of 222 and 247 lb. in Lots 1 and 3, respectively, from older cows fed similarly as reported in Part 3 of this article. The two-year-old heifers are not producing satisfactory calves with either level of winter feeding. The calves will be sold in mid-summer and the cows will be continued on the experiment next year.

Summary

Cows which had previously produced at least one calf before being placed in the experiment have been fed 1.5 lb. of pelleted cottonseed meal or 5.5 lb. of a pelleted mixture of 2.5 lb. cottonseed meal and 3 lb. ground milo. The calves produced by one group of cows within each level of wintering have been creep-fed. The 3-year average increase in gain from creep-feeding was 58 lb. Also, the high level of winter feeding of the cow increased calf gains 29 lb. Neither practice was profitable when costs prevailing during the time of the tests were considered. Preliminary results obtained during the fourth test and with 2.5-year-old heifers are presented.

Protein Supplements for Wintering Fall-Calving Cows

J. A. MILLER, A. B. NELSON and G. R. WALLER

One of the main considerations in any cattle wintering program is the provision of adequate protein. The purchase of protein supplement represents a great portion of the cost of wintering cattle on native grass. Several experiments have been conducted at this station 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 native grass during the winter. Results of these experiments have been summarized in Okla. Agr. Exp. Sta. Bulletin B-437.

Results of these studies indicated that the supplements were not of equal value when fed at the same level of intake under similar management conditions. However, these tests did not provide data concerning the effect of the various supplements when fed to the same animals for several successive winters. The need for information on this 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 crude 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 pasture.
3. To determine the value of a feed supplement containing approximately 50 percent of the total nitrogen as urea for wintering commercial beef cattle grazing native grass.

Experimental Procedure

To accomplish these objectives, 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, the heifers were fed a protein supplement during the winter months as follows:

Lot 1—1 lb. of 40 percent protein pelleted cottonseed meal.

Lot 2—2 lb. of 40 percent protein pelleted cottonseed meal.

Lot 3—2 lb. of 20 percent combination pellet.

Lot 4—2 lb. of 20 percent protein pellet (CSM and corn).

Lot 5—2 lb. of 40 percent pellet containing urea.*

The 40 percent protein pellet contained 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 several different sources of protein, dehydrated alfalfa meal, molasses and minerals which furnished nutrients that 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 mg. per lb. of pelleted supplement: manganese, 55.4; iodine, 1.71; cobalt, 1.18; iron, 43.6; copper, 3.3; and zinc, 3.04.

The simple 20 percent protein pellet was composed of 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 simple 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 (Nx 6.25). The value of this pellet can be related to the simple 20 percent protein pellet or to 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.

The calcium and phosphorus contents of all pellets were equalized by the addition of ground limestone, dicalcium phosphate, and monosodium phosphate. The cost per ton of the various supplements 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 cost was approxi-

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

mately the same with a difference of approximately $4 between the highest and lowest costs per ton.

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 to determine the value of a salt and phenothiazine mixture in the control of cattle grubs.

The pellets were fed in the kinds and amounts as listed to the same cattle as heifer calves during the winter of 1953-54 and as yearling heifers during the winter of 1954-55. At the beginning of the winter feeding period for 1955-56, the allowance of supplemental feed was increased to 1.5 lb. per head daily in Lot 1 and 3 lb. per head daily in the other lots. Thus, as two- and three-year-olds, the same cattle were continued on their respective rations as in the two previous winters with only the amount of each supplement being fed changed. All cattle were allowed to graze the native grass pastures yearlong. After the first two years the acres of native grass available per head were increased from 5 to approximately 8 acres per head. The chemical composition of the protein supplements fed during the 1956-57 season is given in Table 1.

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

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

The yearling heifers were bred to registered Hereford bulls during a period extending from January 3 to March 27, 1955, thus the first calves were born in the fall and early winter when the heifers were approximately 2.5 years old. These calves were weaned August 4, 1956. The two-year-olds were rebred to registered Hereford bulls during a period from December 19, 1955, to April 24, 1956. The second group of calves was born in the fall of 1956 and weaned August 5, 1957.

Observations

The data summarized in Table 2 include only the results from those cattle originally allotted to this study which have weaned two calves, one in 1956 and one in 1957. As stated previously, 20 heifer calves were allotted to each lot, but due to various reasons (see Table 2) the data from certain individuals have been omitted in the calculation of the results. All cattle in good health have been retained in the herd to determine whether or not they will calve in future years. Because an

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]	14	13	15	10	12
Average weight (lbs.)					
Initial 11-2-53	479	476	481	495	479
Winter gain 4-13-54[2]	2	6	—2	—9	—13
Fall 10-30-54	680	685	683	684	674
Winter gain 4-19-55[2]	6	—8	—23	—15	2
Fall 10-10-55	977	960	953	956	948
Winter gain 4-24-56[3]	—221	—141	—181	—214	—146
Fall 9-26-56	1010	1023	1018	992	1020
Winter gain 4-26-57[3]	—324	—255	—273	—311	—321
Final 9-28-57	945	983	985	961	1037
Total gain	466	507	504	466	558
Calf data 1955-56					
Number of steers	6	4	6	6	5
Number of heifers	8	9	9	4	7
Average birth date 1955	10/30	11/23	11/4	11/12	11/14
Average birth weight[4]	74	73	74	74	75
Average weight 4-24-56[6,7]	194	239	219	205	212
Avg. daily gain to 4-24-56	.73	1.00	.88	.79	.83
Avg. final wt. 8-4-56[8,10]	389	436	413	415	426
Calf data 1956-57					
Number of steers	8	9	7	2	6
Number of heifers	6	4	8	8	6
Average birth date 1956	10/21	10/13	10/14	10/11	10/16
Average birth weight[4]	76	75	77	74	73
Average weight 4-26-57[6,7]	180	220	197	197	192
Avg. daily gain to 4-26-57	.55	.76	.63	.65	.63
Avg. final wt. 8-4-57[8,10]	333	405	394	347	381
Reasons for omitting cow data					
Calved spring 1954	0	0	0	2	0
Calved spring 1955	1	4	1	1	0
Calf born dead or died later 1955-56	0	0	0	1	2
Calf born dead or died later 1956-57	0	1	0	2	1
Cow open during 1955-56	3	1	4	3	2
Cow open during 1956-57	1	1	0	0	3
Cow died during study	1	0	0	1	0
Cows open 6-21-57[11]	10	5	6	4	6
Cow died or sold 1957-58	0	1	2	0	0

[1] 20 heifer calves were originally in each lot, but results are given only for cattle which have weaned two calves. Reasons for removal of cattle are given near the bottom of the table.

[2] Weight losses recorded during the first two years indicate no statistically significant differences among lots and years.

[3] Weight losses recorded during the third and fourth years while the cows were suckling calves were statistically significant (P is less than 0.01) differences among lots and between years. The cows in Lot 2 lost significantly (P is less than 0.01) less weight than the cows in the remaining lots, and those in Lot 1 lost significantly (P is less than 0.01) more weight than those in Lots 3, 4 and 5. The weight losses during the third winter were significantly less (P is less than 0.01) than the weight losses during the fourth winter.

[4] Corrected for sex by adding 3 lb. to the actual birth weight of each heifer.

[5] Corrected for age by adjusting all calves to a standard age of 165 days, and for sex by adding 16 lb. to the age-corrected weight of each heifer.

[6] Corrected for age by adjusting all calves to a standard age of 190 days, and for sex by adding 16 lb. to the age-corrected weight of each heifer.

[7] There was a significant (P is less than 0.01) difference in the April calf weights among the treatments of their dams and between years. The calves from cows of Lot 2 were significantly (P is less than 0.01) heavier than calves from any of the other lots. Lot 1 calves were significantly (P is less than 0.05) lighter than the calves from Lots 3, 4 and 5, which were practically equal.

[8] Corrected for age by adjusting all calves to a standard age of 270 days, and for sex by adding 20 pounds to the age-corrected weight of each heifer.

[9] Corrected for age by adjusting all calves to a standard age of 290 days, and for sex by adding 20 pounds to the age-corrected weight of each heifer.

Table 2.—Continued

[10] Statistical analysis indicated a significant (P is less than 0.01) difference in weaning weight among lots and between years. Lot 2 weights are significantly (P is less than 0.01) greater than the other and Lot 1 weights are significantly less (P is less than 0.01) than those in Lots 3, 4 and 5, which were practically equal. The significant (P is less than 0.01) year difference was in favor of the first calf crop.

[11] Indicates the number of open cows that had previously weaned two calves and for which results are reported, but not the total number of open cows in any one lot. Although the records of many cows have been removed from the data, all live cows have remained in the test.

important economic factor is the number of calves weaned per cow of calving age, rebreeding data for the cattle, whether or not they were suckling a calf, were collected near the end of each lactation and used as a measure of the value of the various protein supplements.

A summary of observations recorded during the 4 years is given in Table 2. The following comparisons have been made.

Lot 1 vs. Lot 2

During the first two feeding seasons the gains of heifers fed 1 lb. and 2 lb. of 40 percent protein pelleted cottonseed meal were nearly the same. The protein requirement of growing heifers grazing dried native grass pastures was apparently met by the lower level of supplemental feeding. However, during the winters in which the cows were suckling calves the losses were considerably greater in Lot 1 (1.5 lb. pellets) than in Lot 2 (3 lb. pellets). These weight losses include losses at calving and while suckling a calf during the winter months. The difference in loss was 80 lb. in 1955-56 (—221 vs. —141) and 69 lb. in 1956-57 (—255 vs. —324). Statistical significance between these and various other weights may be noted in the footnotes of Table 2. The differences in weight gains in Lots 1 and 2 indicate that the additional nutrients fed to the cattle of Lot 2 were needed and utilized by the animal body. The total gains in the four-year period were 466 and 507 lb. for Lots 1 and 2, respectively.

The birth weights of the calves were practically the same in both lots within each year. The weights of the calves at the end of the 1955-56 winter feeding period were 194 and 239 lb. for the 1.5- and 3-lb. level of supplemental feeding, respectively. Similar weights in April, 1957, were 180 and 220 lb., respectively. The average difference was 42 lb. One would expect that any difference in value of the ration would be reflected in weights of the calves at this time before the availability of green grass had a chance to mask or overcome any poor results due to inadequate protein intake. Weaning weights of the calves in August also showed a considerable advantage for the higher level of feeding. Calves produced by cows fed 3 lb. of cottonseed meal pellets weighed an average of 60 lb. more at weaning. The difference in individual years was 49 and 72 lb.

Lot 2 vs. Lots 3 and 4

There were minor differences in winter gain during the first two winter seasons, although there was a slight advantage for cattle fed the

40 percent protein supplement. The winter weight losses while the cows were suckling calves were greater for the cows fed 20 percent protein supplements. The average difference was 57 lb. in 1955-56 and 36 lb. in 1956-57. Apparently the greatest need for supplemental feed was for protein and not energy. The 20 and 40 percent protein supplements were not equal in value for reducing weight losses when fed at a level of 3 lb. per head daily. The cows in Lot 2 were the only cattle in the experiment that appeared to be in a relatively satisfactory condition as judged by their general appearance during the winter.

Only minor differences in birth weights of calves were recorded. The cows fed the 40 percent protein supplement raised heavier calves. The two-year average calf weight in April at the end of the winter feeding season was 25 lb. greater for the 40 percent than the 20 percent protein supplement. The difference at weaning in August was 28 lb.

Lot 3 vs. Lot 4

The winter losses as calves and as yearlings were practically the same in both groups fed the 20 percent protein pellets. However, while suckling calves the cows fed the combination pellet (Lot 3) lost less weight than those fed the corn and cottonseed meal pellet. This advantage was 33 lb. in the third season and 38 lb. in the fourth season. These weight changes suggest that the ingredients furnished in the combination pellet apparently provide increased quantities of certain nutrients needed by range cattle for increased utilization of the forage.

In 1956, the April weight of the calves was 14 lb. in favor of the combination pellet. However, when weaned in August the average weight of the two groups of calves was essentially equal. In 1957 both groups of calves weighed the same in April, but in August the calves produced by the cows fed the combination pellet were heavier.

Lot 1 vs. Lots 3 and 4

This comparison is a study of three pellets furnishing equal protein but a considerable difference in amounts of other nutrients. The cattle in Lot 1 were fed 1 lb. (1.5 lb. after the second year) of 40 percent protein pelleted cottonseed meal. Those in Lots 3 and 4 were fed twice as many pounds of a 20 percent protein pellet. Gains during the first two years were slightly in favor of 1 lb. of 40 percent protein pellet. During the next two years the added nutrients fed Lots 3 and 4 resulted in less winter weight loss. The average loss of Lots 3 and 4 was 25 lb. less than the loss in Lot 1 in the third year and 32 lb. less while suckling the second calf.

Calf weights, both in April and August, have been lower in Lot 1. One of the main additions to the supplement fed to Lots 3 and 4 was energy supplied by grain. The results indicate that this added energy (and other nutrients) was needed and utilized. However, the provision of added protein was more valuable (Lot 2 vs. Lots 3 and 4).

Lot 5 vs. Lots 2 and 4

When urea was added to a supplement containing 20 percent protein in such amounts that the protein content (Nx 6.25) of the pellet was increased to 40 percent (Lot 5), the average winter loss of both groups of cattle was nearly the same. However, there was considerable variation between years. There were minor differences in favor of the 20 percent protein pellet in two years and a small difference in favor of the urea-containing pellet in one year. While suckling their first calves (year 3), the cows fed the urea-containing pellet lost considerably less weight than those in Lot 4. Differences in weight gain between the cattle in Lots 2 and 5 (cottonseed meal pellets vs. urea-containing pellets) were not great until the fourth year when the Lot 2 cows lost an average of 66 lb. less.

Calf weights were greater in Lot 2 compared to Lot 5 (27 and 28 lb. in April of 1956 and 1957, respectively) (10 and 24 lb. in August of the two years, respectively). Although the feeding of pelleted cottonseed meal has resulted in heavier calves than feeding the urea-containing pellet, the calves produced by cows fed this latter pellet were slightly heavier than those in Lot 4 (20 percent protein pellet). This would indicate some, but not complete, utilization of urea.

General

Measures of the value of certain rations in a cow and calf program include weight changes of the cow, calf weights, general appearance of animals and reproductive rate. Cows may have an excellent general appearance and the calves produced may be of a desirable weight. However, an important consideration is the birth date and number of calves produced. No conclusions concerning variation in birth date have been made because the largest difference in the four years was only 10 days.

Data from several cows have not been included in the summary presented in Table 2. The reasons for removal of the cows are reported in the lower part of the table. Many of these reasons were not related to the experimental rations. It should be noted that of the 91 cows in the experiment at the end of two years, 13 did not produce calves. This would be an 85 percent calf crop born without consideration of later calf losses. The open cows were found in all lots with a variation from 4 in Lot 3 (combination pellet) to 1 in Lot 2 (high level of cottonseed meal pellets). The weights of the calves weaned in 1956 were considered satisfactory for first-calf heifers.

During the 1955-56 breeding season, while the cows were suckling their first calf, 5 cows failed to rebreed (1 each in Lots 1 and 2, and 3 in Lot 5). The summer of 1956 was very hot and dry with an abnormally low amount of rainfall. Therefore, only litle forage was produced in the pastures. The average acreage available per cow had been previously limited to approximately 5 acres but in 1956 the acreage was increased to 8-9 acres per head. (This is the recommended average stocking rate for the Lake Carl Blackwell experimental range area). The amount of dry forage

available for consumption during the winter in the pastures was relatively low but considered to be apparently adequate. As measured by winter weight losses of the cows, performance of the calves, and rebreeding of the cows, this may not have been true.

The winter losses of the cows were considerably greater in 1956-57 than during the previous winter. The average increase in loss was 116 lb. (—181 vs. —297 lb.) The average losses varied from 25 to 32 percent of the weight at the beginning of the winter season in 1956-57 and from 15 to 23 percent in the 1955-56 season. The average difference in daily gain of calves during the winter period was 0.21 lb. (0.85 vs. 0.64 lb.). One would expect the second calf produced by a cow to be considerably heavier than the first calf. However, the reverse was true in this test. The average weight of the calves weaned in 1957 was 44 lb. less than those weaned in 1956. Also, of the 64 cows which have produced two calves, only 33 rebred for calving in the fall of 1957. During the 4 years this study has been in progress 5 cows died or were sold. None of these 5 losses is believed to be due to experimental treatment. Although the data in Table 2 include records collected from the 64 cows which have produced two calves, there were 95 cows remaining in the experiment. Thirty-three percent of these cows failed to conceive during the 1956-57 breeding season. The definite cause of the poor growth and reproductive performance is not apparent, although apparently related to nutrient intake. All cows have been retained in the herd to determine whether or not they have rebred during 1957-58. Additional observations must be recorded before definite conclusions are made concerning the value of the various supplements.

In another experiment, fall-calving cows of breeding similar to that of cows used in the above test and varying in age from 5 to 7 years grazed native grass yearlong and were fed 1.5 lb. of pelleted cottonseed meal per head daily at the Lake Blackwell range area and produced calves weighing from 422 to 474 lb. in individual years. The 3-year average weight of calves from these cows of similar breeding was 451 lb., and the weight in 1957, when the calves in the study reported in this article were very light, was 474 lb. This is considered a relatively low level of supplemental feeding of fall-calving cows but the production is considerably greater than in the experiment discussed herein.

Summary

One hundred grade Hereford heifer calves were started on a study of the value of different protein supplements fed during several consecutive winters to cattle grazing native grass pasture yearlong. The cattle in each lot have been fed the same kind of supplement for four consecutive winters and data have been collected for two calf crops. Only 64 cows have produced two calves and only 33 of these remain for the 1957-58 season. However, 95 cows remain in the test and are furnishing information not recorded in this report. Because of poor performance in 1956-57, additional data are needed before definite statements can be made regarding the relative value of the supplements fed in this test.

On the basis of data collected thus far, the following summary statements have been made. Only minor differences in weight gains between the five lots of cattle were recorded during the first two years. During the third and fourth years while suckling calves, cows fed 3 lb. per head daily of pelleted cottonseed meal lost less weight during the winter and produced heavier calves than cattle fed 1.5 lb. pelleted cottonseed meal, 3 lb. of 20 percent protein combination pellet or 3 lb. of 40 percent protein pellet containing urea. Feeding 1.5 lb. of pelleted cottonseed meal was the least desirable practice. There were only minor differences in production due to feeding two 20 percent protein pellets or the urea-containing pellet. However, the combination pellet was apparently slightly more desirable than the simple pellet. The test is being continued in order that more data may be collected.

Effect of Rolling vs. Pelleting Milo, Previous Implantation, and Certain Feed Additives on the Feedlot Performance of Steer and Heifer Calves.

L. S. POPE, R. F. HENDRICKSON, LOWELL WALTERS, GEORGE WALLER AND W. D. CAMPBELL

With the high investment in cattle, feed, and labor, it is essential that the feeder seek new methods of feed processing or ration ingredients that will increase gain and lower the cost per cwt. gain. Several new antibiotics and other feed additives have appeared on the market over the past few years. New equipment is constantly being developed to better prepare grains and roughages for fattening cattle. Much attention has been given to pelleting or cubing either the grain or the complete ration.

Much interest has developed in the use of hormone implants for feeder cattle. Elsewhere in this publication, it is shown that two, 12 mg., stilbestrol implants given to suckling beef calves will increase weaning weights by approximately 36 pounds. An important question from the standpoint of the feedlot operator is whether or not this early implantation of feeder calves, or older cattle, will adversely affect their performance during the fattening period. To obtain information on this point, certain calves were selected from the station herd which had been previously implanted at about 100 days of age, together with a like number which were not implanted. The feedlot performance of these calves was studied during a 155-day feeding period.

Many benefits are claimed from the use of hormone-like drugs and other feed additives in cattle fattening rations. The wide use of stilbestrol for fattening cattle has raised questions as to whether our rations are adequate in some nutrients, such as protein. The development of certain new antibiotics has raised questions as to whether fattening cattle will benefit from their use. Recent studies suggest that low levels of tranquilizer in fattening rations will increase gain and improve feed efficiency.