve; one calf in Lot 3 died at two months of age of unknown causes; and one calf in Lot 6 died at two weeks of age of an infection.

observation in these studies that the low-level cows are much better "rustlers" and spend more time grazing than cows receiving more supplemental feed. Winter feed costs were approximately 72 percent higher for the medium fed groups, and 177 percent higher for the high level lots than for those cows wintered at the low level.

Summer weight gains were inconsistent among the lots, and were much smaller than observed in previous years. Among the factors responsible may have been an extreme drouth during the summer of 1956, a severe overnight shrink at the time the fall weights were recorded, and the advancing age of the cows. Since pasture costs were the same for all lots, the total yearly feed cost varied directly with the cost of supplemental winter feed.

Little difference was noted in number of calves born, number weaned, birth weights and weaning weights of the calves. Calving dates were somewhat later for all lots than observed in previous years due to a hand-mating system used in the spring of 1955 to obtain more accurate sire information. Considerable difficulty was encountered in getting the cows settled under this hand-mating program.

In Table 2, data obtained up to the fall of 1956 (first eight years of the test) are presented. In regard to body weight, it will be noted that Lot 1 cows were lightest in body weight while those in Lot 6 were heaviest. Cows calving first as two-year-olds were about 50 lbs. lighter on the average than those which calved first as three's. From body measurements taken during the experiment, it was noted that the lower fed heifers and those calving first as two's, took slightly longer to reach their mature body size. Average winter weight losses during the course of the experiment have been slightly greater for the low-level lots (1 and 2), and least for the high-level lots (5 and 6). Average summer gains have been in reverse order in respect to winter weight gains.

Table 2.—Summary of 8½ Years' Results in Long-Time Study with Beef Cows Wintered at Different Levels (1948-56).

Age at first calving	2-Year-Olds			3-Year-Olds		
Lot number	1	3	5	2	4	6
Level of supplement fed	Low	Med.	High	Low	Med.	High
No. of cows at start of experiment	15	15	15	15	15	15
No. remaining on test Nov. 1956	14	14	10	14	12	13
Ave. Wt. changes of cows on test (lbs.)						
Initial wt. 10/29/48	473	471	476	476	461	470
Ave. Winter weight loss	—108	— 98	— 63	—112	— 97	— 67
Ave. summer gain	188	185	147	198	179	160
Final wt. 10/30/56	1103	1165	1165	1182	1128	1223
Calf production records at 8½ yrs. of age						
Heifers assisted at first calving	6	8	4	--	--	1
Calves lost at first calving	1	1	2	--	--	2
Total no. of calves weaned	91	93	75	82	71	73
% calf crop weaned[1]	93	95	89	97	89	90
Total number of calves weaned/cow	6.44	6.58	6.03	5.79	5.13	5.15
Ave. calving date	3/14	3/9	3/8	3/15	3/4	3/5
Average calf weights (lbs.)						
At birth (sex corrected)	76	76	77	76	76	78
At weaning (age & sex corrected)	480	472	471	495	474	492
Total feed pasture and mineral cost/cow ($)	224.18	299.66	402.54	224.18	299.66	402.54
Cow cost per cwt. calf weaned ($)	7.26	9.65	14.16	7.83	12.31	15.87

[1] Based on number of cows bred to calve each year. Calf losses not due to experimental treatment were not charged against the lot.

Total calf production based on the number of cows bred to calve each year varied slightly. Within each "age at first calving" group, there is no indication that the low levels of winter supplementation, as practiced in this experiment, were deterimental. On the other hand, the high levels of supplemental feed have not been beneficial.

There have been no consistent differences in birth weights (corrected for sex) or weaning weights (corrected for both age and sex) among the groups. The difficulty at first calving with the two-year-old heifers is apparent from the data contained in Table 2. The average calving date for the low level cows has been about one week later than for the high level lots. This difference was somewhat greater for the early years of the project, and has become less since the cows reached maturity.

Total feed, pasture and mineral costs per cow have been 34 percent greater for the medium level and 80 percent greater for the high level as compared to the low level of supplemental feed. Cost per cwt. of calf produced has varied directly with the cow costs, since there has been no significant difference in productivity.

A comparison of the performance of cows bred to calve first as two-year-olds versus those calving first as three's can be found in Table 3. Here the results from 30 additional cows, which were purchased with the original group, were included. These cows were wintered on the medium level and used to test the effect of feeding different supplements during the summer. In general, no significant effect from previous treatment has been noted, hence they are considered in this comparison. The results indicate that cows bred to calve first as two-year-olds may experience more difficulty at first calving (50 percent of the heifers had to be assisted at first calving). The average weaning weight per calf is somewhat lighter due to the small size of first calves by two-year-olds. However, their total lifetime performance, considering possible number of calvings, has shown that they have weaned 1.1

Table 3.—Production Records at 8½ Years for Cows that Calved First as Two- and Three-year-olds.

Age at first calving	Two-Year-Olds	Three-Year-Olds
Number of cows compared	60	60
Number of possible calvings[1]	384	338
Number of calves weaned	350	298
% calf crop weaned	91.1	88.2
Number of calves weaned per cow	6.4	5.3
Ave. weaning wts. lbs. (corrected for age & sex)	477	487
Cow cost/cwt. calf weaned ($)	10.02	11.73

[1] Considers the total number of times the cows should have calved. Per cent calf crop is based on this figure.

more calf per cow than those calving first as three-year-olds. Cow cost per cwt. of calf weaned has been reduced accordingly.

II. Results of the Second Trial (1954-1956)

A repetition of the original project was initiated in October, 1954, with 42 heifers from the experimental herd, divided equally into 3 heifers gained only about two-thirds as much as the medium and low lots of 14 head each. The heifers were allotted on the basis of shrunk weight, age, sire, and productivity of dam, with one lot wintered at each of the low, medium and high levels. In addition, the stocking rate was restricted so that the heifers received only 3.5 acres of grass per head on a year-long basis, as compared to more than 8 acres per head in the original project.

A summary of weight changes up to November, 1956, and production records for the first calf crop are given in Table 4. In addition

Table 4.—Summary of Performance of Beef Heifers Wintered at Low, Medium and High Levels of Supplemental Feed (1954-56).

Lot Number Level of supplement fed	1 Low	2 Med.	3 High
No. of heifers/lot 10/29/54	14	14	14
No. of heifers remaining/lot 11/2/56[1]	12	14	14
Average weights (lbs.)			
Initial 10/29/54	495	493	493
Winter gain to 4/11/55	52	95	153
Summer gain 4/11 to 11/4/55	316	312	290
Winter gain 11/4/55 to 4/17/56	—108	—80	— 6
Summer gain 4/17 to 11/2/56	162	174	110
Final wt. 11/2/56	922	994	1040
Total feed, pasture and mineral cost/cow ($) 10/29/54 to 11/2/56	49.30	67.10	89.40
Calf production records			
No. of calves born	12	13	14
No. of calves weaned[2]	11	11	10
Ave. calving date	3/3	2/24	2/18
No. of heifers requiring assistance	5	8	9
Ave. difficulty at calving score[3]	2.1	2.8	3.3
Ave. calf weights (lbs.)			
At birth (corrected for sex)	67	75	75
At weaning (corrected for age and sex)	396	416	442
Cost per cwt. of calf produced ($)	12.45	16.13	20.23

[1] One heifer became sick in early December, 1954, and was removed from test. One heifer failed to breed as a yearling and was removed in November, 1956, after a pregnancy examination showed her to be open again.

[2] One calf in Lot 1 died soon after birth of unknown causes; one calf in Lot 2 and one calf in Lot 3 died after a very difficult delivery; one calf in Lot 2 was found dead in the pasture at one week of age, and 3 heifers in Lot 3 produced premature calves which were dead at birth.

[3] A numerical score was used to evaluate difficulty at calving. A score of 1 indicates cow calved normally without assistance, and 7 indicates extreme difficulty in which both cow and calf were lost.

to these records, detailed measurements of body growth from photographs and actual body measurements have been taken periodically.

During the winter of 1954-55 as calves, the heifers of Lot 1 gained .32 lbs. per day, while those of Lot 2 gained .58 lbs. and Lot 3 gained .93 lbs. Heifers of all lots made excellent gains during the summer of 1955, with a tendency for those heifers with smaller winter gains to make slightly greater summer gains. Weight losses for the second winter as bred yearlings were greatest for Lot 1, although losses for all lots were somewhat smaller than might have been expected. Gains during the summer of 1956 were rather inconsistent, although Lot 3 heifers gained only about two-thirds as much as the medium and low level groups. These gains were somewhat smaller than the gains produced by similar heifers in previous summers, and may be attributed partly to the extreme drouth and partly to the good condition of the heifers at the start of the summer grazing period.

At the end of the summer grazing period, there was only 118 lbs. difference in body weight between the high and low levels of wintering and 72 lbs. difference between the low and medium groups. Body measurements taken at the end of the summer (November, 1956) indicated that level of wintering had very little, if any, effect on height and length of body. Depth of body, heart girth and width measurements were affected slightly. There was a noticeable difference in the condition of the heifers with Lot 3 heifers in very fleshy condition.

There was no significant difference between the lots in number of calves produced, although the low level heifers weaned the highest percentage calf crop and the high level the smallest percent. Four heifers produced premature calves which were dead at birth. No reason for this high abortion rate is apparent. The heifers were all vaccinated for contagious abortion at about 8 months of age, and have tested clean. Three of the heifers which aborted were on the high level and one was on the low level.

Considerable calving difficulty was experienced in all lots, as might be expected with two-year-old heifers. Difficulty of calving was least for the low level lot, due apparently to the lighter birth weight of their calves and the fleshier condition of the heifers of Lots 2 and 3. Considering all heifers that calved, an average of 56% had to be assisted, although in certain instances it is possible that the heifers could have calved without help. Records obtained at this station on a large number of two-year-old heifers calving in both a commercial herd and at Lake Blackwell experimental range, indicate that the results obtained in the current test were very favorable. Losses running as high as 15 percent of the calves and 5 percent of the heifers have been experienced in calving two-year-old heifers less well developed than the ones used in this study.

Weaning weights of the calves were directly related to the level of supplemental feed, with the calves from the medium level lot averaging 20 lbs. heavier, and those from the high level lot 46 lbs. heavier than the calves from the low level lot. However, the feed costs were considerably less for the low level of supplemental feed. Cost per cwt. of calf produced was 30% greater for the medium level lot and 62% greater for the high level lot than for the low level lot.

III. Results of the Third Trial (1955-57)

A third repetition was initiated in October, 1955, with 3 lots of 14 heifers each from the station herd. Allotment and management of these heifers was the same as for the second trial, with the exception that the level of supplemental feed was varied in an attempt to attain the following gain from early November to mid-April:

First winter as calves:

- Low level—fed to make no gain during the winter period.
- Medium level—fed to gain ½ lb. per day.
- High level—fed to gain 1 lb. or more per day.

Second winter as bred yearlings:

- Low level—no gain to calving, marked loss of body weight after calving to total approximately 250 lbs. loss from fall to spring.
- Medium level—moderate gain to calving (50 lbs.) with approximately 150 lbs. loss from calving to the end of the winter period.
- High level—high gain to calving (100 lbs.) with essentially no loss while nursing calves.

A summary of weight changes from November 1, 1955 to February 4, 1957, and production records for all heifers that had calved by March 5, 1957 are given in Table 5.

During the winter of 1955-56, as calves, Lot 1 heifers gained 21 lbs. more than was intended. This gain was achieved with an average of only .42 lbs. of cottonseed meal per head daily. During the second winter (1956-57) they had lost only 7 lbs. per head to February 4 and had received no supplemental feed. Lot 2 heifers gained .47 lbs. per day on 1.85 lbs. of cottonseed meal during the winter of 1955-56 and gained 37 pounds from November 2 to February 4 of the second winter. They received approximately 2 lbs. of cottonseed meal per day during the second winter of the test. Lot 3 heifers gained .93 lb. per day during the 1955-56 winter and had gained 80 lb. to February 4 of the second winter. They received 2.05 lb. of cottonseed meal and 3.33 lbs. of milo per head daily during the 1955-56 winter as calves and approximately 2.5 lbs. of cottonseed meal and 4 lbs. of milo per head daily during the 1956-57 winter. Summer gains were satisfactory for all lots with the low-level lot making the greatest gain and the high-level lot the least.

An analysis of body measurements taken in November, 1956 indicates very little, if any, effect of the level of wintering on length or height. Heart girth measure was affected to the greatest extent with a tendency for the measures of body width to be slightly greater for the high-level heifers.

Table 5.—Summary of Performance of Beef Heifers Wintered at Low, Medium and High Levels of Supplemental Feed (Third Trial, 1955-57).

Lot Number Level of Supplement fed	1 Low	2 Med.	3 High
No. of heifers/lot 3/5/57	13[1]	14	14
Average weights (lbs.)			
Initial 11/1/55	506	507	506
Winter gain to 4/19/56	21	80	156
Summer gain 4/19 to 11/2/56	308	260	235
Winter gain to calving 11/2/56 to 2/4/57	—7	37	80
Final weight 2/4/57	828	886	978
Total feed, pasture and mineral cost 11/1/55 to 11/2/56	22.84	30.83	40.81
Calf production records to 3/5/57			
No. of heifers calving to 3/5/57	9	6	13
Death loss at calving			
Heifers	1	0	0
Calves	2	1	2
Number of heifers requiring assistance	8	5	11
Average difficulty at calving score[2]	3.7	3.0	3.4
Average birth weight of calves (sex corrected)	75	75	78

[1] One heifer died at calving 2/20/57.

[2] A numerical score was used to evaluate difficulty at calving. A score of 1 indicates cow calved normally without assistance, and 7 indicates extreme difficulty in which both cow and calf were lost.

From the calving data available, death loss and difficulty of calving have been somewhat greater than has been experienced in previous years with this project. The increased difficulty of calving may be due to the heavy birth weights of the calves. The average birth weight is about 5 lbs. heavier than in previous years. No reason for the heavier birth weights is apparent. No significant difference has been observed between the lots in difficulty of calving.

IV. Results of the Fourth Trial (Winter 1956-57).

A fourth trial was initiated in November, 1956 with 45 heifer calves from the experimental herd divided into 3 lots of 15 head each. Allotment was made on the basis of shrunk weight, age, dam productivity, sire, and grade. The amount of winter feed was adjusted in an attempt to attain a desired amount of gain as described for the third trial.

Low-level heifers received no feed until mid-January and then were given approximately 0.5 lb. of cottonseed meal per day. They had lost .32 lbs. per day to March 5. Heifers wintered at the medium-level gained .28 lbs. per day to March 5. They have received approximately 2 lbs. of cottonseed meal per day. High-level heifers received 2.5 lbs. of cottonseed meal and 4 lbs. of milo per day and have gained .86 lbs. per day to date.

It is planned to pasture-mate the heifers, starting May 1, 1957, so that they will calve first in 1958 as two-year-olds. Again in the winter of 1957-58 the extent of body weight gain or loss will be controlled by varying the levels of supplemental feed.

Summary

The results of the eighth consecutive year in a long-time project at the Ft. Reno station on the effects of low, medium, and high levels of supplemental feed on the performance of range beef cows are presented. Data obtained indicate a slight effect of level of winter feed on mature body weight of the cows, but no significant difference in percentage calf crop weaned or average corrected weaning weight of the calves. The cost per cwt. of calf weaned has been least for those cows wintered at the low-level, and has been less for those calving first as two-year-olds than for the cows calving first as three-year-olds. The test with the original cows is now in its ninth consecutive year.

Three repetitions are now in progress with heifers from the experimental herd. Body weight was affected somewhat in all trials by level of winter feeding; however, summer gains have tended to compensate for differences in winter gain. Weaning weights of calves from the second trial were directly proportional to the level of winter feed, but the differences in weaning weight were not great enough to pay for the extra feed cost of the medium and high levels. Calving difficulty was least for the low-level lots in the second trial, but was about equal for all lots in the third trial. In the third and fourth replications an attempt is being made to establish the total amount of winter gain of the heifers by adjustments in the amount of supplemental feed.

Mineral and Management Studies With Beef Cows In Southern Oklahoma

ROBERT TOTUSEK AND WILLIS D. GALLUP

Experiments at the Wilburton Station from 1947 to 1951 clearly demonstrated that the forage in that area is frequently deficient in phosphorus and that a phosphorus supplement must be provided for best results. For example, the feeding of 26 pounds of dicalcium phosphate per head during a period of 21 months increased the weight of heifers 166 pounds. However, the performance of reproducing cows as measured by the number of calves produced and the weaning weight of the calves was very poor even with supplemental phosphorus. Several suggestions regarding the possible causes of poor performance were (1) insufficient phosphorus intake during the summer due to a low consumption of mineral mix; (2) deficiency of trace minerals; (3) internal parasites; and (4) lack of shade during the hot summer months.

To test some of the suggested causes of reproductive failures, the present experiment was started at Wilburton in the fall of 1951. Results of the first, second, third and fourth years' work were reported in the 1953, 1954, 1955 and 1956 Feeders' Day Reports. The fifth year's work (November 1955-October 1956) is summarized here.

Description of the Experiment

At the start of the experiment in 1951, sixty 2-year-old grade Hereford heifers were divided into 6 lots of 10 head each. Lots 2 and 5 had 8 and 9 head, respectively, at the conclusion of the fifth year. The cattle had access to native grass pasture year-long.

During the past year Lots 1 and 4 were offered free-choice a mineral mix of 2 parts salt and 1 part bonemeal; they consumed a relatively low amount of supplemental phosphorus. Lots 2 and 5 were offered free-choice a mineral mix of 2 parts bonemeal and 1 part salt with a small amount (5-15 percent) of cottonseed meal added to increase palatability; they consumed a relatively high amount of supplemental phosphorus.

Lots 3and 6 also were offered a high level of phosphorus in the same manner as Lots 2 and 5 and in addition the trace minerals iron, copper, cobalt and iodine. The trace minerals were fed in the mineral mix. These mineral mixes were fed both winter and summer.

During the winter, Lots 1, 2 and 3 were fed a constant level of 2.5 pounds of cottonseed cake per head daily. Lots 4, 5 and 6 were fed an increasing level of cottonseed cake as the winter progressed. The level was gradually increased from 1.5 pounds initially to 3.5 pounds during late winter after most of the cows had calved.

One-half of the cows and calves in each lot were drenched with phenothiazine at approximately 2 month intervals to determine the value of treating the cattle for internal parasites.

One-half of the cows in each lot were bled at intervals during the year for the determination of blood plasma phosphorus, hemoglobin and red blood cells.

Observations

High Phosphorus Supplementation

The comparison of a low and a high level of supplemental phosphorus intake is shown in Table 1. Compare Lots 1 and 4 with Lots 2 and 5.

Cows of Lots 2 and 5, which received the mineral mix of 2 parts bonemeal and 1 part salt with cottonseed meal added, consumed about 4 times more phosphorus during the year than cows in Lots 1 and 4, which were offered the mineral mix of 2 parts salt and 1 part bonemeal. The calves in Lots 2 and 5 weighed 22 pounds more at weaning than calves in Lots 1 and 4. A similar difference in weaning weight was noted the previous 2 years. Although differences in the performance of the cows have been small, it appears that a level of phosphorus supplementation above the amount furnished by a simple mineral mix of 2 parts salt and 1 part bonemeal may be of some value in southeastern Oklahoma.

The low-phosphorus cows lost more weight during the year than the high-phosphorus cows. This was reverse from the previous 2 years when the weight changes were in favor of the low-phosphorus cows. These weight fluctuations are probably within the range that can be

Table 1.—The effect of level of supplemental phosphorus intake and trace minerals on cows and calves, 1955-56.

	Constant Protein Supplement			Increasing Protein Supplement		
	1 Low Phosphorus	2 High Phosphorus	3 High Phosphorus Trace Minerals	4 Low Phosphorus	5 High Phosphorus	6 High Phosphorus Trace Minerals
No. cows per lot	10	9[1]	10	10	9	10
Av. weight per cow (lb.)						
Initial 11-16-55	1184	1136	1117	1188	1070	1119
End of winter 4-17-56	1006	1030	1018	1092	944	1040
Final 10-11-56	1058	1082	1089	1083	1062	1114
Weight gain or loss (lb.)						
Winter	—178	—106	—99	—96	—126	—79
Summer	52	52	71	—9	118	74
Yearly	—126	—54	—28	—105	—8	—5
Av. birth weight of calves (lb.)[2]	77	75	75	73	75	76
No. of cows open	0	0	1	0	0	3
No. calves weaned[3]	9	7[1]	9	9	9	7
Corrected weaning wt. of calves (lb.)[4]	459	484	473	470	490	487[5]

[1]One cow apparently killed by lightning 3 months after calving, calf sold.
[2]Corrected for sex by adding 5 pounds to the actual birth weight of each heifer.
[3]Death loss record of calves.
Lot 1—calf died 7 days after birth, cause unknown.
Lot 2—1 calf died at calving.
Lot 4—1 calf died after apparently receiving phenothiazine too young.
[4]Corrected for age by adjusting all calves to a standard age of 210 days, and for sex by adding 25 pounds to the age corrected weight of each heifer.
[5]One calf in Lot 6 was sick continuously following birth and was not included in the weaning weight average.

normally expected among relatively small lots of range beef cows, and may not be related to the experimental treatments to any important extent.

Trace Minerals

The influence of feeding trace minerals is indicated in Table 1. Compare Lots 2 and 5 with Lots 3 and 6.

No important differences in weight and appearance of the cows and in the weaning weight of the calves were noted. This agrees with results obtained in three previous years. This experiment has not indicated a need for the feeding of trace minerals.

Phenothiazine Drenching

The effect of drenching cows and calves with phenothiazine is shown in Table 2. Phenothiazine did not greatly influence the weight or appearance of either the cows or calves. Fecal samples taken from cows and calves in October and examined for worm eggs indicated only a light infestation of internal parasites in all groups. Internal parasites have been no problem among the cattle in this experiment and drenching with phenothiazine has not produced any beneficial results.

Table 2.—The effect of drenching cows and calves with phenothiazine, 1955-56.

	No Phenothiazine (one-half of the cows and calves in each lot)	Phenothiazine (one-half of the cows and calves in each lot)
No. of cows	29	29[1]
Av. weight of cows, lbs.		
Initial 11-16-55	1122	1154
End winter 4-17-56	998	1048
Final 10-11-56	1062	1102
Production of cows		
Av. Birth wt. (lbs.)[2]	75	76
No. calves weaned	27	23
Av. weaning weight (lbs.)[3]	477	475[4]

[1]One cow apparently killed by lightning 3 months after calving, calf sold.
[2]Corrected for sex by adding 5 pounds to the actual birth weight of each heifer.
[3]Corrected for age by adjusting all calves to a standard age of 210 days, and for sexx by adding 25 pounds to the age corrected weight of each heifer.
[4]One calf was sick continuously following birth and was not included in the wearing weight average.

Some difficulty was encountered when phenothiazine was administered to calves less than 2 weeks old. One calf died and 4 calves developed blindness in one or both eyes. This type of difficulty was not noted previously in this experiment; in actual practice calves are not dosed with phenothiazine at such a young age.

Distribution of Protein

The influence of increasing the protein intake of cows as the winter progresses is indicated in Table 3.

Table 3.—The effect of increasing the protein intake of cows during the winter (1955-56).

	Constant Protein Level (Lots 1, 2 and 3	Increasing Protein Level (Lots 4, 5 and 6)
No. of cows	29[1]	29
Av. weight of cows, lbs.		
Initial 11-16-55	1146	1164
End winter 4-17-56	1018	1060
Final 10-11-56	1076	1087
Production of cows		
Av. birth wt. (lbs.)[2]	76	74
No. calves weaned	25	25
Av. weaning wt. (lbs.)[3]	471	476

[1]One cow apparently killed by lightning 3 months after calving, calf sold.
[2]Corrected for sex by adding 5 pounds to the actual birth weight of each heifer.
[3]Corrected for age by adjusting all cavles to a standard age of 210 days, and for sex by adding 25 pounds to the age corrected weight of each heifer.

A beef cow requires about 50 percent more protein when suckling a calf than when pregnant. The protein content of native range grass decreases during the fall and winter months. It would appear then that cows calving in late winter should receive more supplemental protein as the wintering period progresses.

All cows received approximately the same total amount of cottonseed cake during the winter. Lots 1, 2 and 3 received a constant level of 2.5 pounds per cow daily, while the level for Lots 4, 5 and 6 was increased at regular intervals from 1.5 to 3.5 pounds. The weight and condition of the cows, and the weaning weight of the calves, were not significantly affected. Different results might be expected under less satisfactory feeding conditions, or if cows went into the winter in a thinner condition than the cows in this experiment.

Moving Cows into Southeastern Oklahoma

In many instances where cows have been moved into southeastern Oklahoma from areas to the west, death losses have been high and performance has been poor. Several possible explanations have been offered. To study this problem, 12 cows were moved from Stillwater to the Wilburton area November 1, 1954. The weight and appearance of the cows have been satisfactory. The weaning weight of their 1955 and 1956 calves at Wilburton was comparable to the average of 4 previous years at Stillwater. It appears that with good feeding practices, and parasite control where necessary, difficulties can be avoided when cattle are moved into southeastern Oklahoma from areas to the west.

General Productivity of the Cows

The average performance of the entire group of cows at Wilburton for the past five years has been excellent regardless of experimental treatment. Year-long access to native grass, with adequate supplemental protein during the winter and adequate supplemental phosphorus year-long, resulted in excellent production on a cow and calf program. There has been no indication of any limiting factor (s) for beef production during the last five years of this experiment. Therefore, this research in the Wilburton area has been terminated.

Summary

Results of studies with beef cattle at the Range Cattle Minerals Station near Wilburton for the year 1955-56 may be summarized as follows:

1. Cows with access to a palatable mineral mix containing cottonseed meal consumed 4 times more phosphorus and weaned slightly heavier calves than cows with access to a simple mineral mix of salt and bonemeal.
2. Feeding trace minerals to cows had no apparent affect either on the cows or on their calves.
3. Drenching with phenothiazine had little effect on cows or calves. None of the cattle appeared to be infested with internal parasites to any important extent.
4. Increasing the amount of cottonseed cake from 1.5 to 3.5 pounds during the wintering period did not prove beneficial compared to feeding a constant amount of 2.5 pounds throughout the winter.
5. Cows moved from Stillwater to Wilburton performed satisfactorily during their second year at Wilburton.
6. The performance of all cattle at the Wilburton Station was very acceptable.

Methods of Management for the Small Commercial Herd Producing "Two-Way" Calves

L. S. POPE, R. D. HUMPHREY AND DWIGHT STEPHENS

In general, the beef industry in Oklahoma has moved toward younger cattle and more intensified systems of production. Increased interest has developed in the production of fat slaughter calves as a means of obtaining a quick return from the cow herd. A strong market for fat calves exists in April, May and June—following the bulk of fed cattle and before grass cattle arrive. Many plain calves can be fattened sufficiently while on the cow and creep-feeder to produce a desirable light-weight carcass of 275 to 350 lbs. in the Good and Choice grades. The keen demand for calf carcasses by large chain stores has stimulated their production in many areas of the state.

Plain calves can often be handled profitably under this system. However, many producers with high-grade commercial herds are considering the possibility of developing "two-way" calves—with enough quality and finish to sell to either the feeder or packer. This necessitates fall-calving and creep feeding in order to obtain desirable weight and finish by the May and June market. Steer calves of good quality may find a strong early feeder market, while the heifers may sell best to the packer.

This report covers the third trial in a project on methods of management for the cow herd. Results of previous trials indicate that the cost of maintaining the beef cow appears to be a serious drawback to this type of production. Cows nursing calves during the winter require more supplemental feed than dry cows. The problem is to keep feed costs at a minimum without effecting the weight or quality of the calves.*

Procedure

Three lots of 19 grade Hereford cows each were used to study the effect of different management systems at the Fort Reno Station. The cows dropped calves from late September to early December of 1955. During the winter of 1955-56, they were handled as follows:

Lot 1—Native grass, at a stocking rate of eight acres per head, with 2½ lbs. of cottonseed meal and 3 lbs. of ground ear corn per head daily during the winter period (November 1 to mid-April).

Lot 2—Native grass, 5 acres per head, plus 1½ lbs. of cottonseed meal and silage from a self-feeding trench silo during the wintering period.

Lot 3—Rye-vetch winter pasture (1½ acres per cow) and no supplemental feed except for 42 days during January and February when it was necessary to feed alfalfa and oat hay.

The cows of Lots 1 and 2 remained on native grass year-long at the described stocking rates. Cows of Lot 3 were allowed 4 acres of native grass per head for the summer period. Supplements for Lots 1 and 2 were fed every day in bunks. The cows of Lot 2 were given access to silage from a self-feeding pit silo on alternate days. Previous tests have shown that large intakes of silage were unprofitable under this system of management. Thus a method of feeding on alternate days was followed in an attempt to limit silage consumption.

Winter pasture for Lot 3 proved to be adequate during the fall and early winter. During a 42-day period in January and February it was necessary to remove the cows from winter pasture and supplement them on native grass with 4 lbs. of alfalfa and 12 lbs. of oat hay per head daily. In late February, the cattle were moved back to the winter pasture.

All cattle had access to a mineral mixture of 2 parts salt and 1 part steamed bone meal. The native grass pastures were predominately bluestems—although there were annual grasses and side oats grama in certain areas. Calves in all lots were creep-fed, using a mixture of 5.5 parts coarsely ground milo, 3 parts whole oats, 1 part cottonseed meal and 0.5 parts dried molasses.

After the wintering phase (last 47 days of the test) 15 calves from each lot, with their dams, were re-divided so that a study could be made of the effect of adding 5 mg. stilbestrol, or 5 mg. stilbestrol and 40 mg. antibiotic, to the creep ration.

All calves were sold on the Oklahoma City yards, June 5, at approximately 8 months of age. In computing on-foot value, the actual

*Results of previous trials can be found in Okla. Agri. Expt. Sta. Misc. Publ. MP-43 and MP-45 value of the carcass was divided by the final weight taken at Fort Reno. An appraisal of the calves as feeders was also obtained at selling time.

Results

The weight gains, supplemental feed and yearly feed costs for the cows under different systems of management are given in Table 1. Only cows raising calves were compared. It is apparent that the average winter weight loss was slightly greater for the cattle wintered on silage and cottonseed meal supplement (Lot 2) than for those on native grass and supplement (Lot 1). Both groups, however, lost more weight than those of Lot 3 wintered on rye and vetch pasture (with supplemental hay as needed). Spring gain from April 19 to June 5 indicated that the cows were making fast recovery and were not apparently affected by any of the previous winter treatments. As in the past, yearly feed costs were greatest for cows of Lot 2 receiving silage and cottonseed meal supplement ($57.70 per head). The cheapest method of wintering was obtained in Lot 3 where maximum use was made of winter pasture, with a reserve feed supply as needed ($41.26). Although the charge made for the rye-vetch pasture for Lot 3 was about $20.00 per cow for the season, total

Table 1.—Average cow data from different feeding systems in the production of fall-dropped calves.

Winter treatment	Lot 1 Native grass + Supplement	Lot 2 Native grass +Silage and Supplement	Lot 3 Rye-vetch pasture
No. of cows producing calves	18	17	18
Av. cow weights (lbs.)			
Fall, 9/15/55	1206	1184	1156
Spring, 4/19/55	1053	1005	1093
Winter weight loss	—153	—179	—63
Spring gain to 5/5/56	85	79	83
Av. daily winter ration, (Nov. 1 to April 9), lbs. or acres:			
Cottonseed meal	2.5	1.5	
Ground ear corn	3.0		
Alfalfa hay[1]			4.0
Oat hay[1]			12.0
Silage[2]		51	
Rye-vetch pasture			1.5A
Native grass pasture	8A	5A	4A (Summer only)
Yearly feed cost/cow ($)			
Winter Supplement	23.59	7.56	6.64
Silage		32.64	
Rye-vetch pasture			20.62
Native grass	22.50	17.50	14.00
Total	46.09	57.70	41.26

[1]Fed during a 42-day period in January and February when it was necessary to supplement Lot 3 cows

[2]Silage (from drouth-damaged, immature corn) was available from a self-feeding pit silo every other day. Amount consumed was estimated from silo measurements at 42 lbs. silage per cubic foot.

yearly cost was nearly $16.00 per head less than for those cows wintered on silage, and $5.00 less for those of Lot 1 wintering on native grass. Further, in the three trials conducted to date, cows of Lot 3 have not received any supplemental grain or protein; all feed and pasture have been produced on the station.

Data on the number of calves marketed, final weights and carcass values are given in Table 2. The results are based on average steer and average heifer comparisons for all lots. Final market weights favored calves from Lot 2 whose dams fere fed silage plus supplement during the winter. These calves weaned approximately 23 lbs. heavier than those of Lot 1 (native pasture and supplement) and approximately 34 lbs. greater than those of Lot 3 (rye-vetch pasture). One reason for the lighter weaning weights of Lot 3 calves is apparent in the total amount of creep-feed consumed by the calves, which was 250-300 lbs. less than that consumed by calves of Lots 2 and 3. When using winter pasture, it has become apparent that less creep-feed is consumed by the calves where the cows are not fed regularly in the same place, and where the calves consume rather large amounts of pasture. However, if this has

Table 2.—Average calf data from study of systems of management (all calves creep-fed and sold for slaughter)[1].

Winter treatment of dams	Lot 1 Native grass + Supplement	Lot 2 Native grass, silage and supplement	Lot 3 Rye-vetch pasture
No. of calves marketed	18	17	18
Steers	10	9	10
Heifers	8	8	8
Av. birth date October	20th	9th	11th
Av. calf weights (lbs.)			
Birth	77	77	69
End of winter phase, 4/19	462	474	440
Final weight, 5/5	551	574	540
Slaughter data:			
Av. yield, percent[2]	57.2	57.7	56.4
Av. carcass grade (U.S.D.A. standard)	Choice—	Choice—	Good+
Av. market value/cwt. ($)[3]	19.50	19.74	18.63
Total value per calf ($)	107.77	113.27	100.65
Creep-feed consumed/calf (lbs.)	898	856	590
Creep-feed cost per calf ($)	21.21	20.22	13.97
Cow feed cost/cow-calf unit ($)	46.09	57.70	41.26
Total cow + calf feed cost ($)	67.30	77.92	55.23
Net return over feed cost ($)	40.47	35.35	45.42

[1]Based on average of steer and heifer data for each lot.
[2]Hot carcass weights shrunk 2½% (minus hide weight). Values based on final Ft. Reno weights.
[3]On-foot market value calculated from yield, grade, and current value of carcass, based on Ft. Reno weights.

no effect on weight gains or carcass quality, it may prove to be a financial advantage for this system.

Carcass grades indicate that calves from Lots 1 and 2 were slightly fatter than those from Lot 3; a further reflection of the smaller amount of creep-feed consumed by the latter group. Lot 3 calves graded slightly lower and computed on-foot value was 90c to $1.10 less per cwt. than for the other lots.

Considering the total cow-and-calf feed cost, the greatest net return was made from cows on rye-vetch winter pasture, and least from those on silage and supplemental protein. Results have indicated that calves from dams wintered on silage and supplement have weighed more and were slightly fatter, but the small increase in market value was not enough to offset the high cost of feed.

Selling as Feeder Calves vs. Slaughter Calves

In Table 3, the possible financial returns if the calves had sold as feeder calves or as "two-way" calves are compared. In considering the sale of the calves as feeders, a customary 3 percent shrink was applied to the final weights at Fort Reno, and the appraised value of the calves as feeders at the yards was used. Steer or heifer calves from all lots would have sold for the same relative price, regardless of treatment of their dams.

Table 3.—Financial returns if calves had sold as feeders, or as "two-way" calves.

Winter treatment of dams	Lot 1 Native grass + Supplement	Lot 2 Native grass, Silage + Supplement	Lot 3 Rye-vetch pasture
Av. results if all calves had sold as feeders:			
Market weight (3% shrink), lbs.			
Steers	563	579	560
Heifers	507	534	488
Appraised feeder value/cwt. ($)			
Steers	20.50	20.50	20.50
Heifers	17.50	17.50	17.50
Av. value per calf ($)	102.07	106.07	100.10
Net return/calf over total feed cost ($)[1]	34.77	28.15	44.87
Steers sold as feeders, heifers as slaughter calves:			
Market weight (lbs.)[2]			
Steers as feeders	563	579	560
Heifers as slaughter calves	523	551	503
Value/cwt. ($)			
Steers	20.50	20.50	20.50
Heifers	19.46	19.87	18.59
Av. value/calf ($)	108.59	114.09	104.17
Net return/calf over total feed cost ($)[1]	41.29	36.17	48.94

[1]For total feed cost per cow-calf unit see Table 2.
[2]Weights of steers shrunk 3%.

The price for feeder steers was relatively advantageous at the time the calves were sold—one reason why many commercial producers prefer an early calving program. Financial returns would not have changed relative to the systems of management had the calves sold as feeders. Again, the most profitable group would have been the lot wintered on rye-vetch pasture, with native grass and supplement intermediate, and silage and supplemental feed the least profitable. Considering two alternatives—selling all calves as feeders vs. selling as fat slaughter calves—the latter method would have been slightly more profitable due to the higher selling price of the heifer calves.

A comparison was made of selling the calves to the highest bidder (either packer or feeder) vs. selling all calves as feeders. If this method had been followed, taking the appraised value of the steer calves as feeders and the actual on-foot value of the heifers based on their carcass merit, the results shown in Table 3 would indicate that the "two way" method was most profitable. The returns from handling the cow herd under the three systems of management would still be in the same order —with the rye-vetch pasture group the most, and the silage-fed group the least, profitable. Selling the calves on a "two-way" basis would have resulted in about $2.00 per head more return than to have sold them as fat slaughter calves. Least profitable would have been to sell all calves as feeders due to the low market value of heifers.

Adding Stilbestrol or Stilbestrol + Terramycin to Creep-Feed

Following the wintering phase and during the last 47 days before marketing, the effect of 5 mg. stilbestrol, or 5 mg. stilbestrol plus 40 mg. terramycin, added to the daily creep-feed per calf was studied.* Previous tests have indicated that stilbestrol might increase the gains of suckling calves during the latter part of the finishing period. Results from other stations indicate that an antibiotic may speed up calf gains.

Fifteen calves (9 steers and 6 heifers) from each of the winter treatment lots were reallotted to form three new groups, each containing 15 head. The control calves were continued on the basal creep mixture; while 5 mg. stilbestrol per calf per day was added to the creep-feed of a second group, and 5 mg. stilbestrol and 40 mg. terramycin to a third. The results are shown in Table 4.

Weight gains of calves were increased slightly over the 47-day period by the addition of 5 mg. stilbestrol to the creep-feed. This increase was only 6 percent, and was much smaller than had been observed in a previous trial. The combination of 5 mg. stilbestrol and 40 mg. terramycin markedly increased weight gains (16% over the controls). Whether or not this apparent additive effect of the hormone and antibiotic is real will depend on further studies. Calves of this age and weight may respond to an antibiotic in the ration. Both groups fed silbestrol or stilbestrol plus antibiotic consumed less creep-feed per calf than those fed the control mixture. Generally, stilbestrol has been shown to increase feed intake slightly; however, this effect did not occur in this trial for unknown reasons.

*Terramycin was supplied by Chas. Pfizer & Co., Terre Haute, Indiana.

Table 4.—Effect of adding 5 mg. stilbestrol or 5 mg. stilbestrol + 40 mg. terramycin to creep-feed of beef calves (last 47 days on test).

	Basal creep-feed	Basal + 5 mg. Stilbestrol per calf	Basal + 5 mg. Stilbestrol + 40 mg. Terramycin
No. of calves per group[1]	15	15	15
Av. calf weights (lbs.)			
Initial, 4/19	470	473	470
Final, 5/5	563	572	578
Av. daily gain	1.97	2.10	2.30
Creep-feed consumed/calf (lbs.)[2]	254	207	229
Creep-feed/cwt. gain (lbs.)	273	209	212
Slaughter data:[3]			
Yield, %	57.9	57.7	57.1
Carcass grade	Good+	Good+ to Choice—	Good+ to Choice—
Marbling score	3.47	2.97	3.32
Financial results ($)			
Av. cow and calf feed cost[4]	67.28	66.36	66.82
Market value/cwt.[5]	19.54	19.57	19.23
Total value per calf	110.01	111.92	111.15
Net return/calf	42.73	45.56	44.33
Difference over controls		+ 2.83	+ 1.60

[1]Nine steer calves and six heifers per group, 5 calves in each group from each lot of the original treatment.
[2]Concerns only the amount during this phase.
[3]Yield based on hot carcass weight shrunk 2½% (hide off).
Marbling score: 1= abundant, 3= moderate, 5= very slight.
[4]Costs prior to this phase based on average for original lots (see Tables 1 and 2).
[5]Based on current value of carcass according to grade and final Ft. Reno weight.

Slaughter data indicated that calves of the basal group were similar in yield to those receiving the hormone, or the hormone plus antibiotic, although carcass grades favored the latter groups. Marbling scores differed only slightly, but tended to indicate more marbling in the hormone-fed calves.

The results would indicate a financial advantage from adding either 5 mg. stilbestrol, or 5 mg. of stilbestrol plus 40 mg. terramycin, to the creep-fed mixture. During the short experiment, an increase of $2.83 for those calves fed stilbestrol over the controls, and $1.60 for those calves fed the hormone-antibiotic combination, was obtained. It seems possible that had the hormone been fed for a longer period the increase in weight gains would have been greater. Research is in progress in which stilbestrol is being added over a 5 to 6 month period prior to slaughter.

Summary

The third trial in a study of different systems of management for fall calving cows has been reported. Three treatments, i.e., year-long grazing on native grass with winter supplementation, year-long grazing with silage plus supplement during the winter, and native grass during

the summer and rye-vetch winter pasture, have been compared. As in the past, the low cost of the winter pasture system has resulted in the most profit. Under this system, cow cost has been held to a minimum and although the calves have weighed slightly less and have not been as well finished, they have returned more for this system of production. Most costly has been the system featuring silage during the winter plus supplemental protein. However, under the silage program a maximum amount of feed could be produced on limited acreage. Intermediate in profit was year-long grazing on native grass plus supplemental winter feed.

Calves produced from each system have yielded from 56 to 57 percent and graded good-to-choice. They have been of good enough quality and finish to sell either as slaughter calves or to the feeder. The marketing system in which the steer calves sell as feeders and the heifers as slaughter calves has proven to be most profitable.

The addition of a small amount of stilbestrol to the creep-feed of calves during the last 47 days before marketing increased profits slightly and might be more beneficial if continued over a longer period.

Over all, the most profitable system of management would appear to be the use of rye-vetch winter pasture with supplemental roughage as needed. Calves should be creep-fed and the steers sold as feeders and the heifers as slaughter calves. The addition of 5 mg. stilbestrol to the creep-feed may further increase the rate of gain and profit.

Fattening Steers and Heifers on Rations Containing Different Levels of Concentrate.

L. S. POPE, R. D. HUMPHREY, LOWELL WALTERS and GEORGE WALLER

The majority of the cattle fattened in the southwest are fed in large commercial feed lots. Generally, ground or rolled milo is the principal grain fed, and alfalfa hay, silage and cottonseed hulls are the chief roughages. There is considerable difference from one feed lot to another in the proportion of concentrate (grain and protein supplement) to roughage in the ration. Opinions vary as to which ratio is best in terms of maximum feed consumption, rate of gain and time required to reach a slaughter grade.

This report deals with the second trial in a project designed to study the performance of steers and heifers self-fed mixed rations in which the amount of concentrate varied from 35 to 80 percent.

Procedure

Eighty-eight, choice, Hereford calves were obtained in July, 1956, from the Harding Ranch, northeast of Stillwater. The calves had been dropped in the fall of 1955, and had been creeped during the summer. In the interval between purchase and the start of the feeding trial, they were fed supplements on native grass in order to maintain condition.

The drove contained 48 steers and 40 heifers, selected to be as near alike in grade and condition as possible. The feeder price per cwt. was $20 for steers and $18 for heifers at the time the fattening trial was initiated.

The calves were started on feed in early September at the Fort Reno station. Allotment within each sex was based on shrunk weight and feeder score. Duplicate pens of 5 calves each made up each lot. The calves were fed in small pens with concrete exercise slabs and an open shed to the north under which the self-feeder was located. A watering device and salt box (2 parts salt and 1 part bone meal) was available beneath the shed in each pen.

The mixtures fed, by lots, are shown in Table 1, together with the chemical composition and cost of the mixed rations. The concentrate

Table 1.—Composition and cost of self-fed mixtures.

Lot number Conc: Roughage ratio	1 & 2 35:65	3 & 4 50:50	5 & 6 65:35	7 & 8 80:20
Feeds used (%)				
Ground milo	17.0	33.2	49.7	65.1
Cottonseed meal	11.0	9.5	7.7	7.0
Molasses	7.0	7.0	7.0	7.0
Chopped alfalfa	32.5	25.0	17.5	10.0
Cottonseed hulls	32.5	25.0	17.5	10.0
Grd. limestone	0.0	0.3	0.6	0.9
	100.0	100.0	100.0	100.0
Ration Composition (%)				
Dry matter	90.55	91.21	90.18	88.52
Ash	5.62	6.55	4.61	4.76
Crude protein	14.36	16.17	13.24	13.49
Ether extract	1.02	1.49	1.43	2.60
Crude fiber	26.27	22.29	16.40	9.66
N-free extract	43.28	44.01	54.50	58.01
Estimated T.D.N. content (%)	55.7	60.4	65.2	69.8
Cost per cwt. ($)	1.85	2.01	2.17	2.33

portion of the ration consisted of ground milo, cottonseed meal and molasses; while the roughage was one-half cottonseed hulls and one-half chopped alfalfa hay. Small amounts of ground limestone were added where necessary to provide approximately the same calcium and phosphorus levels in all rations. In an additional lot, eight steer calves were used to study the effect of a larger pen area on performance.

The cattle were weighed off test and shipped to Oklahoma City as they were estimated to have reached a slaughter grade of high-good to low-choice. On-foot grade was estimated by a committee from the Animal Husbandry Department and a commission firm. In all, three shipments were made during the trial and the calves to be shipped were

Table 2.—Performance of steers and heifers self-fed rations varying in concentrate-to-roughage ratios (10 calves/lot)

Conc:Roughage Ratio	35:65		50:50		65:35		80:20[1]	
Lot Number	1	2	3	4	5	6	7	8
Sex	Steers	Hfrs.	Steers	Hfrs.	Steers	Hfrs.	Steers	Hfrs.
Av. days on feed	170	167	156	155	165	156	150	169
Av. Weights (lbs.)								
Initial 9-14-56	552	505	552	504	552	504	551	504
Gain to 128 days	258	202	242	212	218	212	242	201
Total gain	328	255	276	255	265	225	267	242
Av. daily gain	1.93	1.52	1.77	1.65	1.61	1.44	1.78	1.43
Av. daily feed consumption (lbs.)[2]								
Concentrates	8.05	7.02	10.79	10.58	12.15	12.31	14.04	13.59
Roughage	14.95	13.05	10.79	10.58	6.54	6.63	4.03	3.86
Total	23.00	20.07	21.57	21.15	18.69	18.94	18.07	17.45
Av. daily T.D.N. intake	12.81	11.18	13.03	12.77	12.19	12.35	12.49	12.07
Feed Per cwt. gain (lbs.)								
Concentrates	417	462	610	640	755	855	789	950
Roughage	775	859	610	640	406	460	226	270
T.D.N. per cwt. gain (lbs.)	6.64	7.36	7.36	7.74	7.57	8.58	7.02	8.44
Feed cost per cwt. gain ($)	22.05	24.32	24.51	25.84	25.25	28.50	23.41	28.12

[1] These calves were started on the 65-35 mixture and gradually changed to the 80-20 mix over the first 3 weeks of the trial. All other calves started on their respective mixtures.

[2] Computed from records of feed consumed and composition of rations.

selected regardless of treatment. Since length of time on feed varied, a shrunk weight at 128 days (prior to the first shipment) is given as a basis for comparing performance, as well as over-all gain.

Slaughter data included dressed weights, carcass grades, and marbling scores. The live, or "on-foot" value of the cattle was computed from carcass value according to grade and weight, and was based on the final shrunk weight off test at Ft. Reno.

Results

Table 2 shows the average gains, feed consumption and feed required per cwt. gain for each treatment. Market value, carcass data and financial returns are shown in Table 3.

In Table 4, a comparison of steers vs. heifers is given. As in the first trial, average daily gains for both steers and heifers were disappointing. Periodic weights from this and the previous trial indicate that within each treatment, gains were satisfactory for approximately 100 days, whereupon feed consumption declined and gains dropped accordingly. The reason for this slacking off in feed consumption is not apparent. Some difficulty was encountered in getting the various mixtures to feed down uniformly in the self-feeders. Further, the calves on the 80:20 concentrate-to-roughage ration tended to sort out the roughage and leave the concentrates. The fact that the calves were in fleshy feeder condition at the start of the trial probably reduced gains.

Despite the poor gains, trends in this trial were similar to those observed in the first trial (1955-56) and may be summarized as follows:

1. **Time on feed, gains and feed consumption.** There was little variation in the time required to reach market grade. Daily gains were greatest for steer calves fed the least concentrated ration (35-65 mixture), and for heifers fed the 50-50 mixture. As in the first trial, feed intake declined as the level of concentrates in the ration increased. When the daily T.D.N. (total digestible nutrient) intake is calculated for each lot, only small differences are apparent. This may be the chief explanation for the lack of difference in performance among the lots. Calves fed the bulkier rations (35-65 and 50-50 mixtures) required slightly more total feed, but less concentrates, to reach market condition. In general, feed costs per cwt. gain increased as the concentrates in the ration were increased.

2. **Slaughter data.** Dressing percent (yield) and carcass grades were quite uniform, as is to be expected since the cattle were removed for slaughter at the same estimated grade. There is some indication from carcass grades and yield that calves fed the 80-20 mixture could have been sold earlier. Generally, the carcasses in all lots were amply covered outside, but many lacked the inside finish necessary to meet current grading standards. Marbling scores, however, failed to show a significant difference among the lots.

Table 3.—Carcass data and Financial Results.

Conc.: Roughage Ratio	35:65		50:50		65:35		80:20	
Lot number	1	2	3	4	5	6	7	8
Sex	Steers	Hfrs.	Steers	Hfrs.	Steers	Hfrs.	Steers	Hfrs.
Carcass Yield (%)[1]	59.3	59.4	59.6	59.7	59.1	59.4	60.0	60.9
Av. U. S. Carcass Grade	Gd.+	Gd.+	Gd.+	Gd.+	Gd.+	Gd.+	Gd.+	Ch—
Numerical Score[2]	5.7	5.9	6.1	5.7	6.2	6.2	6.2	5.4
Marbling Score[3]	2— to 3+	3+	3	3+	3	3	3	2
Financial Results ($)								
On-foot Value[4]	19.54	19.43	19.39	19.76	19.19	19.38	19.49	20.19
Market value/calf	171.99	147.51	160.19	150.01	156.78	141.26	159.27	150.95
Feed Cost/calf	72.34	62.01	67.64	65.89	66.92	64.12	62.50	68.06
Total Steer & Feed Cost[5]	182.74	152.91	178.04	156.61	177.32	154.84	172.70	158.78
Net Return/calf	—10.75	—5.40	—17.85	—6.60	—20.54	—13.58	—13.43	—7.83

1 Hot carcass weights shrunk 2½%, based on final Ft. Reno weights.
2 Numerical score: Prime=1, Choice=4, Good=7, Standard=10.
3 Marbling score: 1=abundant, 3=moderate, 5=slight to none.
4 On-foot value computed from carcass value according to grade and yield, and based on final live weights at Ft. Reno
5 Steers charged into feedlots at $20.00/cwt., heifers at $18.00.

Table 4.—Comparison of steers and heifers based on lot averages[1].

	Steers Lots 1,3,5, & 7	Heifers Lots 2,4,6 & 8
Ave. days on feed.	160	162
Ave. weights (lbs.)		
Initial	552	504
Gain to marketing	284	244
Ave. daily gain	1.78	1.51
Total feed consumed/calf/day (lbs.)	20.34	19.41
Feed per cwt. gain (lbs.)		
Concentrates	643	727
Roughage	504	557
Feed cost/cwt. gain ($)	23.81	26.70
Marketing data:		
Yield, %	59.5	59.9
Ave. carcass grade	6d + (6.1)	6d + (5.8)
On-foot value/cwt. ($)	19.40	19.69
Net return per calf ($)	—15.64	—8.35

[1] Individual lot data shown in Tables 2 and 3.

3. **On-foot value and net returns.** Little difference is apparent in on-foot value, as computed from grade and yield. Again this was due to the likeness of grade at the time the cattle were marketed. All calves lost money due to the high cost of cattle and feed vs. the low value of dressed beef. Greatest financial losses occurred with calves fed the 50-50 and 65-35 rations, while those fed either extreme lost the least. In the case of the 35-65 mixture, this was probably due to a cheaper ration, while for the 80-20 mixture, less total feed was required to fatten the calves.

4. **Steers vs. heifers.** Taking an average of all lots, steer calves outgained heifers about .25 lbs. per head daily, at nearly 10 percent less feed cost per cwt. gain. Time required to reach market grade was about the same, although carcass data showed a slight advantage for heifers—as was further borne out by marbling scores. Considering the grade and yield of their carcasses, the heifers should have sold for slightly more than the steers on-foot. Because of a cheaper initial investment as feeders, they suffered less financial loss.

5. **Effect of pen size.** Eight comparable steer calves fed a 65-35 mixture in a special pen approximately twice the size of those used for the other calves gained faster (0.2 lbs. more per head daily) than the steer calves of Lot 5 which served as controls. They were essentially the same in carcass grade and yield. The small pens (approximately 15 × 90 feet) may have adversely affected feed consumption and reduced gains in this trial.

Summary

Eight lots of fall-dropped calves (four lots of steers and four of heifers) were self-fed four different mixtures containing 35, 50, 65 or 80 percent concentrates. The cattle were marketed when it was estimated

they would grade top-good to low-choice. Although gains were disappointing, the results show no significant difference between the mixtures fed in time required to reach slaughter grade, daily gains or carcass grade and yield. Daily feed consumption declined as the concentrate in the ration increased, so that T.D.N. intake was approximately the same for all lots. The data indicate that concentrate-to-roughage ratios in fattening rations for calves can vary widely, with essentially equal results.

The Value of Dehydrated Alfalfa Meal and Molasses in Supplements for Wintering Weanling Calves

A. B. NELSON, M. G. GREELEY, G. R. WALLER and W. D. CAMPBELL

Recent studies with beef cattle supplements have emphasized the feeding of rations which contain the proper balance of the various nutrients. There are suggestions that dehydrated alfalfa meal may have value other than as a source of known nutrients. Molasses may have value above that resulting from added energy or possible increased palatability of the ration. The addition of these components to fattening rations is being extensively studied but little information is available concerning their use in wintering rations. Their use in wintering rations in this area would ordinarily be restricted to their addition to pelleted supplements.

The data reported here are the results of the fourth trial of a study of the value of adding dehydrated alfalfa meal and cane molasses to a wintering ration containing mature, weathered native grass hay as the roughage.

Procedure

Thirty grade, Hereford calves were divided into 3 lots on November 15, 1956. There were six steers and four heifers per lot. All calves were fed the poor-quality hay, free-choice. This hay had been cut from native grass pastures in early November, was relatively coarse textured and was lower in content of protein and phosphorus than prairie hay cut from a similar area in July. Much of the roughage was growth from previous summers. The hay had no apparent green coloring.

In addition to the low-quality hay, the calves had access to a mineral mixture of two parts salt and one part steamed bone meal and were fed an average of two lbs. of protein supplement per head daily. The pelleted supplements contained approximately equal amounts of protein (Table 1) and the ingredients were fed to the various lots as follows:

Lot 1. 1.5 lbs. cottonseed meal, 0.5 lb. corn.

Lot 2. 1.35 lbs. cottonseed meal, 0.15 lb. corn, 0.5 lb. dehydrated alfalfa meal.

Lot 3. 1.6 lbs. cottonseed meal, 0.3 lb. corn, 0.1 lb. cane molasses.

Table 1.—Chemical composition of feeds.

	Percent Dry Matter	Percentage composition of dry matter						
		Ash	Protein	Fat	Fiber	N.F.E.	Ca	P
CSM-Corn	91.65	5.80	37.37	3.81	10.78	42.24	0.23	0.51
CSM-Corn-Dhy. Alfalfa Meal	92.07	7.22	35.84	3.58	14.74	38.62	0.55	0.44
CSM-Corn-Molasses	92.99	5.57	36.63	2.74	12.88	42.18	0.18	0.87
Weathered hay	91.90	7.18	3.72	1.53	37.92	49.65	0.35	0.04

All feeds were fed every other day. A considerable quantity of the hay was wasted but no estimates of this waste were made.

Results

A summary of the results is given in Table 2. In the 133-day wintering period the average gain of the calves was approximately the same, 2, 4, and -4 lbs. for the calves in Lots 1, 2, and 3, respectively This would indicate that there was no practical value of adding dehydrated alfalfa meal or cane molasses to the supplemental feed of calves fed poor-quality hay, hay that was of much lower feeding value than good-quality prairie hay.

Table 2.—Dehydrated alfalfa meal and molasses in supplements for wintering calves (133 days).

	Lot 1 Corn, CSM	Lot 2 Dehydrated alfalfa meal Corn, CSM	Lot 3 Corn, CSM Molasses
Average weight per calf (lbs.)			
Initial 11-15-56	381	380	382
Final 3-28-57	383	384	378
Gain	2	4	—4
Average daily ration (lbs.)			
Weathered hay[1]	10.0	10.0	10.0
Protein supplement	2.0	2.0	2.0
Mineral mixture	.04	.04	.04
Winter feed cost[2] ($)	22.83	22.98	22.78

[1] An equal amount of roughage was fed to each lot. There was considerable wastage of this poor quality hay. This weathered hay was valued at $20 per ton.
[2] Pellets cost $70.76, $71.88 and $70.40 per ton in Lots 1, 2, and 3, respectively.

The average gains of calves fed the three different pellets in each of four years are given in Table 3. During the first three years there was a consistent difference, although not great in some instances, in favor of adding dehydrated alfalfa meal or cane molasses to the ration. The 4-year average gains were 4, 15, and 19 lbs. for the simple pellet, the pellet containing dehydrated alfalfa meal, and the pellet containing cane molasses, respectively.

These results indicate that the inclusion of dehydrated alfalfa meal or molasses in a pellet to be fed as a supplement to weathered hay could be recommended. The nutrients furnished by dehydrated alfalfa meal

Table 3.—Dehydrated alfalfa meal and molasses in supplements for wintering calves (4-year ave.).

	Lot 1 Corn, CSM	Lot 2 Corn, CSM Dehydrated alfalfa meal	Lot 3 Corn, CSM Molasses
Total number of Calves	40	40	40
Average weight per calf (lbs.)			
Initial	422	420	420
Final	426	435	439
Gain (ave. 118 days)	4	15	19

and molasses are more likely to be present in prairie hay or the dry forage available in a native grass pasture during the winter months than in the weathered hay fed in our tests.

Although conclusive data are not available, it might be assumed that the addition of dehydrated alfalfa meal or molasses to pellets fed as supplements to higher quality roughages such as prairie hay is not as valuable as when the addition is made to pellets fed as supplements to poor-quality, weathered hay.

The Response of Dwarf Carrier and Normal Beef Cattle to Insulin Induced Stress

E. J. TURMAN

Although dwarf individuals have been observed in practically all species since ancient times, their occurrence was sporatic and usually regarded as a curiosity. In contrast, dwarfism in beef cattle has shown a sharp increase within the last decade, and has become a serious economic problem. Not only does the dwarf calf represent the loss of a cow's production for the year, but considerable stigma has been attached to animals and lines of breeding known to produce dwarf calves.

While some have suggested that non-genetic factors may be responsible, careful analysis of many records has clearly demonstrated that dwarfism in beef cattle is hereditary. The dwarf calf is homozygous for a single autosomal recessive gene. Non-dwarf calves are either homozygous for the dominant normal gene, or heterozygous and thus carriers of the recessive dwarf gene. Heterozygous animals, while apparently normal themselves, can produce dwarf offspring. Homozygous normal animals, on the other hand, cannot transmit a recessive dwarf gene, and would produce no dwarf calves regardless of the genotype of the animal to which they were mated.

The problem facing the breeder has been the identification of the carrier animals among his normal individuals. To date his only method has been the mating of animals of unknown genotype to animals known to carry the dwarf gene. Such progeny tests will either prove an animal a carrier if a dwarf calf is born, or make the odds against his being a carrier so great he may be presumed clean. For example there is only one chance in one hundred that a carrier bull would sire only normal calves when mated to sixteen known carrier cows. The odds decrease or increase as fewer or more carrier matings are produced. It is evident that the progeny test is not only expensive and time consuming, but also limited almost entirely to testing bulls. The productive life of a cow would be ended before she had produced enough calves to test her to a very high level of probability.

Progeny testing of prospective herd sires has been largely limited to the larger purebred herds. Most breeders have been forced to rely upon pedigree information. This has resulted in discrimination against certain lines of breeding and the possible elimination of animals that carried superior germ plasm for important performance characteristics. It is readily apparent that an accurate diagnostic technique that would permit early detection of carrier animals would be a definite contribution to breed improvement.

Early dwarfism research was directed toward studying differences between dwarf and normal calves. It was hoped that such differences might also be manifest, to a lesser degree, in carrier animals when compared to clean animals. One of the big handicaps in this research is the lack of a method, other than the slow and time consuming progeny test, for determining the dwarfism genotype of the normal animals.

In general the methods proposed as a result of these studies have not permitted a clear-cut differentiation between clean and carrier animals. One such method, which shows some promise, is the x-ray technique discussed in the report starting on page 33 in this publication.

Research has also been directed towards studying the basic physiological differences between dwarf and normal calves. In general these studies have failed to reveal any gross physiological differences between dwarf and normal calves under normal conditions. However, several new studies have been initiated in which the physiological response to stress is being studied. As an outgrowth of one such study utilizing insulin as the stressor mechanism, a new, and very promising, technique has been proposed by workers at the University of Missouri. The object of this paper is to discuss briefly the procedure of this test and present some preliminary results.

Procedure

The animals under test are restrained and a 3-5 ml. sample of blood is drawn from the jugular vein. As soon as the blood has been collected, 0.36 units zinc insulin per pound of body weight is injected into the jugular vein through the same needle. Two additional blood samples are drawn at intervals of 1 hour and 2 hours after the intravenous insulin injection. The blood collecting tubes contain an anti-coagulant to prevent clotting of the blood. Care is exercised in handling the animals to prevent undue excitement.

As soon as possible after the blood is drawn, blood smears are prepared to be stained with Wright's stain for later differential counts.

Samples of blood are then diluted in standard white cell pipettes, using either a 1% acetic acid or 0.08 N hydrochloric acid solution as the diluting fluid. After diluting and shaking for approximately two minutes the blood cells in the diluted samples are counted immediately under low power of a microscope in a standard haemocytometer using the large white blood cell squares.

Results and Discussion

The characteristic changes in blood cells in clean and carrier animals following the insulin injections is given in Table 1. These counts include both the true white blood cells, and the smaller cells that are present but have not yet been positively identified. The large increase in these small cells within one hour in the clean animals is the diagnostic feature of this test. As can be seen in the sample results given in Table 1, clean animals exhibit a marked increase from zero to one hour after insulin, reaching a peak at this time and decreasing in numbers of cells between one hour and two hours after insulin. Carrier animals on the other hand do not increase as rapidly from zero to one hour after insulin, but either continue to increase or remain at relatively the same level from one hour to two hours.

The Missouri workers have also reported that certain characteristic changes occur in the kinds of white blood cells as observed on the stained blood smears. The clean animals show a decrease in lymphocytes and an increase in neutrophils from zero to one hour after insulin. In general, carriers show the reverse change. Stained slides have been

Table 1.—Cells per cubic millimeter of blood of Angus cattle before insulin and at 1 and 2 hours after an intravenous injection of 0.36 units insulin per lb. body weight.

Animal No.	Sex	Dwarfism Status	Cells per mm³ at Hours After Insulin		
			0	1	2
	Group Predicted Clean				
1	F	Pedigree Clean	8,000	19,150	14,600
2	F	" "	10,300	22,300	15,900
3	F	" "	9,800	14,900	9,900
4	F	" "	13,800	25,300	16,800
5	F	" "	14,050	30,550	16,500
6	M	" "	12,300	18,300	10,850
7	M	" "	12,000	19,400	12,000
8	M	" "	13,500	25,000	16,500
Average for predicted cleans			11,719	21,863	14,131
	Group Predicted Carrier				
1	F	Known Carrier	11,050	16,900	16,000
2	F	" "	9,900	14,100	15,000
3	F	Carrier Parent	13,800	15,200	13,550
4	F	" "	14,150	15,000	15,850
5	F	" "	12,500	14,200	18,100
6	M	" "	15,450	16,800	20,300
7	M	" "	9,650	12,000	15,400
8	M	" "	7,450	10,200	14,900
Average for predicted carriers			11,744	14,300	16,138

prepared from animals tested at this station and will be studied at a later date, but such data cannot be reported at this time.

The data included in Table 1 were selected to show one of the characteristic responses that appears to differentiate clean and carrier animals in this test. Although these data were obtained with Angus, similar results have been obtained for Herefords that have been tested. No differences have been observed in the response of bulls as compared to cows under insulin stress.

Much of the work to date at this station has been preliminary studies designed to develop skill in counting the cells. In these studies young animals, whose genotype for dwarfism was not known, were used to avoid the bias that might result if the technician was aware of the results he should obtain. It was found that young animals, one to four years of age, gave a very definite response. However, the older animals that have been tested show little or no response at the dosage level that has yielded excellent results with young cattle. This apparent influence of age on the test has prevented an appraisal of the accuracy of the test since most of the available animals of known genotype were older animals. Further work is needed to determine how age influences the test, not only in the case of older animals, but also to determine the earliest age at which the test may be safely conducted.

In general the results that have been obtained on young animals at this station agree very closely with the expected based upon pedigree information. Approximately 90 percent of the animals believed free of the dwarf gene from pedigree information have given the response assumed to be typical of clean animals. Slightly more than one-half of the offspring of a carrier parent have given a reaction typical of known carriers. One would expect slightly more than one-half of these offspring to be carriers since it was probable that in some cases both parents were carriers. Three young animals known to be heterozygotes have been tested and all gave a carrier response.

Although the results that have been obtained at this station, and other stations, indicate that this technique has promise, it is still in the research stage. There are many questions which remain to be answered by additional research. Work is under way at the present time to determine the accuracy of the test, its limitations, and the factors that influence it. Whether this test will be suggested for routine use in the field will depend upon the results of this research.

Levels of Supplemental Winter Feeding of Beef Cows and Creep-Feeding Fall Calves

A. B. NELSON, R. F. HENDRICKSON, and W. D. CAMPBELL

In recent years there has been an increased number of cows calving in the fall. This change in calving season has resulted in a need for additional data on feeding and managing such cattle grazing native grass yearlong. The cow's requirements for nutrients are markedly increased while she is suckling a calf and supplemental winter feed represents a large portion of the total cost of producing a calf. The amount and kind of supplemental feed needed is determined by the amount and quality of forage available in a pasture. In parts of our state the native grasses furnish practically all of the roughage consumed by a cow herd. Considerations in planning a winter feeding program under such conditions include: What is the effect of level of winter feeding on weaning weights of calves and rebreeding rate of the cows? Should creep-feeding be recommended for fall-dropped calves which are to be marketed as feeders in late summer?

In order to answer the above and other questions, an experiment having the following objectives was initiated in the fall of 1954:

1. To compare two levels of supplemental winter feeding of beef cows suckling calves.

2. To study the value of creep-feeding suckling calves born in the fall and sold as feeder calves.

3. To study the relationship between the level of winter feeding of cows and creep-feeding of their calves.

The results obtained during the 1954-55 season were summarized in Oklahoma Agricultural Experiment Station MP-45 (p. 39). Reported here is a summary of results obtained during the second year of the study and preliminary results obtained during the third winter.

Procedure

In October, 1955, 80 grade Hereford cows were divided into 4 lots of 20 head each. The cattle were allowed to graze in the native grass pastures at the Lake Carl Blackwell experimental range area and during the winter were fed supplemental feed and their calves were fed as follows:

- Lot 1. 1½ lbs. pelleted cottonseed meal; calves not creep-fed.
- Lot 2. 1½ lbs. pelleted cottonseed meal; calves creep-fed.
- Lot 3. 2½ lbs. pelleted cottonseed meal; 3 lbs. ground yellow corn; calves not creep-fed.
- Lot 4. 2½ lbs. pelleted cottonseed meal; 3 lbs. ground yellow corn; calves creep-fed.

The supplemental feed was fed in bunks every other day in amounts to furnish the above listed pounds per head daily. A mineral mixture of two parts ground rock salt and one part steamed bone meal was available at all times. The concentrate mixture which was creep-fed contained 55% rolled milo, 30% whole oats, 10% cottonseed meal and 5% cane molasses. The mixture was available in mid-December but only small quantities were consumed until late January.

Purebred Hereford bulls were placed with the cows on December 19, 1955, thus, the first calves were born in late September.

Results

A summary of the data collected in the 1955-56 season is given in Table 1.

The cows on the low level of wintering, Lots 1 and 2, lost 203 and 320 lbs., respectively, during the 192-day winter feeding period. Those cows on the high level lost 198 and 214 lbs. during the same period. The average loss of these two lots was 206 lbs. as compared to an average loss of 262 lbs. in Lots 1 and 2. Thus, the level of supplemental feeding was reflected in weight gains.

The reason for the difference in winter gain of the two groups of cows on the low level is not apparent. The "yearly" gain (beginning

Table 1.—Creep-feeding fall calves and levels of wintering cows suckling calves.

Lot number	1	2	3	4
Level of feeding cow	1½ lbs. CSM	1½ lbs. CSM	2½ lbs. CSM 3 lbs. corn	2½ lbs. CSM 3 lbs. corn
Calf feeding	None	Creep-fed	None	Creep-fed
Number of cows raising calves[1]	18	18	17	19
Average weight per cow (lbs.)				
Initial 10-8-55	1082	1152	1129	1125
Spring 4-17-56	879	832	931	911
Final 7-9-56	1072	1092	1131	1093
Winter gain	—203	—320	—198	—214
"Yearly" gain	— 10	— 60	2	— 32
Average weight per calf (lbs.)				
Birth[2]	78	80	79	79
Weaning 7-9-56[3]	472	509	512	528
Daily gain	1.56	1.79	1.75	1.86
Average birth date of calves	Oct. 30	Nov. 12	Nov. 4	Nov. 11
Supplemental feed per animal (lbs.)				
Cow				
Cottonseed meal	288	288	480	480
Corn	---	---	576	576
Mineral	30	30	30	30
Calf (creep-feed)[4]	---	744	---	655
Total feed cost per head ($)				
Cow	32.47	32.47	55.26	55.26
Calf	---	19.05	---	16.77
Total	32.47	51.52	55.26	72.03
Selling value minus feed cost ($)	49.83	38.09	34.87	22.21
Per 100 lbs.				
Steers[5]	19.30	19.30	19.30	19.30
Heifers[6]	16.25	17.00	17.00	17.50
Per head[7]	81.40	89.61	90.13	94.24
Selling value minus feed cost ($)	48.93	38.09	34.87	22.21

[1] There were originally 20 cows per lot. Losses in Lot 1 were a crippled calf which died shortly after birth and a dead calf taken by Caesarian section. In Lot 2 one calf was born dead after malpresentation at parturition and one cow died at time of parturition at the Veterinary clinic. Lot 3 losses were one calf died shortly after birth, one calf died of unknown causes when 4 months old and one cow died of unknown causes (apparently lightning) in May 1956. The loss in Lot 4 was death of twin calves shortly after birth.

[2] Corrected for sex by the addition of 5 lbs. to the weight of each heifer calf.

[3] Average weight of steers plus average weight of heifers divided by 2.

[4] Cost of creep-feed was $2.56 per cwt.

[5] All steers except 1 per lot were sold as feeders at $19.50 per cwt. The remaining steers sold at $17.50 per cwt.

[6] The fatter heifers were sold for slaughter at $18 per cwt. This included 1,5,4, and 7 heifers in Lots 1,2,3, and 4, respectively. The remainder of the heifers (9,5,5, and 2 in Lots 1,2,3, and 4, respectively) sold as feeders at $16 per cwt.

[7] Stillwater weights were shrunk 3%.

of winter period until weaning) was —10 and —60 for these low-level cows. The cows of Lot 2 were heavier in the fall, lost more during the winter, and gained more from April to weaning.

Both the winter gain and yearly gain of the cows, (Lot 1 vs. 2, and Lot 3 vs. 4), were in favor of not creep-feeding the calves. This is in contrast to statements that creep-feeding calves results in heavier cows. The importance of such weight differences is not understood completely.

The average birth weights of the calves were only slightly different. The calves were weaned on July 9 and sold at the Oklahoma City livestock market. The weaning weight of the calves in Lot 1 was 472 lbs. which was 37 lbs. less than the weight of calves in Lot 2 (509 lbs.). The calf weights in Lots 3 and 4 were 512 and 528 lbs., respectively. The calves in Lots 2 and 4 were creep-fed and the increased gain resulting from creep-feeding was 37 lbs. for calves from the low-level cows and 16 lbs. for those from the high-level cows.

Nearly all steers were sold as feeders at $19.50 per cwt. The fatter heifers sold for slaughter at $18 per cwt. and the remainder of the heifers sold as feeders at $16 per cwt. Within a level of wintering there were more creep-fed heifers sold at $18 than at $16 per cwt. All the heifers could have been sold as feeders at approximately $17 per cwt. The steers were appraised at $16.50 per cwt. for slaughter.

The calves in Lot 2 consumed an average of 744 lbs. of creep-feed which cost $19.05. In Lot 4 the 655 lbs. of feed per calf cost $16.77. The cost of feeding the cows in Lots 1 and 2 (low-level) was $32.47. When this cow-feed cost and creep-feed cost are subtracted from the selling value per calf, the "net return" is more than $10 per head in favor of not creep-feeding ($48.93 vs. $38.09). In Lots 3 and 4 (high-level) the difference is $12.66 in favor of not creep-feeding ($34.87 vs. $22.21). These results are in agreement with those obtained during the previous year.

Apparently creep-feeding will increase the gain of the calves and the calves will probably be slightly fatter at weaning. However, when these calves were sold in July the feeder value of the steers was $3 per cwt. more than their value for slaughter. High quality creep-fed and non-creep-fed calves ordinarily sell at the same price or within $.50 per cwt. as feeders. Under such conditions creep-feeding the steer calves cannot be recommended. It is possible that steer calves could profitably be creep-fed during the winter months but not creep-fed after green grass is available in the spring. Data on such a system are not available. The creep-feeding of heifer calves is sometimes recommended. The profitableness of this practice would depend upon the relative value of slaughter and feeder cattle when the calves are sold.

There were small differences in average calving date which cannot be explained. One might expect cows wintered on the low-level to calve later than those in the high-level. This was not true in this test. When the cows were examined for pregnancy in mid-summer, there were 3 open cows in Lot 2, and 2 open cows in Lot 4. Since feeding the low level of supplemental feed during the winter has not delayed the average calving date nor increased the number of open cows but has increased the net return per calf, the present recommendations for winter feeding of cows suckling calves may be too high.

Preliminary Results of 1956-57 Test

All except one of the cows used in the previous test remained in the experiment. One cow was replaced with one of similar breeding; therefore, each lot contained 20 cows. The feeds were the same as those used in the previous test except that milo replaced corn in the high-level ration. The cottonseed meal and milo were mixed and pelleted for convenience in feeding. Data collected to March 1 are summarized in Table 2.

Table 2.—Preliminary 1956-57 results of levels of winter feeding beef cows nursing calves.

Lot number	1	2	3	4
Level of feeding cow	1½ lbs. CSM	1½ lbs. CSM	2½ lbs. CSM 3 lbs. milo	2½ lbs. CSM 3 lbs. milo
Calf feeding	None	Creep-fed	None	Creep-fed
Number of cows raising calves[1]	19	14	18	17
Average weight per cow (lbs.)				
Initial 9-29-56	1099	1129	1096	1153
Spring 3-1-57	807	761	826	863
Gain, 153 days	—292	—368	—270	—290
Avg. birth weight per calf (lbs.)[2]	81	80	80	79
Average calving date, October[3]	13	27	17	11
Avg. wt. per calf, 3-1-57 (lbs.)[4]	212	206	215	257
Total feed per animal (lbs.)				
Cow[5]				
Cottonseed meal	230	230	382	382
Ground milo	---	---	426	426
Calf	---	188	---	177
Supplemental feed cost per animal ($)				
Cow	7.82	7.82	23.64	23.64
Calf[6]	---	5.79	---	5.45
Total	7.82	13.61	23.64	29.09

[1] There were originally 20 cows per lot. One cow in Lot 1 died of unknown causes. In Lot 2 there were 3 open cows. In addition, 1 calf was born dead and 2 cows died from accidental urea poisoning. Two calves died in Lot 3. In Lot 4 one cow was open, 1 cow drowned and 1 calf died following castration and dehorning.

[2] Corrected for sex by the addition of 5 lbs. to the weight of each heifer calf. Includes all calves born.

[3] Includes all calves born.

[4] No corrections for age or unequal numbers of steers and heifers in each lot.

[5] Feeding of cottonseed meal pellets began 9-29-56. Milo was fed beginning 10-10-57.

[6] Creep-feed cost $3.08 per 100 lbs.

Winter gains of the cows were approximately the same as those recorded during the previous test. The weight loss was particularly great in Lot 2, but the loss in Lot 1 was not much different from the losses in Lots 3 and 4, although the average losses for the cows on the low- and high-levels of wintering were 330 and 280 lbs., respectively.

The average birth weight of calves was nearly the same in all lots. The average birth date varied considerably between lots with no consistent relation between birth date and level of wintering of the cows.

The calves in Lot 4 (high-level of wintering cows and creep-feeding calves) weighed considerably more on March 1 than the other calves. These are the oldest calves and some of the difference may be due to the unusually large number of steers in this lot. There is an unusually large number of heifers in Lot 2 and these calves are the youngest. No weight corrections due to differences in number of each sex and age of calves have been made in these data.

Further evaluation of the feeding method for each of the 4 groups of cattle will be made when the calves are sold in late June or early July.

Supplements to High-Silage Rations for Fattening Two-Year-Old Steers

L. S. POPE, R. D. HUMPHREY, LOWELL WALTERS and GEORGE WALLER

Much attention has been given to the development of complex protein supplements for fattening cattle. Increased use has been made of stilbestrol and other synthetic hormones in an attempt to increase gain and lower the feed requirements. Using the "artificial rumen" technique, it has been possible to show that a wide variety of feeds and other ingredients will improve the medium for rumen bacteria.

As important as these advances are, much remains to be learned as to the practical importance of the many feed additives now being used in beef cattle supplements. Small differences in rate and efficiency of gain may mean the difference between profit or loss to the cattle feeder. Yet it is generally true that the more complex the supplement the greater the cost of the fattening ration. Thus, practical feeding trials are necessary to show the possible beneficial effects of complex supplements as opposed to commonly used oil meals on a protein- and energy-equal basis.

To test certain feed additivies and complex supplements for fattening beef cattle, a project was initiated at the Fort Reno station in 1953. In these tests, long-yearling and two-year-old feeder cattle have been used. They have been fattened on high-silage rations, with limited amounts of ground milo and a protein supplement. This report gives the results of the 4th trial. To date, the tests have included comparisons of 12 supplements vs. soybean meal.

Procedure

Seventy, coming two-year-old steers from the Experiment Station herds at Guthrie and Lake Carl Blackwell were selected in August and September, 1956, for this study. Forty-two steers were obtained from the Guthrie station. These cattle had been purchased the previous fall from the Louis Ham Ranch at Paoli in the southern part of the state, and had been used in grazing trials at the Guthrie station. Twenty-eight of the steers used were from the Lake Blackwell station herd.

One-half of the cattle from the Blackwell group had been implanted with 45 mg. of stilbestrol in June, 1956, as reported elsewhere in this publication. Allotment to the feeding test at Fort Reno was made on the basis of source, previous treatment, summer gain, shrunk weight (off feed and water for 16 hours) and grade. The cattle were charged into the feeding pens at $18.50 per cwt.

A "two phase" feeding program was followed in which silage was fed **ad lib.** during the first 84 days, following which the steers were raised to a full-feed of grain (approximately 2 lbs. of grain per cwt.) plus silage and supplement for the last 100 days on test. During the entire test, the same amount of supplement was fed per steer daily as follows:*

- Lot 1—2.0 lbs. soybean meal.
- Lot 2—3.0 lbs. of a special mixture containing soybean meal, dried molasses, ground limestone, B-vitamin concentrate (Fortafeed), vitamin A and trace minerals.
- Lot 3—3.45 lbs. of a urea-molasses mixture plus minerals.
- Lot 4—Same as Lot 1 plus antibiotic (90 mg. aureomycin).
- Lot 5—Same as Lot 2 plus antibiotic.
- Lot 6—Same as Lot 3 plus antibiotic.
- Lot 7—2.0 lbs. soybean meal, to which 150 mg. of a thyroid depressor was added during the heavy grain feeding phase (last 100 days).

The amount of supplement fed the experimental lots was adjusted to provide essentially equal protein intakes in all lots. The milo fed Lots 2 and 5 was reduced slightly to account for the higher energy content of the supplement fed.

All steers received 10 mg. stilbestrol per head daily, mixed with the protein supplement. A previous trial had shown that feeding stilbestrol throughout the fattening period would increase gains by 24%, and lower the feed required per cwt. gain by 15%. In Lots 3 and 6, the bone meal, trace minerals, stilbestrol and aurofac (Lot 6) were mixed with a small amount of ground milo, and the urea and molasses were mixed at each feeding.

The cattle were fed once daily in deep bunks beneath an open shed. A mineral mix of 2 parts salt and 1 part steamed bone meal was available to all cattle. At the completion of the trial, a final shrunk weight (16 hours off feed and water) was obtained and the cattle were sold the following day on the Oklahoma City market. Data were obtained on shrink to market, yield, carcass grade, marbling score of the rib eye, and carcass value based on dressed beef prices at Oklahoma City. From this information, an "on-foot' value per cwt., based on individual final weights at Fort Reno, was calculated and used in figuring net returns.

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*The Aurofac and Fortafeed were obtained from American Cyanamid Corporation, Lederle Division, New York City; the vitamin A concentrate (Quadrex 30) was supplied by Nopco Chemical Co., Harrison, New Jersey; the urea was supplied by Allied Chemical and Dye, New York City; the trace minerals by Calcium Carbonate Company, Chicago, Ill., and the thyroid depressor (1-methyl-2-mercaptoimidazole) supplied by Eli Lilly and Co., Indianapolis, Indiana.

Results

The chemical composition of the feeds used in this trial are shown in Table 1. Average daily gains, rations fed, feed required per cwt. gain and its cost are shown in Table 2. Slaughter data and financial returns are shown in Table 3.

1. **Soybean meal vs. a complex supplement.** The relative value of soybean meal vs. a complex supplement containing soybean meal, dried molasses, calcium, trace minerals, B-vitamin supplement and vitamin A can be seen by comparing Lots 1 and 4 with Lots 2 and 5. Average daily gains were almost identical, and feed costs per cwt. gain therefore reflected the higher cost of the complex supplement fed to Lots 2 and 5. Under the prevailing prices of this trial, the cattle of Lots 2 and 5 needed to gain about 30 lbs. per head more than the controls to have paid for the additional feed cost due to the higher-priced protein supplement.

Carcass grades were somewhat higher for steers of Lots 2 and 5 and their on-foot market value was increased about $.50 per cwt; yield and marbling scores further reflected the better condition of these cattle. Financial returns were not improved due to high cost of the supplement.

2. **Soybean meal vs. urea-molasses.** Steers of Lots 3 and 6 fed a urea-molasses supplement fortified with bone meal and trace minerals gained significantly less than those of Lots 1 and 4 fed soybean meal. Carcass data showed little difference between the two groups, although the packer buyers actually bid $1.00 less for Lot 3 cattle than for the other lots. In terms of rate of gain and feed efficiency, the use of a urea-molasses mixture to supply all the crude protein for fattening steers was not justified. Further, the high price of molasses in this trial tended to make the substitution even more unprofitable. It would appear that the use of urea-molasses mixtures now being sold commercially in this area as the sole protein supplement for fattening cattle is unwise. Previous research has shown that urea can substitute for one-half of the protein of a supplemental mixture, but that substitution at a higher level may adversely effect feed efficiency and market value. Palatability is often a problem with urea supplements. However, with the urea-molasses mixture fed Lots 3 and 6 no adverse effect on palatability was noted.

3. **Effect of a thyroid-depressor.** The thyroid-inhibitor fed to Lot 7 cattle during the last 100 days was used in an attempt to improve carcass quality. Previous tests with stilbestrol have shown marked improvement in rate and economy of gain, but no improvement in carcass grade. Average daily gains were apparently not affected by use of the thyroid depressor in this trial. Also, yield, carcass grade and marbling scores taken from the rib eye showed essentially no difference. Thus, it appears that the product fed was either (1) not effective against cattle

Table 1.—Chemical composition of feeds, 1956-57 trial.

FEED	Moisture	Ash	Crude Protein	Fat	Fiber	N-Free Extract	Ca	P
Sorghum Silage	71.14	2.16	2.08	.82	5.85	17.95	.09	.06
Soybean Meal	9.58	5.79	48.48	1.11	5.71	29.33	.39	.33
Special Mixture[1]	8.95	8.29	35.99	1.00	5.74	40.03	1.57	.25
Urea[2]			262.00					
Milo	10.15	1.57	11.56	2.52	.99	73.21	.14	.27

[1] Special mixture fed Lots 2 and 5 supplied per steer daily (lbs.): 2.0 soybean meal; 0.83 dried molasses; 0.05 B-vitamin supplement; 0.1 ground limestone, 0.066 dry stabilized vitamin A (30,000 U. S. P. units), and 1 gram trace minerals.

[2] Urea-molasses mixture fed Lots 3 and 6 supplied 3.0 lbs. molasses and 0.35 lb. urea per steer daily. In addition, 0.1 lb. steamed bone meal and 1 gm. commercial trace mineral mixture was added to the ground milo fed daily. Substitution of urea-molasses for soybean meal was made by step-wise replacement during the first 21 days of the test.

Table 2.—Weight gains, rations fed and feed required per cwt. gain (183 days on test, 10 steers/lot)[1]

	No Antibiotic			With Antibiotic			
Lot Number	1	2	3	4	5	6	7
Supplement Fed	S.B. Meal	Special Mix	Urea-Mol.	S.B.M. + Aurofac	Spec. Mix + Aurofac	Urea-Mol. + Aurofac	S.B.M. + Thy. Depressor
Av. weights (lbs.):							
Initial 9-21-56	790	790	789	784	790	791	789
Final 3-24-57	1266	1280	1215	1276	1260	1236	1263
Av. daily gain	2.60	2.68	2.33	2.69	2.57	2.43	2.59
Av. daily ration (lbs.), all cattle received 10 mg. stilbestrol.							
Milo	12.6	11.9	12.6	12.2	11.9	12.7	12.6
Soybean meal	2.0		.9[3]	2.0		.9[3]	2.0
Special mix[2]		3.0			3.0		
Urea-molasses[2]			3.3			3.3	
Aurofac				.05	.05	.05	
Thyroid depressor[4]							150mg.
Silage	38.3	38.8	38.6	40.2	37.3	38.0	39.0
Minerals (2-1-mix)	.08	.08	.08	.08	.05	.08	.08
Feed required/cwt. gain (lbs.)							
Milo	484	444	541	469	463	522	486
Supplement	77	112	140	76	119	136	77
Silage	1472	1449	1658	1492	1452	1563	1506
Feed cost/cwt. gain ($)	22.42	24.46	26.96	22.55	25.73	26.36	22.66

1 One steer removed from Lot 4, December 10, for coccidiosis.
2 For composition, see foot-note to Table I.
3 Ave. daily amount fed during the first 21 days when soybean meal was gradually replaced by the urea-molasses supplement.
4 Thyroid depressor was fed only during the last 100 days (heavy grain phase).

Table 3.—Marketing data, carcass grades and financial results.

	No Antibiotic			With Antibiotic			
Lot number	1	2	3	4	5	6	7
Supplement fed	S.B. Meal	Special mix	Urea-Mol.	S.B.M. + Aurofac	Spec. Mix + Aurofac	Urea-mol. + Aurofac	S.B.M. + Thy. Depressor
Slaughter data:							
Shrink to Market (%)	3.95	3.52	3.95	3.45	3.77	2.18	2.73
Yield (%)[1]	59.6	60.2	59.7	60.0	60.5	60.6	59.6
Carcass grades:[2]							
Top choice						1	
Av. choice		1	1		5		2
Low choice	3	5	4	3	1	4	2
Top good	6	3	5	4	3	4	5
Av. good	1	1		2	1		
Marbling score[3]	6.8	5.6	6.3	6.8	5.9	5.2	6.4
Financial results ($)							
On-foot value/cwt.[4]	19.97	20.40	20.20	20.06	20.61	20.62	20.11
Feed cost/steer[5]	106.74	119.86	114.86	110.95	120.92	117.32	107.39
Total steer + feed cost[6]	252.89	266.01	260.83	255.99	267.07	263.66	253.36
Net return per steer	—0.07	—4.89	—15.40	—0.02	—7.38	—8.80	+0.63

[1] Hot carcass weights shrunk 2½%, values based on final Ft. Reno weights.
[2] Carcass grade lost on one steer in Lot 6.
[3] Marbling score: 1— abundant, 7—average or moderate, 13— very slight.
[4] On-foot value computed from carcass grade, yield and value, based on final Ft. Reno weight.
[5] Cost of Special supplement, $107.80 per ton; urea-molasses plus minerals, $66.20. No charge made for thyroid depressor used in Lot 7.
[6] Does not include costs of transportation, labor, spraying or marketing. Initial cost of steers into feedlot, 18.5¢ per lb.

of this age and weight at the levels fed, or (2) may have been altered or destroyed in the rumen before its action could become effective.

4. **Effect of an antibiotic.** The performance of steers of Lots 1, 2 and 3 receiving no antibiotic can be compared with those fed 90 mg. of aureomycin per steer daily in the crude product (Lots 4, 5 and 6). Average daily gains for the two groups were nearly identical, as were feed efficiency values and carcass merit. In a previous trial, the antibiotic had given a slight response—but in this trial with larger numbers the effect was not apparent. It would appear that under the conditions of this trial, adding an antibiotic to the supplement was of no benefit. A number of experiment stations have reported similar results. However, a number of large commercial feeders who fatten cattle in the same pens throughout the year and who buy cattle from many sources, argue that the antibiotic will improve gains, particularly during the early part of the feeding period. Such differences in response between the experimental pens and the commercial feedlots may exist. Each feeder may need to conduct tests to determine the effect of antibiotics under his own conditions.

5. **Effect of previous implantation with stilbestrol on feedlot gains.** It was possible in this test to so allot the Blackwell cattle that the performance of 14 steers which had been implanted with 45 mg. stilbestrol in June could be compared to a like number from the same herd which served as controls. Gains during the feeding test were essentially the same (2.66 lbs. per head daily for the controls vs. 2.63 lbs. for cattle previously implanted), hence no adverse effect of implantation on subsequent feedlot performance was apparent. However, the summer gains of the two groups indicated little response to stilbestrol and it is possible where no improvement due to stimulation occurs, subsequent performance on fattening rations will not be affected.

Summary

Seventy yearling steers were divided into 7 uniform lots and used to test the effect of different supplements vs. soybean meal in high-silage rations. The supplements included a complex vitamin and mineral mixture, a urea-molasses mixture fortified with minerals, an antibiotic (aureomycin) added to each of three supplements, and a thyroid-depressor added to one lot during the last half of the fattening period. None of the supplements tested appeared to improve rate of gain or feed efficiency, although certain of the supplements improved carcass grade slightly. The urea-molasses mixture was inferior to soybean meal as a protein supplement in this type of fattening ration.

The results from four trials in which 12 supplemental mixtures have been compared to soybean meal on a protein- and energy-equal basis have indicated that the simple protein is apparently sufficient to

meet the needs of rumen bacteria, as measured by steer performance. Thus, when silage of good quality is the roughage, selection of the protein supplement should be based on cost per unit of protein. Urea-molasses mixtures as the entire supplement are not equal to soybean meal.

Fattening Trials with Western Feeder Lambs

ROBERT L. NOBLE, RICHARD PITTMAN, and
GEORGE WALLER, Jr.

A lamb feeding enterprise during the fall and winter can fit into many farm programs in Oklahoma. Lambs make excellent utilization of wheat pasture. Lambs also can be finished in dry-lot to a satisfactory slaughter grade on a lower-concentrate higher-roughage ration than most meat producing animals. The proximity of an adequate supply of feeder lambs, reasonably mild winters, ready market for the finished lambs and the usual supply of home grown feeds make lamb feeding an enterprise worthy of consideration.

The study reported here was initiated at Ft. Reno Station with the following objectives:

(1) To study the feeding value of sorghum silage in a lamb-fattening ration.

(2) To test alfalfa in various forms as a supplement to sorghum silage.

(3) To study the effect of stilbestrol implant in lambs on a high roughage and also on a high grain ration.

(4) To determine the value of uncombined milo and winter grass for lambs.

(5) To study a deferred feeding system with lambs, thus marketing at a later date.

Procedure

Two hundred and ninety-two Southwestern feeder lambs were used. These lambs were purchased in the range area of New Mexico. They were shipped via rail from Artesia, New Mexico, and were received at the Ft. Reno Station, October 15. The lambs grazed Bermuda grass pasture around the Station Headquarters until November 8. During this period the lambs were handled as follows:

October 26, 27—all lambs were sheared.
" 27—vaccinated against enterotoxemia.

November 1—weighed individually, to check shrinkage and for preliminary allotment.

November 7—weighed individually and allotted according to weight, and the lots assigned to treatment at random.

The lambs were started on their experimental rations November 8. The treatments used were as follows:

Standard feeding program (24 lambs per lot, each treatment replicated).

Lot 1 & 6—45% milo, 5% molasses, 50% alfalfa hay; ground, mixed, and self-fed.

Lot 2 & 7—same as 1 & 6, plus silage.

Deferred feeding program. Roughage for the first 75-80 days then self-fed ration 1 & 6 for 50 days. (24 lambs per lot, each treatment replicated).

Lot 3 & 8—1.15 pound dehy. alfalfa meal; silage, full feed.

Lot 4 & 9—1.4 pound alfalfa hay, silage, full feed.

Lot 5 & 10—Alfalfa hay, free choice; silage, full feed.

Utilization of uncombined milo and winter grass. (52 lambs per lot).

Lot 11—Milo stubble and winter grass first 70 days then self-fed ration, 1 & 6.

One-half of the lambs of each lot were implanted with 6 mg. of diethylstilbestrol, commonly called Stilbestrol[1]. The only mineral offered the lambs of Lots 1,2,6, and 7 was salt. A mineral mix of 70% salt and 30% steamed bone meal was offered free choice to the lambs of the other lots.

Individual weights following an overnight period without access to feed and water were taken at the beginning of the trial, at about 30 days, again at 78 days and at the end of the trial. The lambs of Lots 1,2,6, and 7 were sold on the Oklahoma City Market, February 10. The lambs of the other lots were sold March 18. Marketing data included shrinkage, selling price, carcass grade, and yield. Average weight gains, consumption records, marketing data, and financial results are shown in Table 1 and 2. The effect of stilbestrol implants on rate of gain, carcass grade, and yield are shown in Table 3. Chemical analysis of the feeds are presented on Table 4.

Observations

Standard Feeding Phase

The results are shown in Table 1. The lambs of both treatments made very satisfactory gains and the gains were essentially the same for both groups. The feed required, cost per cwt. gain, carcass grade,

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[1] The stilbestrol implants were supplied by Norden Laboratories, Lincoln, Nebraska.

Standard Feeding Program

Table 1.—Weight gains, rations fed, and financial results obtained with fattening lambs self-fed in dry-lot. (95 days, November 8, 1956—February 10, 1957)

Treatment	1. 45% milo, 5% molasses, 50% alfalfa hay ground and mixed		2. 45% milo, 5% molasses, 50% alfalfa hay ground and mixed: silage, free-choice	
Lot number	1	6	2	7
Number of lambs/lot	24	24[1]	24	24
Initial weight	63.2	64	63.3	63.7
Final weight	102.3	103	102.6	104
Av. Daily gain	.41	.41	.41	.42
Av. Daily ration				
Mixture	3.4	3.3	3.1	3.3
Silage	--	--	1.2	1
Feed per cwt. gain (lbs.)				
Mixture	8.2	8.2	7.4	7.7
Silage	--	--	2.9	2.5
Feed cost/cwt. gain	18.70	18.70	18.30	18.80
Financial Results ($)				
Av. selling price/cwt.	18.50	18.50	18.50	18.50
Total value/lamb (minus actual shrink + wool credit)[2]	21.60	21.73	21.65	21.91
Initial Cost[3]	12.95	13.12	12.98	13.06
Miscellaneous cost[4]	.55	.55	.55	.55
Feed cost/lamb	7.31	7.29	7.19	7.58
Profit or Loss/lamb[5]	.79	.77	.93	.72
Dressing percentage	53	53.1	52.8	53
Carcass Grade				
Choice	17	14	13	15
Good	6	9	11	9
Utility	1	--	--	--

[1] One lamb in Lot 6 died from enterotoxemia.
[2] Wool credit (5.12 lbs. at 62¢ (includes U. S. Government incentive)—50¢ shearing charge).
[3] Initial cost: 17.50 F.O.B. Artesia, New Mexico; 20.50 on experiment, which includes 10% shrink.
[4] Includes cost of vaccinating, drenching, and marketing.
[5] Does not include transportation charges.

Deferred Feeding Program

Table 2.—Weight gains, rations fed, and financial results obtained with fattening lambs in dry-lot. (128 days, November 8, 1956 to March 16, 1957)

	Deferred Phase — 78 days						
Treatment	3. Silage, full feed 1.1# dehy. alf. meal		4. Silage, full feed 1.4# alf. hay		5. Silage, full feed alf. hay, free choice		6. Uncombined milo winter grass *70 days*
Lot Number	3	8	4	9	5	10	11
Number of lambs per lot	24	24	24	24	24	24	52[1]
Initial weight	63.8	64.2	64.0	65.2	64.3	64.3	51.5
Final weight	79.2	79.9	83.2	81.8	86.7	87.0	73.9
Av. Daily gain	.20	.20	.25	.21	.29	.29	.32
Av. Daily ration (lbs.)							
silage	3.7	3.8	3.7	3.7	3.6	3.3	
dehy. alf. meal	1.12	1.11	--	--	--	--	
alfalfa hay	--	--	1.38	1.38	2.5	2.55	
milo field & winter grass	--	--	--	--	--	--	free choice
Feed/cwt. gain							
silage	1879	1882	1492	1779	1262	1113	
dehy. alf. meal	569	560					
alfalfa hay			558	647	873	874	
Feed cost/cwt. gain	23.62	23.41	15.83	18.60	19.40	18.68	
Feed cost/lamb	3.64	3.67	3.05	3.09	4.33	4.26	2.00[2]
	Full-Feeding Phase—50 days						*Self-fed on pasture (50 days)*
Initial weight	79.2	79.9	83.2	81.8	86.7	87.0	73.9
Final weight	105.3	107.7	109.4	105.7	107.3	107.9	99.9
Av. Daily gain	.52	.56	.52	.49	.41	.40	.52
Av. Daily ration (lbs.)							
mixture	4.25	4.31	4.28	4.32	4.17	4.08	2.58
Feed/cwt. gain	814	776	817	885	1012	1021	506
Feed cost/cwt. gain	18.56	17.69	18.63	20.18	23.07	23.28	11.50
Feed cost/lamb	4.84	4.92	4.88	4.92	4.75	4.66	3.00

Table 2.—Con't.

Financial Results-Both phases							
Av. Selling price	21.25	21.25	21.25	21.25	21.25	21.25	21.25
Total value/lamb (minus actual shrinkage + wool credit)[3]	24.60	25.08	25.45	24.69	25.03	25.13	22.85
Initial cost[4]	12.93	13.16	13.11	13.37	13.19	13.17	11.19
Miscellaneous cost[5]	.55	.55	.55	.55	.55	.55	.55
Feed cost/lamb	8.48	8.59	7.93	7.99	9.05	8.92	5.00
Profit/lamb	2.64	2.78	3.86	2.78	2.24	2.49	6.11
Dressing percentage	50.6	50.7	50.4	51.8	50.9	50.7	49.5
U. S. Carcass Grade							
Choice	13	17	14	19	18	21	15
Good	10	7	10	3	6	3	34
Utility	1	--	--	2	--	--	--

[1] Three lambs died, lot 11. Charged to experiment.
[2] Basis on a pasture charge of 50¢ per lamb per month.
[3] Wool credit (5.12 lbs. for lots 3, 8, 4, 9, 5 and 10; 4.14 lbs. for lot 11 at 62¢, includes U. S. Government incentive)—50¢ shearing charge.
[4] Initial cost 17.50 F.O.B., Artesia, New Mexico; 20.50 on experiment, which includes 10% shrink and death loss (lot 11).
[5] (Includes cost of vaccinating, drenching, and marketing.

yield, and profit per lamb were also about the same. The lambs of Lots 2 and 7 consumed just over 1 pound of silage per day.

Alfalfa in Various Forms as a Supplement to Sorghum Silage

The results are shown in Table 2. The average daily gain during the deferred phase for the three supplements were as follows: 1.15 lb. dehy. alfalfa meal, .20, 1.4 lb. alfalfa hay, .23, and alfalfa hay, free choice, .29. The feed cost per cwt. gain was about $4 cheaper for the lambs fed alfalfa hay as compared to dehydrated alfalfa meal.

During the full-feeding phase the lambs of treatment 3 (Lots 3 & 8) and treatment 4 (Lots 4 & 9) made excellent gains. Their gains were about .5 lb. as compared to .4 for treatment 5 (Lots 5 & 10) (alfalfa hay, self-fed). They were also more efficient in feed utilization. There was little difference in dressing percentage but the lambs of treatment 5 were fatter as indicated by carcass grade. The profit per lamb was the greatest for the lambs on treatment 4 (1.4 lb. of alfalfa hay).

This year the lambs fed on the deferred program were more profitable than those fed on a standard feeding program. This difference was due primarily to a difference in selling price. Those fed on the standard feeding program were sold February 10 for $18.50 as compared to $21.25 for those sold March 16th.

Utilization of Uncombined Milo and Winter Grass

Sixteen acres of milo which was not good enough to combine was used for this phase. This field also had a heavy cover of winter grasses, predominantly Bromus Secalinus and Bromus Tetorus, as indicated by Table 2, 52 lambs were used. This served as only source of feed for the first 70 days and then the lambs were self-fed on the pasture using the same mixture as fed the lambs of Lots 1 & 6. The average daily gain for the first 70 days was .32 lbs. and for the last 50 days, .55 lb. On the basis of total gain minus the actual shrinkage and death loss times market price, the milo field was worth $24.85 per acre.

The Effects of Stilbestrol Implants

The results are shown in Table 4. Stilbestrol increased the gains in every treatment. The average increase for standard feeding program, the deferred feeding program, and for lambs grazing uncombined milo were 16%, 18%, and 4%, respectively. Little difference was noted in dressing percentage. The stilbestrol lambs graded slightly lower. One yearling carcass was produced by a non-implanted lamb. No harmful effects were noted. Stilbestrol **has not** been approved by the Federal Food and Drug Administration for use with lambs either as an implant or mixed with the feed.

Table 3.—The effects of stilbestrol implant on feed lot performance, yield, and carcass grade

Treatment	Standard Feeding Program						Deferred Feeding Program					
	Mixture		Mixture silage		Silage 1.1# dehy. alf. meal		Silage 1.38# alf. hay		Silage alfalfa hay, free choice		Milo Field + winter grass	
Lot numbers	1 & 6		2 & 7		3 & 8		4 & 9		5 & 10			
	without	*with*	*without*	*with*	*without*	*with*	*without*	*with*	*without*	*with*	*without*	*with*
No. of lambs	24	24	24	24	24	24	24	24	24	24	26	23
Total Gain	35.41	42.87	37.85	41.91	39.62	44.74	38.41	46.97	40.75	48.83	47.54	49.48
Percentage increase		21		11		13		22		20		4
Yield	53	53	53.5	52.3	50.2	51.2	50.4	51.2	51.4	50.3	49.9	49.1
U.S. Carcass Grade												
Choice	14	17	17	11	17	13	16	17	21	18	10	5
Good	9	6	7	13	6	11	6	7	3	6	16	18
Utility	1	--	--	--	--	--	2	--	--	--	--	--

Table 4.—Chemical analysis of feeds (percent as feed).

	H_2O	Ash	Protein	Fat	Fiber	N.F.E.	Ca	Phos.
Alfalfa hay	9.70	8.45	16.69	1.50	30.66	34.00	1.09	.24
Dehy. meal	5.71	11.54	18.44	2.53	23.45	38.33	1.28	.26
Milo	10.15	1.57	11.56	2.52	.99	73.20	.14	.27
Silage	68.39	1.92	1.86	.73	5.21	15.99	.08	.05

Levels of Protein and Protein Supplements to Milo Rations for Swine

J. C. HILLIER, R. W. MacVICAR, and WILSON POND

The importance of adequate amounts of high quality protein in the ration of growing pigs has been pointed out many times. The quality and quantity of protein in the swine ration probably has a greater influence on rate and economy of gain than any other single item. It has also been shown that the pig's need for protein changes as he grows and matures, with a higher percentage of protein as well as high quality protein being required by the younger pigs than by the more mature animals.

Previous tests at this station have indicated that high quality soybean meal was the most economical source of supplemental protein commonly available to swine feeders. Studies this year deal with the levels of protein needed by pigs during the various stages of growth, from weaning to market. Milo-soybean meal type rations containing 16, 14, and 12 percent crude protein were used. Ration changes were made when the pigs in a lot averaged 100 pounds and (or) 150 pounds.

The levels of protein fed at the various weight intervals are shown in Table 1..

Table 1.—Percentage of crude protein in the ration fed pigs of various weights.

Lot No.	1	2	3	4	5	6
Weight Periods:						
Up to 100 pounds	16	16	16	14	14	14
100-150 pounds	16	16	14	14	14	12
150-190 pounds	16	14	12	14	12	12

Nine to ten week old pigs weighing about 55 pounds were divided into groups of eight pigs each and self-fed their respective rations throughout the test. Hampshire, Poland China, and Yorkshire pigs were used. Two groups of 8 pigs each were fed on each ration in the summer trial (May to September) and a similar number in a winter trial (November to March). Water was available in automatic watering cups. Each pig was removed from the trial when it reached a weight of approximately 180 pounds in the summer trial and 190 pounds in the winter trial. Pigs fed during the summer were cooled by a water spray during the hottest part of the day (approximately 9:00 a.m. to 6:00 p.m.). Each pen was equipped with a nozzle which delivered about two gallons per hour in the form of a fine mist. The nozzles were placed about three feet above the floor.

The rations fed are shown in Table 2.

Table 2.—Rations Fed.

Percent Crude Protein Ingredients[1]	16	14	12
Kafir 4414%	76.3	82.4	88.5
Soybean Meal	15.8	9.7	3.6
D. Alf. L. Meal	5.0	5.0	5.0
Bone Meal	2.0	2.0	2.0
T. M. Salt	0.5	0.5	0.5
Aurofac[2]	0.3	0.3	0.3
Fortafeed[3]	0.1	0.1	0.1
Total	100.0	100.0	100.0
Crude Protein %	16.01	13.99	12.02
Ration Cost per cwt. ($)	2.82	2.76	2.70

[1] Zinc sulfate was added to all rations at the rate of 0.02% or 0.4 pounds per ton for prevention of parakeratosis.
[2] Aurofac—an antibiotic and B_{12} supplement which contains 1.8 grams of aureomycin and 1.8 milligrams of B_{12} per pound.
[3] Fortafeed, a B vitamin supplement which contains 2,000 mg. riboflavin, 4,000 mg. pantothenic acid, 9,000 mg. niacin and 90,000 mg. choline chloride per pound of Fortafeed.

Ration changes were made when the average weight of the pig in a lot averaged 100 or 150 pounds.

The milo was ground moderately fine in a burr mill and mixed with the other components of the ration. All rations were self-fed.

Table 3 gives a summary of the results obtained on the four feeding trials. It can be observed that there is a gradual reduction in rate of gain as one moves from the higher to the lower protein levels. Pigs receiving a 16 percent protein ration throughout the trial gained 0.21

Table 3.—Summary of results of four trials on optimum levels of protein required by growing pigs.

Lot No.	1	2	3	4	5	6
Pigs per lot	31	31	31	32	30	32
Av. In. Wt. (lbs.)	56.7	57.5	56.6	57.0	57.0	56.6
Av. Final Wt. (lbs.)	192.7	192.0	189.3	185.3	187.8	187.6
Av. Daily Gain (lbs.)	1.58	1.57	1.54	1.42	1.46	1.37
Feed/Lb. Gain (lbs.)	3.55	3.61	3.66	3.87	4.06	4.26
Feed cost/lb. gain (cents)	10.30	10.30	10.30	10.89	11.33	11.80

pounds more per day than those receiving a 14, 12, 12 percent protein ration for the three periods. The relative average daily gain varied some from trial to trial but there was only one case in which pigs fed any combination starting on a 14 percent protein ration outgained those starting on a 16 percent protein ration. It, therefore, appears that pigs, weighing around 55 pounds need at least 16 percent protein in their ration to start with, possibly more, on this type of ration. Reducing the protein to 14 percent as the pigs reached 150 pounds had little effect on the rate of gain, nor did a change to a 14 percent ration at 100 pounds. Only slightly more feed was required when the protein level was reduced as the pigs became older (lot 3) than was required when a 16 percent protein ration was fed throughout the trial (lot 1). All three lots started on 16 percent protein (1,2,3) had a feed cost of 10.30 cents per pound of gain.

There was a distinct observable difference between the pigs started on a 16 percent protein ration and those started on the 14 percent protein ration. More bloom was evident on the pigs on 16 percent protein at the start of the trial but the pigs started on the 14 percent level were not particularly unthrifty in appearance.

Among the lots started on 14 percent protein, those in which the protein was reduced as the pigs became older (lots 5 and 6) produced the slowest and most expensive gain. Pigs in lot 6 (14,12,12) gained at the rate of 1.37 pounds per day with 4.26 pounds of feed required per pound of gain while pigs in lot 1 (16% protein throughout) gained at the rate of 1.58 pounds per day with 3.55 pounds of feed required per pound of gain. This is a difference of about 13 percent in rate of gain and 16 percent in feed required per unit of gain. There was also a difference of 1.50 cents per pound of gain in feed cost for those two lots.

The 16 percent crude protein ration cost $2.82 per hundred, the 14% ration, $2.76 and the 12 percent ration, $2.70. An unusual feed price situation prevailed in which the soybean meal cost only $0.95 per hundred more than the milo, making the rations quite similar in cost. Usually the difference in price between milo and soybean meal would be greater than this.

Combinations of soybean meal and cottonseed meal were tested in mixed rations containing about 14 percent crude protein. The results are summarized in Table 4.

From these results it appears that a low gossypol cottonseed meal may be fed with satisfactory results in combination with soybean meal if two parts soybean meal are used to one part cottonseed meal. When equal parts of soybean meal and cottonseed meal were fed, the rate of gain was not reduced but the feed required per hundred pounds of gain was increased by 22 pounds. Feeding larger proportions of cottonseed meal produced entirely unsatisfactory results. Results published

Table 4.—Soybean meal and combinations of soybean meal and cottonseed meal as protein supplements to a milo ration for swine.

(All rations 14% protein throughout the trial)
Summer 1956

Rations[1] [2]	I All S.B.M.	II ¾ SBM-¼ CSM	III ½ SBM-½ CSM	IV ¼ SBM ¾ CSM	V All CSM
Kafir 4414	82.4	82.2	82.1	81.9	81.5
Soybean meal	9.7	6.6	5.0	3.4	----
Cottonseed meal[3]	----	3.3	5.0	6.8	10.6
Alfalfa meal	5.0	5.0	5.0	5.0	5.0
Bone meal	2.0	2.0	2.0	2.0	2.0
Salt	0.5	0.5	0.5	0.5	0.5
Aurofac[4]	0.3	0.3	0.3	0.3	0.3
Fortafeed[5]	0.1	0.1	0.1	0.1	0.1
Total ration	100.0	100.0	100.0	100.0	100.0
Ration cost per cwt. $	2.76	2.75	2.75	2.75	2.75
Pigs per lot	8	8	8	8	8
Av. initial wt. (lbs.)	78.8	78.8	78.4	78.4	78.4
Av. Final wt. (lbs.)	193.5	193.4	190.9	188.5	181.6
Av. daily gain (lbs.)	1.48	1.53	1.49	1.34	1.19
Av. feed required per cwt. gain (lbs.)	370.8	370.8	392.8	398.9	404.5
Feed cost/Lb. gain (cents)	10.23	10.20	10.80	10.97	11.12

[1] 0.02 percent zinc sulfate was added to all rations for the prevention of parakeratosis.
[2] The Kafir 4414, soybean meal, cottonseed meal and alfalfa meal contained 10.78, 43.75, 41.00, and 17.34 percent protein, respectively.
[3] High quality, prepressed, solvent extracted, low gossypol meal with a high nitrogen solubility.
[4] Supplies 10.8 grams of aureomycin and 10.8 mg. of vitamin B_{12} per ton of ration.
[5] Supplies 4.0 gms. of riboflavin, 8.0 gms. of pantothenic acid, 18.0 gms. of niacin and 80.0 gms. of choline chloride per ton of ration.

in the 1955-56 Feeder's Day Report emphasized the dangers from feeding as little as 7.8 percent of a high gossypol cottonseed meal.

On the basis of a cost of $3.45 per hundred for soybean meal and $3.30 per hundred for cottonseed meal, as used in this test, there is little economic advantage for feeding a mixture of three parts of soybean meal and one part cottonseed meal. With a greater spread in price between these two feeds, there would be an economic advantage of feeding the combination over the soybean meal alone.

Urea in Protein Supplements for Wintering Beef Cattle

A. B. NELSON, M. G. GREELEY and W. D. CAMPBELL

Because of the complex nature of the ruminant stomach, cattle and sheep are able to utilize, to varying degrees, the nitrogen from urea and other non-protein nitrogen compounds. This utilization is possible because of the microorganisms in parts of the ruminant stomach. The utilization of non-protein nitrogen is apparently affected, therefore, by the nutrition of the microorganisms. Efficient utilization of urea may result only when other nutrients are provided in needed amounts.

There have been many studies which indicate that urea may satisfactorily replace part of the protein in the rations of fattening cattle. There is a lesser number of tests on the value of urea in wintering rations in which the quantity of concentrate feed offered as a supplement to grass hays or dry, native grass pastures is very limited.

In a test conducted by the Oklahoma Agricultural Experiment Station during the 1953-54 winter season, heifer calves fed 2 lbs. per head daily of a feed having 50 percent of the nitrogen furnished by urea as a supplement to dry, native grass lost more weight than similar heifers fed the basal ration. The basal supplement was a mixture of corn and cottonseed meal and contained approximately 20 percent protein. The supplement containing urea was the basal supplement plus sufficient urea to make the nitrogen content equivalent to 40 percent protein. A third supplement was pelleted cottonseed meal (40 percent protein). Also, the calcium and phosphorus contents were equalized. The average gain per heifer (20 per lot) during the 152-day wintering period was -5, -15, and -33 lbs. for those fed the 40 percent protein, 20 percent protein, and 40 percent protein supplement containing urea, respectively. This indicated little, if any, utilization of urea.

During the 1954-55 winter feeding season, heifer calves grazing native grass were fed an average of 2 lbs. per head daily of a 20 percent protein supplement, a 40 percent protein supplement with 50 percent of the nitrogen furnished by urea, or the 40 percent protein supplement with urea plus trace minerals. The winter gains of these heifers were 31, 6 and 53 lbs., respectively. This indicated utilization of urea when additional trace minerals were included in the ration.

Two tests were conducted during the 1955-56 winter feeding season. In the first test, yearlings (steers and heifers) grazed the native grass pastures and were fed 2 lbs. per head daily of a 28 percent protein supplement, a 40 percent protein supplement, a 40 percent protein supplement with one-third of the nitrogen furnished by urea (28 percent protein supplement plus urea), or a 40 percent protein supplement containing urea plus trace minerals. The gains of these cattle were -54, -2, -62 and -45 lbs., respectively. Apparently little, if any, of the urea in the pellets was utilized, although the addition of trace minerals to the urea-containing pellet resulted in slightly less loss than when the trace minerals were not added.

In a second test in 1955-56, steer calves were fed prairie hay. The supplements, fed at the rate of 1 lb. per head daily, were: 40 (basal), 40 percent protein supplement containing urea, or this latter supplement plus trace minerals. Gains were 82, 70 and 78 lbs., respectively. The gains varied only slightly, indicating utilization of urea in a pellet fed as a supplement to prairie hay.

The chemical composition of the pelleted supplements and prairie hay fed during the 1956-57 winter feeding season is given in Table 1.

Table 1.—Chemical composition of supplements and prairie hay.

	Percent Dry Matter	Percentage composition of dry matter						
		Ash	Protein	Fat	Fiber	N.F.E.	Ca	P
40-CSM	92.89	8.62	43.46	3.43	10.41	34.08	0.94	0.66
40-Urea	91.59	8.05	45.04	3.60	8.29	35.02	0.96	0.70
40-Urea + trace minerals	91.72	7.93	44.63	4.19	9.04	34.21	0.97	0.69
40-Urea + dehy. alfalfa meal	91.59	8.33	45.34	4.03	11.48	30.82	0.97	0.68
Prairie Hay	94.85	6.61	4.59	1.68	35.27	51.85	0.40	0.08

Trial 1, Yearling Heifers Grazing Native Grass

Fifty-one grade Hereford yearling heifers were divided into 3 lots of 17 each and were allowed to graze the native grass pastures on the south side of Lake Carl Blackwell. In addition to the dried grass, they were fed an average of 2 lbs. per head daily of the following protein supplements starting November 10, 1956:

Lot 1. 40 percent protein supplement.

Lot 2. 40 percent protein supplement containing urea.

Lot 3. Same as Lot 2 plus trace minerals.

The 40 percent protein supplement was 97.9 percent cottonseed meal, 1.1 percent dicalcium phosphate and 1.0 percent monosodium phosphate. The latter two ingredients were added at such rates that the calcium and phosphorus contents of all pellets were approximately equal. The 40 percent protein supplement containing urea was 59 percent cottonseed meal, 33 percent ground yellow corn, 5 percent urea* and 3 percent dicalcium phosphate. Urea furnished approximately one-third of the nitrogen in this pellet. The third supplement was the same as that fed to Lot 2 except trace minerals** were added at the rate of 0.1 lb. per 100 lbs. of the supplement. According to the manufacturers' recommendations the additional minerals provided were, in mgs. per pound of pelleted supplement: manganese, 55.0; iodine, 1.76; cobalt, 1.18; iron, 36.6; copper, 3.3; and zinc, 3.04. At the rate fed the trace minerals cost only 1-2 cents per head during the winter.

All pelleted supplements were fed every other day. A mixture of 2 parts salt and 1 part steamed bone meal was available in all lots.

*Urea was provided by Nitrogen Division, Allied Chemical and Dye Corporation.
**Commercial mixture provided by Calcium Carbonate Company.

The cost of the various pellets was calculated from the cost of the several feed ingredients plus a mixing and pelleting charge of $5 per ton. On this basis the costs per ton were as follows: 40 percent protein supplement, $73.86; 40 percent protein supplement containing urea, $73.26; and supplement containing urea and trace minerals, $73.30.

Results

The heifers fed the cottonseed meal pellet (Lot 1) lost 35 lbs. (Table 2) in the 118-day wintering period. When one-third of the nitrogen in the supplement was supplied by urea the heifers (Lot 2) lost 96 lbs. per head. This would indicate little apparent utilization of urea. However, when a trace mineral mixture was included in the supplemental feed, the loss was 30 lbs. or approximately the same as that of the control heifers (Lot 1). Apparently the trace minerals provided were lacking in the range grass and the urea-containing pellet fed to Lot 2.

Table 2.—Urea in protein supplements for wintering yearling heifers grazing native grass (118 days).

	Lot 1 40-CSM	Lot 2 40-Urea	Lot 3 40-Urea + trace minerals
Number of animals[1]	16	16	17
Average weight per head (lbs.)			
Initial 11-10-56	727	726	736
Final 3-8-57	692	630	706
Gain	—35	—96	—30
Daily gain	— 0.30	— 0.81	— 0.25
Supplemental feed cost per head[2] ($)	8.72	8.64	8.65

[1] There were originally 17 heifers per lot but 1 in each of Lots 1 and 2 were removed when they were found to be pregnant.
[2] Two lbs. of supplement per head daily. Added feed costs would be $4 per head for winter grazing and $.12 for minerals which were consumed at the rate of .05 lb. per day.

Trial 2, Steer Calves Grazing Native Grass

Forty grade Hereford steer calves were divided into 4 lots of 10 head each on November 13, 1956. They were allowed to graze the dry native grass in the pastures on the south side of Lake Carl Blackwell and were fed an average of 2 lbs. per head daily of the following supplements:

Lot 1. 40 percent protein supplement.

Lot 2. 40 percent protein supplement containing urea.

Lot 3. Same as Lot 2 plus trace minerals.

Lot 4. Same as Lot 2 plus dehydrated alfalfa meal.

The supplements fed to Lots 1, 2 and 3 were as described in Trial 1. The supplement fed to Lot 4 was 56 percent cottonseed meal, 26 percent corn, 5 percent urea, 10 percent dehydrated alfalfa meal, 2.5 percent dicalcium phosphate and 0.5 percent monosodium phosphate. The two phosphates were added in order to equalize the contents of calcium and phosphorus in all pellets. This pellet cost $74.36 per ton. As in Trial 1, twice the daily ration was fed every other day. A mixture of 2 parts salt and 1 part steamed bone meal was available in all lots.

Results

A summary of the weight gain and feed cost is given in Table 3. The greatest gain (60 lbs.) was made by those steers fed the basal ration of pelleted cottonseed meal (Lot 1). As was true in Trial 1, the steers utilized little, if any, of the urea fed to Lot 2. These steers gained only 4 lbs. in the 115-day test. The addition of trace minerals or dehydrated alfalfa meal apparently increased the utilization of urea as measured by weight gain of the steers. The gains were 34 and 36 lbs. for additional trace minerals and dehydrated alfalfa meal, respectively. The utilization was not complete, however, because these gains were approximately 25 lbs. less than the gains the steers fed pelleted cottonseed meal in Lot 1.

Table 3.—Urea in protein supplements for wintering steer calves grazing native grass (115 days).

	40-CSM Lot 1	Lot 2 40-Urea	Lot 3 40-Urea + trace minerals	Lot 4 40-Urea + dehy. alf. meal
Average weight per steer (lbs.)				
Initial 11-13-56	456	456	458	455
Final 3-8-57	516	460	493	491
Gain	60	4	34	36
Daily gain	0.52	0.03	0.28	0.31
Supplemental feed cost per head[1] ($)	8.49	8.42	8.43	8.55

[1] Two lbs. of supplement per head daily. Added feed costs would be $3 per head for winter grazing and $.10 for minerals which were consumed at the rate of .04 lb. per day.

Trial 3, Heifer Calves Fed Prairie Hay

In Trials 1 and 2, cattle have been wintered on dry range grass and pelleted supplements. In Trial 3, the roughage was prairie hay. Prairie hay is known to contain more protein and phosphorus than dry range grass. Its composition of these and other nutrients makes prairie hay of greater feeding value than dry range grass.

On November 15, 1956, sixty heifer calves were divided into 6 lots of 10 head each. They were fed prairie hay and an average of 1 lb. per head daily of the following supplements:

Lots 1 and 2. 40 percent protein supplement.

Lots 3 and 4. 40 percent protein supplement containing urea.
Lots 5 and 6. Same as Lots 3 and 4 plus trace minerals.

These supplements were as described in Trial 1. A mixture of 2 parts salt and 1 part steamed bone meal was available in all lots. Because physical facilities (insufficient water in some ponds) did not permit the feeding of 6 separate lots of cattle, the two lots fed each supplement were combined and fed as 3 groups of 20 head each. All lots of heifers were fed approximately the same quantity of hay. Weight data for the different lots are kept separate in order to allow study of the variation among two groups of animals fed alike. The results are summarized in Table 4.

Table 4.—Urea in protein supplements for wintering heifer calves fed prairie hay (133 days).

	40-CSM		40-Urea		40-Urea & trace minerals	
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Number per lot	10	10	10	10	10	9
Average weight per head (lbs.)						
Initial 11-15-56	448	448	448	448	448	439
Final 3-28-57	540	552	529	529	537	522
Gain	92	104	81	81	89	83
Daily gain	0.69	0.78	0.61	0.61	0.67	0.62
Average daily feed per head (lbs.)						
Prairie hay[1]	14.9	14.9	14.9	14.9	14.9	14.9
Protein supplement	1.0	1.0	1.0	1.0	1.0	1.0
Mineral	0.04	0.04	0.04	0.04	0.04	0.04
Feed cost per head[2] ($)	29.81	29.81	29.77	29.77	29.78	29.78

[1] An equal number of bales of prairie hay was fed to each group. Several bales were weighed periodically for calculation of the average weight per bale.
[2] Pellets cost $73.86, $73.26, and $73.30 per ton in Lots 1, 2, and 3, respectively.

Results

The addition of trace minerals to a pellet containing urea which was fed as a supplement to prairie hay apparently increased the utilization of urea only slightly, if at all. The gain (86 lbs.) of these cattle fed additional trace minerals was only an average of 5 lbs. greater than the gain of heifers fed the urea-containing supplement without trace minerals. The gains of the heifers fed pelleted cottonseed meal (Lots 1 and 2) were 92 and 104 lbs., which are slightly greater than the gains in the other lots. Urea was apparently at least partially utilized by the heifers in Lots 3, 4, 5 and 6.

The average winter gains of the two groups of heifers fed the same supplement were nearly the same.

Summary

Urea is apparently not utilized by cattle wintered on dry range grass when it is added to a mixture of corn and cottonseed meal to produce a pellet containing 40 percent protein with one-third of the nitrogen furnished by urea. However, the addition of trace minerals to the urea-containing pellet results in increased gains indicating increased utilization. Prairie hay apparently furnishes nutrients not present in dry range grass, because the addition of trace minerals to a urea-containing pellet fed as a supplement to prairie hay did not result in increased gains. These results are in agreement with the results of previous tests and indicate that considerable attention must be given to trace minerals and nutrients furnished by a small quantity of dehydrated alfalfa meal when formulating supplements containing urea.

Grub Control with Dow ET-57, A Recently Developed Systemic Insecticide[1]

D. E. HOWELL

Estimates of the losses caused by cattle grubs in the United States vary from $100 million to $300 million annually. The loss in Oklahoma approaches $12 million. Current control measures for this serious pest require at least three applications of rotenone as a spray, wash or dust at monthly intervals from December to March. Unfortunately, much of the damage has been done by the grubs before control can be accomplished with rotenone as it is effective only after the grubs have cut through the hide late in their larval life. Phenothiazine was reported to be effective in controlling grubs and internal parasites by low level feeding but extensive tests at this Station indicated it did not provide appreciable grub control. Preliminary results in 1955-56 with a newly developed organic phosphate systemic were so encouraging that large-scale cooperative tests were established in several parts of the State.

The insecticide used was developed by the Dow Chemical Company and formulated as a drench, bolus (elongated pill) or capsule. Chemically the material is O,O-dimethyl O-2, 4, 5-trichlorophenyl phosphorothioate commonly called Dow ET-57. It was used at the rate of approximately 100 mg./kg., roughly 1.6 oz. of pure material for a thousand pound cow. The insecticide was given before the grubs had appeared in the backs of the cattle.

Grub control tests involving 1,498 animals were superimposed on genetics, feeding, or management experiments at Stillwater, Lake Carl Blackwell, Fort Reno, Fort Supply, and Coalgate by treating half of each group. The other half was left untreated as a check. A test under ranch conditions was carried on with the cooperation of the Codding brothers at Foraker, Oklahoma.

The effectiveness of the insecticide was determined by comparing the number of grubs in the backs of treated animals with those in the untreated group at monthly intervals during the grub season.

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[1] This cooperative work involved the Oklahoma A & M College Departments of Agronomy, Animal Husbandry, and Entomology; Ft. Reno and Southern Great Plains Field Station Range Unit at Fort Supply.

A summarization of the results is shown in Table 1. The control obtained was not significantly affected by the age of the animals, calving, location in the State, or the formulation of Dow ET-57 used. Control in individual lots varied from 92 to 50 percent and averaged 76 percent for the 1,498 animals.

Minor toxicity was noted in only one group of 24 feed lot steers where some scouring was evident for several days after treatment. In all other cases no evidence of adverse effects were seen, even though the animals were treated immediately before or after calving.

Dow ET-57 is still an experimental material and is not available for commercial use yet. It should be used on beef cattle only, as small amounts of the insecticide appear in the milk for several days after treatment.

Table 1.—Summarization of cattle grub tests with Dow ET-57

			Animals in Test		Ave. No. of Grubs/Animal	
Location	Age of Animals	Formulation	Treated	Un-treated	Treated	Un-treated
Fort Supply	Yearlings	Capsules	42	42	2.1	21.9
Fort Supply	Mature Cows	Capsules	44	44	1.3	16.3
Fort Reno	Mature Cows	Drench	76	75	3.4	8.9
Fort Reno	Mature Cows	Drench	49	47	1.3	6.5
Fort Reno	2 yr. Heifers	Drench	16	17	3.6	15.2
Fort Reno	Yearlings	Drench	19	18	3.1	10.8
Fort Reno	Calves	Drench	24	25	2.5	19.5
Coalgate	Yearlings	Drench	10	9	10.5	31.0
Coalgate	Yearlings	Drench	9	10	16.0	34.4
Coalgate	Yearlings	Drench	9	10	8.5	33.9
Coalgate	Yearlings	Drench	10	8	10.5	55.2
Lake Carl Blackwell	3 yr. Cows	Drench	50	50	4.8	9.9
Lake Carl Blackwell	5 yr. Cows	Drench	50	49	.8	3.9
Stillwater	Yearlings	Drench	24	20	1.9	4.3
Stillwater	Yearlings	Capsule	16	20	.6	4.3
Foraker	Mature Cows	Bolus	39	81	4.5	13.5
Foraker	Mature Cows	Bolus	104	23	1.8	6.8
Foraker	Heifers	Bolus	53	104	2.0	18.3
Foraker	Mature Cows	Capsules	43	81	2.5	13.5
Foraker	Heifers	Drench	39	39	1.2	12.8

Protein Supplements for Wintering Fall-Calving Cows.

A. B. NELSON, JAMES MILLER AND GEORGE WALLER

One of the main considerations in any cattle wintering program is the provision of adequate protein. The purchase of protein supplements represents a great portion of the cost of wintering cattle on native grass. Recently completed at this station was a test designed to study the relative value of supplements containing 20-, 30- and 40-percent protein when fed to heifer calves wintered on prairie hay or allowed to graze dried native grass during the winter. These data are summarized in Okla. Agr. Exp. Sta. Bulletin B-437.

Results of the study indicated that the supplements were not of equal value when fed at the same level of intake under similar management conditions. However, the test did not provide data on the effect of the various supplements when fed to the same animals for several successive winters. The need for information on these and related problems led to the present study which has the following objectives:

1. To determine the relative value of supplements containing 20- and 40-percent protein when fed for several successive winters to commercial beef cattle grazing native grass.

2. To compare a 20-percent protein supplement composed of corn and cottonseed meal to one composed of several feed ingredients for wintering commercial cattle grazing native grass.

3. To determine the value of a feed supplement containing approximately fifty percent of the total nitrogen as urea for wintering commercial beef cattle grazing native grass.

Procedure

One hundred grade Hereford heifer calves were divided into 5 lots of 20 head each on November 2, 1953. Each of these lots was placed in pastures which provided approximately 5 acres of native grass per heifer. In addition to the dried grass at the Lake Carl Blackwell experimental range area, during the winter months the heifers were fed a protein supplement as follows:

Lot 1. 1 lb. of 40-percent protein pelleted cottonseed meal.
Lot 2. 2 lbs. of 40-percent protein pelleted cottonseed meal.
Lot 3. 2 lbs. of 20-percent protein combination pellet.
Lot 4. 2 lbs. of 20-percent protein pellet (CSM and corn).
Lot 5. 2 lbs. of 40-percent protein pellet containing urea.*

The 40-percent protein pellet was 97.99 percent cottonseed meal and 2.01 percent dicalcium phosphate.

The 20-percent protein combination pellet consisted of several different feed ingredients. Included were different sources of protein, dehydrated alfalfa meal, molasses and minerals which furnish nutrients which might add to the value of a simple mixture of corn and cottonseed meal. The percentages of the various ingredients in this 20-percent protein combination pellet were: cottonseed meal, 12.5; linseed meal, 12.5; soybean oil meal, 12.5; dehydrated alfalfa meal, 5; yellow corn, 41.7; molasses, 10; monosodium phosphate 3.7; ground limestone, 1; salt, 1; and trace mineral mixture**, 0.1. According to the manufacturer's recommendations the additional trace minerals provided were, in mgs

* Urea was supplied by Du Pont Company, Wilmington, Delaware.
**Trace mineral mixture furnished by Calcium Carbonate Company, Chicago, Illinois.

per pound of pelleted supplement: manganese, 55; iodine, 1.76; cobalt, 1.18; iron 36.6; copper, 3.3; and zinc, 3.04.

The simple 20-percent protein pellet was 37 percent cottonseed meal, 58.84 percent yellow corn, 2.36 percent dicalcium phosphate, and 1.80 percent monosodium phosphate.

The 40-percent protein pellet containing urea was the same as the 20-percent protein pellet except that 7.64 percent of the corn was replaced with urea in order to make the nitrogen content of the pellet equivalent to 40 percent protein (N x 6.25). The value of this pellet can be related to the 20-percent protein pellet or the 40-percent protein pelleted cottonseed meal. The amount of urea in this pellet is above the amounts which can be included according to state law in mixed feeds prepared for sale.

Table 1.—Chemical composition of protein supplements (1956-57)

	Percent dry matter	Percentage composition of dry matter						
		Ash	Protein	Fat	Fiber	N.F.E.	Ca	P
40 percent protein pellet	92.29	8.89	43.81	3.69	13.78	29.83	0.73	1.19
20 percent protein combination pellet	91.21	10.38	24.33	3.07	6.01	56.21	0.85	1.55
20 percent protein simple pellet	90.98	7.92	24.80	4.74	6.45	56.09	0.77	1.41
40 percent protein with urea pellet	89.52	6.69	46.70	4.02	6.37	36.22	0.73	1.33

The calcium and phosphorus contents of all pellets were equalized by the addition of ground limestone, dicalcium phosphate, and monosodium phosphate where necessary.

At all times except during the summer of 1955 a mixture of 2 parts salt and 1 part steamed bone meal was available in all lots. During the summer of 1955 the only mineral supplement available was salt because the heifers were used in a test of the value of a salt and phenothiazine mixture in the control of cattle grubs.

The pellets were fed in the kinds and amounts listed during the winter of 1953-54 to heifer calves and during 1954-55 to these same cattle when they were yearlings. All heifers were allowed to graze the native grass pastures yearlong. The heifers were bred to registered Hereford bulls during the period January 3 to March 27, 1955, thus the calves were born in the fall and early winter when the heifers were approximately 2½ years old.

During the winter of 1955-56 the allowance of supplemental feed was increased to 1½ lbs. per head daily in Lot 1 and 3 lbs. per head daily in the other lots.

The cost of the various pellets was calculated from the cost of the several feed ingredients plus a mixing and pelleting charge of $5.00

per ton. On this basis the costs of the pellets fed during the 1955-56 winter feeding season were, per ton: 40-percent protein cottonseed meal pellet, $69.66; 20-percent protein combination pellet, $73.95; 20-percent protein corn and cottonseed meal pellet, $68.26; and 40-percent protein pellet containing urea, $72.54. It should be noted that the many ingredients in the 20-percent protein combination pellet increased its cost considerably above that of the simple 20-percent protein pellet. In this test a phosphorus supplement was mixed with cottonseed meal to make the 40-percent protein cottonseed meal pellet. The mixing increased considerably the cost of the pellet. A cattleman could have purchased cottonseed meal pellets at $65 per ton. Thus, cottonseed meal was given a slight cost disadvantage in the test because of mixing charges.

The rations will be fed to the same cattle for several successive winters in order to study the long-time effect of the winter protein supplement on the reproductive performance of the cattle. The data collected from the beginning of the winter feeding period as calves in 1953 until these cattle weaned their first calves August 8, 1956 are given in Table 2.

Results

The data summarized in Table 2 include only the results with those cattle that weaned a calf in 1956. Originally there were 20 heifers per lot. The reasons for removal of the cattle are listed near the bottom of the table. All live cows have been retained in the herd to determine whether or not they will calve in future years. Because an important economic factor is the number of calves weaned per cow of calving age, rebreeding data for the cows, whether or not they were suckling a calf, were collected in 1956 and used as one of the measures of the value of the various protein supplements.

Gains during the first 29 months of the test were summarized in the 1956 Feeder's Day report (Oklahoma Agricultural Experiment Station MP-45). Gains during the summer of 1956 were related to the gains during the previous winter. Those that lost the most during the winter gained the most during the following summer. The average weight losses during the winter varied from 133 to 227 lbs. Apparently cows have a remarkable ability to recover winter weight losses during the summer and produce satisfactory calves.

The protein supplement, mineral, and pasture cost per cow for the complete test were $81.84, $105.03, $106.58, $102.92, and $105.80 for Lots 1, 2, 3, 4 and 5 respectively. Feeds costs in the latter four lots are nearly the same. The lower feed cost in Lot 1 was due to the fact that these cows were fed one-half as many pounds of protein supplement during the winter.

The average weaning weights of the calves were low in all lots. The weights were 391, 406, 411, 401, and 399 lbs. for Lots 1, 2, 3, 4 and 5, respectively. The differences were so small that the winter ration of the

Table 2.—Protein supplements for wintering fall-calving cows (summary).

	Lot 1 40-CSM	Lot 2 40-CSM	Lot 3 20 Comb.	Lot 4 20-Simple	Lot 5 40-Urea
Number of cows[1]	16	15	15	11	15
Average weight (lbs.)					
Initial 11-2-53	484	474	482	488	470
Spring 4-13-54	485	488	479	480	457
Fall 10-30-54	682	680	683	678	664
Spring 4-19-55	687	674	660	657	660
Fall 10-10-55	983	953	953	955	934
Spring 4-24-56	756	820	772	740	773
Final 8-4-56	980	984	981	987	975
Average gain (lb.)					
Winter of 1955-56	—227	—133	—181	—215	—161
Summer '56	224	164	209	247	202
Total gain in 33 months	496	510	499	499	505
Protein supplement (lbs.)					
Winter 1 and 2	1.0	2	2	2	2
Winter 1955-56	1.5	3	3	3	3
Feed cost ($)					
Winter 1955-56	15.54	25.84	27.10	25.42	26.69
Total to 8-4-56	81.84	105.03	106.58	102.92	105.80
Calf data					
Number of steers	8	6	6	7	7
Number of heifers	8	9	9	4	8
Birth date, November	3	19	3	11	19
Birth weight[2]	73	71	72	75	74
Final Weight 8-4-56[3]	391	406	411	401	399
Daily gain	1.16	1.29	1.24	1.23	1.26
Reason for removal of cows					
From summary of results					
Calved spring of 1954	0	0	0	3	0
Calved spring of 1955	1	4	1	1	0
Open fall of 1955	3	1	4	4	2
Calves born dead or died later	0	0	0	1	3
Open 6-22-56	1	1	1	1	5

[1] Includes only those cows which weaned a calf.
[2] Corrected for sex by the addition of 3 lbs. to the weight of the heifers.
[3] No allowances were made for unequal numbers of steers and heifers within a lot.

cow had little, if any, effect on weaning weights. No allowances for unequal numbers of steers and heifers in each lot were made. The average birth date was not the same; therefore, the average daily gain of the calves was calculated. The highest daily gain was 1.29 lbs. in Lot 2 and the lowest was the daily gain of 1.16 lbs. in Lot 1. It is possible that these gains are a reflection of winter ration of the cow. In this instance the cows of Lot 1 were fed 1.5 lbs. and those in Lot 2 were fed 3 lbs. of 40-percent protein cottonseed meal pellets.

The results of a pregnancy examination on June 6, 1956 may be noted in Table 2. There was one open cow in each of the first four lots and 5 open cows in Lot 5. It will be interesting to note whether or not similar results will be recorded in the future. The cows in Lot 5 have appeared to be very thin during the winter months although the 1955-56 winter loss was greater in several other lots. At the end of the test the lightest cows were those in Lot 5.

Summary

In a comparison of different protein supplements fed to cattle for three successive winters the weight gains of the cows and weaning weights of the calves have been only slightly different. There are differences in winter weight losses of the cows apparently related to winter ration. Apparently cows have remarkable ability to recover from the adverse effects of winter feeding when adequate green feed is available during the summer months. This test is being continued in order that long-time effects may be studied.

1956-57 Preliminary Results

The test is being continued during 1956-57 and the cows were fed as described previously for the 1955-56 winter feeding season. The data collected to April 1, 1957 are summarized in Table 3. The cow weights include only those cows which were suckling a calf on April 1. The reasons for removal of the cows in each lot are listed in a footnote of the table.

Table 3.—Protein supplements for wintering fall-calving cows, 1956-57.

	Lot 1 40-CSM	Lot 2 40-CSM	Lot 3 20 Comb.	Lot 4 20-CSM & corn	Lot 5 40-Urea
Protein supplement (lbs. daily)	1.5	3.0	3.0	3.0	3.0
Number of cows[1]	18	16	19	16	14
Average weight (lbs.)					
Initial 9-26-56	1051	1050	1039	1021	1026
Final 4-1-57	659	719	670	638	655
Winter gain (186 days)	—392	—331	—369	—383	—371
Protein supplement cost[2] ($)	10.11	20.22	21.30	20.22	21.25
Calf data					
Number of steers	8	10	9	6	8
Number of heifers	10	6	10	10	6
Birth date, Oct.	22	11	17	22	15
Birth weight (lbs.)[3]	75	75	76	75	73
Weight 4-1-57 (lbs.)[4]	152	203	170	154	159

[1] Originally there were 20 cows per lot. In Lot 1, 1 cow was open and 1 drowned. In Lot 2, 1 cow was open, 1 died during the winter and 2 calves died shortly after birth. There was 1 open cow in Lot 3. In Lot 4, 1 cow was open and 3 cows had died in previous years (2 from urea toxicity). There were 5 open cows in Lot 5. One of these had cystic ovaries and was sold. In addition, 1 calf was born dead.

[2] Feed costs per ton were: 40-CSM, $72.50; 20 Combination, $76.36; 20 CSM-corn, $72.49; and 40-Urea, $76.16.

[3] Corrected for sex by the addition of 3 lbs. to the weight of each heifer calf.

[4] No corrections were made for age or unequal number of heifers and steers in each lot.

All cows lost considerable weight during the winter feeding period. The greatest loss (392 lbs.) occurred in Lot 1 which was fed 1.5 lbs. of pelleted cottonseed meal. The least loss was 331 lbs. in Lot 2 which was fed 3.0 lbs. of pelleted cottonseed meal. Therefore, the amount of supplemental protein fed was reflected in winter weight gains. The weight losses were intermediate in the other three lots. The losses were 369, 383, and 371 lbs. for Lots 3, 4, and 5 respectively. The loss in Lot 2 was 31.5 percent of the original weight. The losses in the other lots were within the range of 35.5 to 37.5 percent. These weight changes would indicate that the most satisfactory lot of cattle was those fed 3 lbs. of pelleted cottonseed meal. However, all losses seem excessive and whether or not such losses will affect the production of the cow will be measured as the test is continued. These cows will be examined for pregnancy during the summer and the test will be continued next year.

The average birth date was earlier in all lots during the second calving season. The number of days earlier varied from 11 to 40. These extremes were in Lots 1 and 2, respectively. The average birth weight of all calves was nearly the same; however, the weight in Lot 5 was slightly lower. These weights were corrected for sex by the addition of 3 lbs. to the weight of each heifer calf.

The average weights of all lots of calves was quite low on April 1. No corrections for age and sex have been made in these averages. The calves in Lot 2 (fed 3 lbs. pelleted cottonseed meal) are the heaviest. The lightest calves are in Lot 1. Final weights of these calves will be taken at time of weaning in late July.

Preliminary results of the 1956-57 season indicate that 3 lbs. of pelleted cottonseed meal was the most satisfactory supplement fed in our tests when winter weight changes of the cow and weight of the calves were used as measures.

Effect of Certain Hormones and Feed Additives on the Performance of Steer Calves

L. S. POPE, R. F. HENDRICKSON, GEORGE WALLER and W. D. CAMPBELL

Due to the high costs of cattle and feed, and low returns for finished beef, attempts have been made to increase profits by the use of hormones and complex protein supplements in the fattening ration. Many commercial feeds for fattening cattle are now fortified with stilbestrol (a hormone-like drug), antibiotics, and complex vitamin and mineral additives. Combinations of certain hormone-like drugs may soon appear on the market. These additives invariably increase the cost of the supplement, and therefore the cost per cwt. gain unless additional performance is obtained from their use. Many of the feed additives now used in complex supplements have not been tested under proper experimental conditions.

Recently, stilbestrol implants for beef cattle have become available. Questions have been raised as to their effect on young calves

Table 1.—Chemical composition of feeds. (percent as fed)

Feed	Moisture	Ash	Crude Protein	Fat	Crude Fiber	N-Free Extract	Ca	P
Sorghum Silage	70.10	2.15	3.21	.82	8.18	15.54	.16	.05
Dehydrated alfalfa meal pellets	5.30	9.31	18.06	2.87	27.74	36.72	1.43	.25
Cottonseed meal[1]	6.02	5.85	43.00	5.73	13.42	25.98	.19	1.12
Cottonseed Meal + Stilbestrol[2]	6.60	6.35	41.97	3.21	14.40	27.47	.26	1.17
Special mixture[3]	5.59	16.60	22.25	2.19	6.79	46.58	5.32	.40
Milo	10.89	2.61	10.75	3.05	1.97	70.73	.07	.26

[1] Fed to Lots 1 and 2.
[2] Fed to all other lots. Stilbestrol added to supply 10 mg. per steer daily.
[3] Special mixture fed Lot 7 supplied, per steer daily: 0.40 lbs. dried molasses. 0.40 lbs. condensed fish solubles, 0.11 lbs. calcium carbonate, 2 gm. dry stabilized vitamin A (20,000 U.S.P. units), 1 gm. commercial trace mineral mix, 75 mg. aureomycin in the crude product (Aurofac). Cost = $108.40 per ton.

as well as older stocker cattle. Little research has been done on the effect of low level stilbestrol implants on the weaning weights of suckling calves.

As in many other phases of beef production, the use of stilbestrol implants in the production of feeder cattle should be viewed in its broad aspects. Increased gain from implanting as suckling calves or older stockers may not be desirable from an over-all standpoint if subsequent feedlot gain or carcass grade is lowered. Thus the role of hormone implants in the complete management program should be investigated.

This study is the first experiment in a new project designed to test the value of (a) stilbestrol implants for young suckling calves, and their possible effect on subsequent feedlot performance and (b) the effect of a thyroid depressor, complex protein supplement, and a high protein intake on fattening calves receiving stilbestrol in the ration.

Procedures

Part I. In one phase of this study, 10 Hereford steer calves were selected from the Lake Blackwell experimental herd and 14 calves from the Fort Reno herd at approximately 3½ months of age. Within each group, they were divided into 2 lots on the basis of age and weight; within the Ft. Reno group, information on sire and dam productivity were taken into consideration in allotment. To the calves of one lot, a 15 mg. stilbestrol pellet was implanted at the base of the ear, while

Table 2.—Performance of steer calves implanted with 15 mg. stilbestrol at approximately 3½ months of age.

Source of Calves and Treatment	Lake Blackwell		Fort Reno	
	Controls	Implanted with 15 mg. Stilbestrol	Controls	Implanted with 15 mg. Stilbestrol
No. of calves compared	5	5	7	7
Ave. birth date,	3-13	3-19	3-12	3-14
Ave. age when implanted (days)	94	88	113	111
Weaning date	10-11	10-11	10-11	10-11
Initial weight, lbs.	269	269	344	343
Weaning weight, lbs.	468	498	545	576
Gain from implantation to weaning	199	229	201	233
Difference due to implantation		+30		+32
Feeder grade[1]	B(4.2)	B+(3.4)	B−(4.7)	B+(2.9)
Cost of implanting ($)[2]		$0.40		$0.40
Value of implanting at 20¢/lb. less cost ($)		$5.60		$6.00

[1] Feeder grades were: A (Fancy) = 1, B (Choice) = 4, and C (Good) = 7.
[2] Actual cost of material was about 2¢ per implant. Additional charge was made for implanting instrument and labor.

the others served as controls. The calves were continued on their dams in a common pasture at each station. The calves were not creep-fed and received only their mother's milk and native grass.

The results obtained are shown in Table 2. At weaning, the calves were brought to the experimental feeding shed west of Stillwater to be fattened. They were weaned on oat hay, silage, a small amount of cottonseed meal and rolled milo. After recovering from the effects of weaning (two week period), the calves were regrouped into 4 lots of 6 calves each for the fattening period. One half of the controls (6 calves) were placed on a fattening ration of rolled milo (full-fed), 1.5 lbs. cottonseed meal, 1.0 lb. dehydrated alfalfa meal pellets and sorghum silage, with minerals (2 salt and 1 bone meal) free choice. The remainder of the controls were placed on the same ration, plus 10 mg. stilbestrol mixed with the cottonseed meal. A similar division was made among the calves which had previously been implanted while on their dams; one-half were fed the basal ration and the remainder received the basal plus 10 mg. stilbestrol.

Part II. In the second phase of the study, forty uniform Hereford steer calves were selected from the station herds at Wilburton and Ft. Reno. The calves were weaned in early October and allowed three weeks to recover from the effects of weaning and to become accustomed to the feeds to be used in the trial. They were divided into 4 uniform lots of 10 calves each on the basis of source, age, grade, shrunk weight and sire (where possible). They were all fed the same basic ration described above—rolled milo (full-fed), protein supplement, 1.0 lb. dehydrated alfalfa meal pellets, sorghum silage, and minerals free choice. All calves received 10 mg. stilbestrol mixed with the protein supplement.

The protein supplements fed, per steer daily, were:

Lot 5. 1.5 lbs. cottonseed meal.

Lot 6. 1.5 lbs. cottonseed meal plus 100 mg. of a thyroid inhibitor, to study its effect of feedlot performance and carcass quality.

Lot 7. 2.4 lbs. of a complex supplemental mixture containing cottonseed meal, dried molasses, condensed fish solubles, calcium carbonate, trace minerals, vitamin A concentrate and aureomycin (aurofac)*

Lot 8. 2.5 lbs. of cottonseed meal to study the effect of a higher protein level on the performance of steer calves receiving stilbestrol.

All cattle were hand-fed, one half the daily ration allowance at each feeding. The feeding tests lasted approximately 160 days. An appraisal of market value was made by a committee from the Oklahoma City yards at the completion of the test. Following Feeder's

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* The trace minerals were supplied by Calcium Carbonate Company, Chicago, Ill., the vitamin A concentrate by Nopco Chemicals, Harrison, New Jersey, and the aurofac was obtained from American Cyanamid Corp., Lederle Division, New York City.

Day, the cattle will be sold on the Oklahoma City market and data will be obtained on shrink to market, yield and carcass grade.

Results

The average daily gains of all cattle were considered good. Rather severe death loss occurred in certain lots during the trial. Of the 64 calves started on test, 7 were lost or had to be removed during the trial. Drenching the calves with a systemic insecticide for control of grubs in the third week of the test resulted in severe depression of appetite and scouring in all lots. Two calves were lost due to this treatment. One calf died of bloat and another was removed from test for a chronic bloat condition. One calf died and two were removed with urinary calculi. These losses were severe enough in certain lots to limit the conclusions which can be drawn from the data.

Table 3.—Feedlot performance of steer calves previously implanted with stilbestrol

	Not Fed Stilbestrol		Fed Stilbestrol	
Lot Number & Previous Treatment	1 Controls	2 Implanted at 3½ mo.	3 Controls	4 Implanted at 3½ mo.
Number of calves	6[1]	6[1]	6[1]	6
Av. weights (lbs.)				
Initial 10/25/56	504	515	493	499
Final 4/5/57	879	920	923	912
Av. daily gain	2.38	2.52	2.67	2.57
Av. daily ration (lbs.)[2]				
Rolled milo	13.5	13.9	13.7	13.8
Cottonseed Meal	1.5	1.5	1.4	1.4
Dehydrated Alfalfa Meal Pellets	1.0	1.0	1.0	1.0
Sorghum Silage	11.3	11.3	10.8	10.8
2-1 Mineral Mix	.05	.05	.05	.05
Feed required per cwt. gain (lbs.)				
Milo	580	553	513	538
Cottonseed Meal	64	60	52	55
Dehydrated Alfalfa Meal Pellets	43	40	37	39
Sorghum Silage	485	449	404	421
Financial Results ($)				
Feed cost per cwt. gain	20.21	19.11	17.75	18.58
Total steer + feed cost[3]	176.58	180.39	174.91	176.52
Appraised value/cwt.	22.00	22.00	22.50	22.50
Total value/steer	193.38	202.40	207.68	205.20
Net return over cost of steer + feed[4]	16.80	22.01	32.77	28.68

[1] One calf from Lot 1 and one from Lot 2 died following treatment with systemic insecticide for grubs. One steer in Lot 3 removed as a chronic bloater, and one steer in Lot 1 died of urinary calculi. Only performance of steer removed from Lot 1 for urinary calculi was considered in computing weight gains and feed efficiency.

[2] All steers received 1 oz. $CaCO_3$ per head daily.

[3] Initial cost, $20.00 per cwt.

[4] Does not include costs of labor, equipment, insecticides, transportation or marketing.

Effect of Implanting Young Calves on Weaning Weight and Subsequent Feedlot Performance.

The effect of one 15 mg. stilbestrol implant to 3-4 months old calves on weaning weight, feeder grade and net returns can be seen from the results given in Table 2. No adverse side effects, as have been observed in older cattle, were noted. The improvement in feeder grade of implanted calves was apparently due to more bloom and slightly fatter appearance at weaning. This difference in condition might effect their price as feeders, depending on the local market demand and the preference of the feeder buyer. No heifers were implanted in this study.

In the feedlot, the allotment of the calves permittd a comparison of controls vs. implanted calves—either with or without stilbestrol in the ration. Due to the small numbers, and death loss and removal of certain steers, little emphasis can be placed on the data from this trial. The results obtained show no apparent effect of previous stilbestrol implantation when all cattle are considered. It should be noted that the difference in actual weight between control and implanted groups was much smaller at the start of the feeding trial than at weaning—indicating a greater shrinkage among implanted calves during the two-week interval between weaning and the start of the feeding trial.

The apparent carryover effect of previous implantation (compare Lots 1 & 2) is not believed to be real difference since early period gains were essentially the same. Feeding stilbestrol to either controls or implanted calves increased gains, but slightly more for calves not previously stimulated by the hormone. The committee of market representatives appraising the calves at the close of the feeding trial apparently could not discern between control calves and previously implanted calves, although they could readily pick out the groups fed stilbestrol during the fattening trial. They tended to give these a higher on-foot value.

Effect of Different Supplements to Stilbestrol-Containing Rations.

Including stilbestrol in supplements for fattening cattle poses many problems concerning the best ration to obtain maximum benefit. The majority of studies indicate a slightly lower carcass grade and yield where stilbestrol is fed. It is now the belief that hormone-fed cattle must be fattened for the same length of time as normal cattle—thus increasing weight with no improvement in grade. In an attempt to increase fat deposition, a thyroid depressing drug was added to the protein supplement fed Lot 6. The data shown in Table 4 indicates that weight gains and efficiency of feed conversion was not altered by feeding the drug in rations containing stilbestrol. Carcass grades and yield will be obtained at slaughter to determine the over-all effect of thyroid inhibitor. In a trial with yearling steers reported elsewhere in this publication, the same product was fed and no beneficial effect

Table 4.—Effect of certain hormones and feed additives on the performance of fattening steer calves

Lot Number & Treatment	5 Basal (with Stilbestrol)	6 Basal + Thyroid Inhibitor[1]	7 Basal + Complex Supplement	8 Basal + Additional Protein
Number of calves	10	10[2]	10[2]	10
Av. weights (lbs.)				
Initial 10/29/56	491	493	490	490
Final 4/5/57	904	914	913	912
Av. daily gain	2.64	2.68	2.69	2.69
Av. daily ration (lbs.)[3]				
Rolled milo	12.6	12.5	12.7	12.5
Cottonseed meal	1.5	1.5	1.4	2.5
Special mixture			.92	
Dehydrated Alf. meal pellets	1.0	1.0	1.0	1.0
Sorghum silage	12.0	12.1	12.2	12.0
2-1 Mineral mix	.07	.05	.06	.05
Feed required per cwt. gain (lbs.)				
Milo	479	466	471	465
Cottonseed meal	57	56	52	93
Special mixture			34	
Dehydrated Alf. meal pellets	38	37	37	37
Sorghum silage	456	451	453	446
Financial Results ($)				
Feed cost per cwt. gain	17.36	16.94	18.78	18.10
Total steer + feed cost[4]	169.89	169.90	177.46	174.40
Appraised value/cwt.	21.35	21.95	22.40	22.35
Total value/steer	193.00	200.62	204.51	203.83
Net return over steer + feed cost[5]	23.11	30.72	27.05	29.43

[1] Thyroid inhibitor (1-methyl-2-mercaptoimidazole) was supplied by Eli Lilly & Co., Indianapolis, Indiana. No charge for this compound was made against Lot 6 in computing feed costs.
[2] Two steers from Lot 6 removed for urinary calculi during the last month of the trial, and one steer in Lot 7 died of bloat in December. Data on these cattle were not included in computing gains or feed efficiency.
[3] All steers received 1 oz. $CaCO_3$ per head daily.
[4] Initial cost, $20.00 per cwt.
[5] Does not include costs of labor, equipment, insecticides, transportation or marketing.

was noted. The possibility exists that the material used may have been altered in the rumen, or was not effective at the levels fed.

Do stilbestrol-fed cattle have different nutrient requirements than non-treated cattle? To study this possibility, Lot 7 was fed a complex mixture containing many factors believed beneficial to either the steer or the rumen bacteria, and Lot 8 was fed additional protein above that fed the basal group.

Results show that daily gains and feed conversion were not markedly effected by either treatment. Feed costs were increased from $5 to $8 in Lots 7 & 8, as is further reflected in the increased feed cost per cwt. gain. In this trial, however, the increase in market value of Lot 7 & 8 cattle resulted in larger net returns as compared to the controls (Lot 5). Whether or not this advantage is real may become apparent when carcass grades and yields are obtained. There was a tendency for Lot 8 cattle, fed a high level of protein, to gain faster during the first 100 days of the trial.

From these results, it appears unlikely that a complex supplement will result in increased performance as compared to a simple protein in this type of ration. Further, the level of protein supplement fed the basal lot was apparently sufficient for optimum performance.

Summary

The effect of stilbestrol implants for young suckling calves (approximately 3½ months of age) and their effect on subsequent feedlot performance was studied. Implanting young calves with 15 mg. stilbestrol resulted in approximately 30 lbs. greater gain to weaning, and slight improvement in feeder grade. Although only a limited number of calves were available to study feedlot performance, the results indicate no marked effect of previous implantation on feedlot gains, feed efficiency or market value.

Four lots of steer calves were used to study the effect (a) a thyroid inhibitor, (b) a complex supplement containing antibiotic, and (c) a high level of protein in stilbestrol-containing rations. Daily gains and feed required per cwt. gain showed little or no improvement over the basal group. The thyroid inhibitor resulted in no greater feedlot performance, but the slightly higher appraised value at the completion of the trial increased the net return in this lot. The groups fed a complex supplement with antibiotic, or those receiving an additional amount of cottonseed meal, showed little improvement in gain, and feed cost per cwt. gain was increased. Using the appraised market values, they proved to be more profitable than the basal group fed 1.5 lbs. of cottonseed meal.

FEED PRICES FOR 1956-57 FEEDER'S DAY REPORTS

(NOTE: Feed prices given below are those for the trials conducted during the fall and winter of 1956-57. For work conducted in the summer of 1956, and reported herein, feed prices are the same as given in the 1956 Feeders' Day Report [Misc. Pub. MP-45]. Where two or more years of work are summarized, the feed prices used may be found in the annual reports 1954-55, MP-43, and 1955-56, MP-45).

	PER TON
Corn	$ 58.94
Oats	61.26
Milo	50.00
Cottonseed Meal	66.00
Cottonseed Meal Pellets	68.00
Cottonseed Meal + Stilbestrol	72.00
Soybean Meal	69.00
Soybean Meal + Stilbestrol	75.00
60% Tankage	75.00
Urea	110.00
Dehydrated Alfalfa Meal	50.00
Dehydrated Alfalfa Meal Pellets	52.00
Molasses	60.00
Dried Molasses (Omalass)	140.00
Aurofac	560.00
Aurofac D	1360.00
Fortafeed	900.00
Salt	19.00
Iodized Salt	43.00
Trace Mineral	150.00
Steamed Bone Meal	96.00
Ground Limestone	15.00
Alfalfa Hay	30.00
Prairie Hay	25.00
Cottonseed Hulls	22.50
Sorghum Silage	10.00

COST OF NATIVE GRASS PASTURE (PER HEAD)

Cows—year long	25.00
summer	17.50
winter	7.50
Yearlings—year long	18.00
summer	14.00
winter	4.00
Calves—winter	3.50