Responses of Southern Range Cattle to Protein Supplementation

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Highlight

Reproductive performance of range cows receiving 312 lb of cottonseed cake between November 1 and March 31 equaled that of cows receiving 432 lb fed from October through May, or 555 lb fed throughout the year. High-treatment cows were consistently heavier than those receiving medium or low rations. Cows fed the low ration were highest in plasma vitamin A, but other blood constituents were unaffected.

Despite a general abundance of grass, beef breeding herds grazing throughout the year on pine forest ranges in the South are often plagued by malnutrition. Toward maturity, forage becomes deficient in protein, even for dry cows (Campbell et al., 1954). Phosphorus content is never adequate for lactating cows (Duncan and Epps, 1958). Since few cattlemen have devised effective supplementation programs, calf production is generally low and winter mortality is often high.

Feeding cottonseed cake during winter reduces mortality and increases calving percentages,

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weaning weights, and market grades, but optimum amount of cake and length of feeding period have not been determined. Cassady and Whitaker (1956) reported that feeding 297 lb/cow of cottonseed cake from December until March was ineffectual. Calf crops were 50% and 6-month weights averaged only 240 lb. In a second study, by Duvall and Whitaker (1963), the quantity was increased to 373 lb/cow, fed between November 1 and May 4. On that schedule, calf crops averaged 83% and 192-day weights averaged 433 lb; annual mortality was 2.5% among cows and 0.5% among calves. Since the experiment included only one level of cottonseed cake supplementation, however, the amount needed for optimum performance remained undetermined.

A third feeding trial, described in this paper, attempted to delimit quantity and feeding-period requirements. Three supplementation treatments were compared. In two treatments the amounts of cottonseed cake fed and the lengths of the feeding periods were greater than those tested by Duvall and Whitaker; in the third treatment they were less. Cattle responses are reported in terms of calf production, cow weights, and levels of several critical constituents in cow blood.

Experimental Procedure

The experiment was conducted from 1959 through 1963 on two 570-acre range units of the Palustris Experimental Forest in central Louisiana. Forage vegetation of the 2 units was similar. Native grasses, mainly bluestems (*Andropogon* spp.) and panicums (*Panicum* spp.), furnished most of the forage. Prior to the study, herbage production averaged about a ton/acre annually. A third of each range unit was burned per year in rotation.

Range units, stocked for 40- to 50% use, were grazed throughout the year by about 33 cows each. Cows were typical "native" stock. Almost half showed evidence of Brahman breeding, in combination with Jersey or British beef breeds. The remainder were mixtures of British beef breeds, Jersey, and dual-purpose breeds.

Herds grazing each range unit were divided into three 11-cow treatment groups, designated as high, medium, and low. In each group, 10 cows were study animals; the other, a replacement. Cows were assigned to treatments as equitably as possible according to age, weight, and breeding. Treatments consisted of feeding cottonseed cake (41% crude protein) at 3 rates per cow-year: high—555 lb, medium—432 lb, low—312 lb. Cows receiving the high treatment were fed throughout the year, while those assigned to the medium and low groups were fed for about 8 and 5 months, respectively (Table 1). These schedules were followed in all years except 1960, when quantities were increased to 604, 482, and 362 lb/cow because of severe winter weather. Feeding started in the fall of 1957. Thus, cows had been receiving experimental supplements for several months when the first calves were conceived.

Each treatment group received its cake in a separate pen, but the 3 groups in each replication grazed the same range. In addition to cottonseed cake, all cows received 3 to 4 lb of grass-legume hay daily during late winter. Steamed bonemeal (10% phosphorus) and loose salt were provided *ad libitum* in separate compartments of covered feeders.

Cows grazing 1 range unit were mated to a Red Poll bull, those grazing the other to a Shorthorn. Bulls were turned in annually on February 20 and removed on July 1. Hence, calves were dropped from about December 1 to April 10. Calving dates were recorded for all cows.

Table 1. Cottonseed cake allowances (lb) per cow.

Period	Feeding level High	Medium	Low
January	3.0 D[1]	3.0 D	2.5 D
February	3.0 D	3.0 D	2.5 D
March 1-10	3.0 D	3.0 D	2.5 D
March 11-31	2.0 D	2.0 D	1.5 D
April	2.0 E	2.0 E	
May	2.0 E	2.0 E	
June	2.0 E		
July	1.0 E		
August	1.0 E		
September	1.0 E		
October	2.0 E	1.0 E	
November	1.5 D	1.0 D	1.0 D
December	3.0 D	2.5 D	2.5 D

[1] D indicates quantity fed daily; E, quantity fed on alternate days.

Calves were marketed directly off the cows in mid-August. Only calves reaching weaning age were included in calf crops.

Cows were weighed 3 times yearly: April, late August or early September, and November. During the first 3 years of study, a 50 ml blood sample was taken from each cow at each weighing. Hemoglobin and hematocrit values were determined, and plasma was analyzed by standard procedures (A.O.A.C., 1955) for protein, carotene, vitamin A, iron, calcium, phosphorus, and magnesium.

Cows with serious physical defects and those failing to calve once in 2 successive years were removed from the experiment. This standard of culling, though low, is commonly followed by range cattlemen in the area. Also, it permitted retaining most of the original cows throughout the study. When a cow was removed, the replacement was redesignated as an experimental animal. Additional replacements were bought, as needed, at local stockyards.

Results and Discussion

Calf Production.—The proportion of cows weaning calves was unaffected by amount of supplementation. Although calf crops ranged from 78% for the medium treatment to 71% for the low

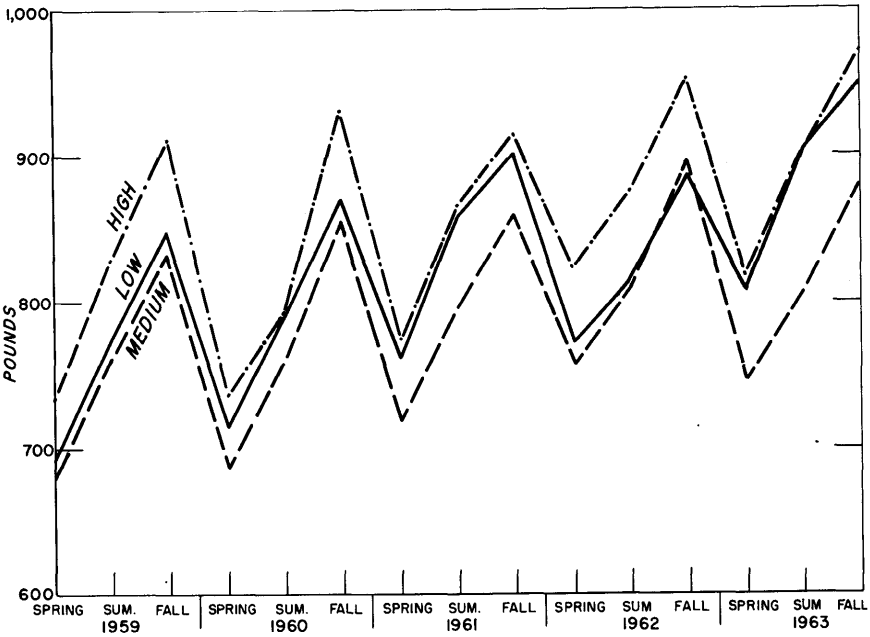

FIG. 1. Body weights of cows by treatments, years, and seasons.

Table 2. Calf crops, weaning ages, weaning weights, and market prices, by treatments, 1959 through 1963.

Feeding level	Calf crop (%)	Weaning age (days)	Weight (lb)	Price ($/cwt)
High	75$_a$[1]	212$_a$	445$_a$	23.38$_a$
Medium	78$_a$	206$_a$	429$_a$	23.25$_a$
Low	71$_a$	200$_a$	412$_a$	23.24$_a$

[1] In any one column, values having the same subscript are not different at the 0.05 level.

(Table 2), observed differences were not significant at the 0.05 level.

Calf crops for all feeding treatments were lower than in the previous study (Duvall and Whitaker, 1963), where cows received 373 lb of cake between November 1 and May 4. A wider cow-bull ratio in the present study (33:1 as compared to 25:1) may have contributed to the difference.

Of 229 calves dropped, 6 were born dead or died soon after birth. Mortality totaled 3 calves for the high treatment, 2 for the medium, and 1 for the low. These differences were not significant.

The calf mortality level of 2.6% contrasted sharply with the 16.7% reported by Speth et al. (1962) for cows fed high-protein supplements. These researchers found calf deaths to be significantly higher among cows receiving cottonseed and soybean oil meal supplements than among controls of those fed supplements of relatively low protein content.

Calf ages at weaning differed significantly among years but not treatments (Table 2). Beginning in 1959 and through 1962, averages for all treatments at mid-August weaning varied only 4 days. In 1963, however, calf age averaged 168 days, as compared to 215 days for the previous 4 years.

At the outset of the study, it was suspected that rate of supplementation might affect the interval between parturition and first estrus, thereby influencing date of calving. Bond et al. (1958) had shown that low-energy intake caused cessation of estrus in beef heifers. Witt et al. (1958) had noted that period from calving to first breeding was 32 days longer for cows receiving 50% of the required protein than for those fed the full requirement. In the present trial, however, rate of supplementation either did not influence calving date or replications were insufficient to detect the relatively small differences.

Observed differences among weaning weights, like those among weaning ages, were not significant. Evidently, supplementation level of dams did not affect market grade of calves, for sale prices did not vary significantly among treatments (Table 2). Solely on the basis of returns from calf sales, therefore, 312 lb/cow of cottonseed cake during winter was the most efficient allowance tested. This quantity only slightly exceeded the 297-lb ration that was ineffectual in a previous experiment (Cassady and Whitaker, 1956), but feeding began a month earlier and ended a month later.

Cow Weights.—Feeding treatments influenced cow weights (Fig. 1). Cows receiving the high ration of cottonseed cake were significantly heavier, at the 0.05 level, than those fed medium and low rations. This result may have been entirely attributable to additional energy supplied by cottonseed cake, but possibly cows fed the high ration consumed more forage and utilized it more efficiently than those on medium and low rations. Pope et al. (1954) found that steer calves fed 1 and 1.5 lb of cottonseed cake daily had keener appetites than those fed 0.5 lb. Also, steers receiving 1.5 lb required less feed per unit of gain than those fed lesser amounts.

Cow weights varied significantly by seasons. November weights were highest, averaging 897 lb/cow. Weight reduction during winter, including birth weight of calves and other losses attending parturition, was 150 lb/cow; hence, cows averaged 747 lb in April. Gains averaged about 75 lb/head during both the spring-to-summer and summer-to-fall periods. Season-treatment interaction was not significant.

Cow weights varied significantly among years. In 1959,

Table 3. Levels of blood constituents in cows, by seasons and treatments, 1959 through 1961.

Season	Feeding treatment	Hemoglobin in whole blood (gm/100 ml)	Iron	Vitamin A	Carotene	Protein	Phosphorus	Calcium	Magnesium
			Blood plasma						
			— — — (mcg/100 ml) — — —			(%)	— — — (mg/100 ml) — — —		
Spring	High	11.5	172.5	64.7	1067	8.2	6.0	13.5	1.70
	Medium	11.7	184.7	67.2	1074	8.2	5.7	14.0	1.70
	Low	11.6	177.7	65.2	1038	8.0	5.8	14.2	2.00
	Average	11.6	178.3	65.7	1060	8.1	5.8	13.9	1.80
Summer	High	12.7	199.3	45.5	828	8.1	6.5	14.0	2.78
	Medium	12.9	206.3	42.7	791	8.3	6.4	13.3	2.47
	Low	12.5	205.7	51.7	760	7.9	5.6	13.3	2.57
	Average	12.7	203.8	46.6	793	8.1	6.1	13.6	2.61
Fall	High	13.6	206.8	46.5	720	8.4	6.7	12.9	2.45
	Medium	14.0	209.3	40.7	645	8.4	6.1	13.1	2.63
	Low	13.7	216.3	45.5	672	8.3	6.5	12.5	3.13
	Average	13.8	210.8	44.2	679	8.4	6.4	12.8	2.74
All seasons	High	12.6	192.9	52.2*	872	8.2	6.4	13.5	2.31
	Medium	12.9	200.1	50.2*	837	8.3	6.0	13.5	2.27
	Low	12.6	199.9	54.1*	823	8.1	6.0	13.3	2.57

*Values differ from each other at 0.05 level.

cows averaged 785 lb. Thereafter, weights increased steadily, reaching 864 lb in 1963. Probably these gains were partly attributable to advancing ages, as cows generally add weight until about 8 years old and then decline slightly (Brinks et al., 1962). Additional factors were apparently involved, however, because average age was estimated at 10 to 11 years when the trial terminated. Low calving percentages possibly contributed to high weights in 1963.

Cow Blood Values.—Hemoglobin and hematocrit values were unaffected by rate of supplementation. Average hemoglobin values for all treatments (Table 3) slightly exceeded the 12.4-gm/100 ml level reported by McDonald et al. (1956) for normal 800-lb heifers. Therefore, the low treatment was judged adequate to maintain normal hemoglobin content.

Speth et al. (1962) reported that protein-supplemented cows grazing Nevada range showed consistently higher hemoglobin values than controls or those receiving barley supplements. Amount of protein fed was considerably less than in the present study.

Plasma iron was not significantly affected by treatment. Protein content of plasma was remarkably uniform, varying only 0.2 percentage point among treatments. These findings, together with that of adequate hemoglobin levels among all treatments, indicated that neither iron metabolism nor level of blood protein was influenced by plane of protein intake.

Although herds in the previous trial consumed 29 lb of bonemeal per cow-year (Duvall and Whitaker, 1963), their phosphorus requirements apparently were not completely satisfied. Symptoms of aphosphorosis—"creepy" gait, depraved appetite, and loss of weight — were observed during spring and summer in several cows that were nursing calves born in November or December. Black et al. (1949) reported low levels of blood phosphorus in lactating cows receiving bonemeal from self-feeders on Texas range.

In the present study, phosphorus added to the diet by cottonseed cake did not affect levels of plasma phosphorus. Treatment averages consistently exceeded the satisfactory level of 4 mg/100 ml (Speth et al., 1962), but numerous individual samples contained less than 3 mg/100 ml, irrespective of supplemental feeding. Shortly after calves were weaned in 1959, 2 cows receiving the low treatment developed symptoms typical of aphosphorosis. Both began recovering after receiving 2 lb of cottonseed cake per head daily for 2 weeks.

Range forage provided ample calcium and magnesium (Duncan and Epps, 1958), and the bonemeal and cottonseed cake eaten added substantially to the supply. Plasma levels of both elements were unaffected by treatment. McCance et al. (1942) suggested that plane of protein nutrition may influence absorption, but if such an effect developed it was apparently masked by the large quantities of calcium and magnesium consumed.

Plasma vitamin A was affected by treatment, but plasma carotene was not. Cows fed the low ration of cottonseed cake were highest in vitamin A. They averaged 54.1 mcg/100 ml of plasma, as compared to 52.2 and 50.2 mcg/100 ml for the high and medium rations. These differences were significant. Cows on the medium ration, though lower in plasma vitamin A than the others, averaged substantially higher than the minimum requirement of 18 mcg/100 ml (Madsen and Davis, 1949).

Comparatively high level of plasma vitamin A in cows receiving the low ration corresponds with results of 2 experiments on Nevada ranges. Bohman et al. (1961) reported that, at the end of the winter supplementation period, plasma vitamin A in weanling Hereford calves was lower among those receiving high protein feeds than among those fed grain. Speth et al. (1962) described similar responses in cows. In view of these findings, the relationship between cows fed medium and high rations is not clear. High-treatment cows consumed substantially more protein than the medium, but had higher vitamin A content.

Overall differences among seasons were not significant for any blood component evaluated. Partitioning sums of squares for seasons showed, however, that spring levels of hemoglobin and carotene tended to exceed those of summer and fall. Range studies conducted elsewhere provided a basis for expecting these relationships. Speth et al. (1962) noted that hemoglobin increased when succulent new forage became available. Pope et al. (1961) reported that carotene and vitamin A in plasma were directly related to carotene content of grass, which increased rapidly by late April or May on Oklahome range; also, after carotene in forage began increasing, plasma carotene increased faster than plasma vitamin A. The latter may explain the tendency, on Louisiana range, for the April level of plasma carotene to exceed that of summer fall, while plasma vitamin A remained about constant. Plasma vitamin A possibly increased after April, but declined before the summer sampling period.

Summary

Responses of beef breeding herds to protein supplementation were studied in a 5-year experiment on forest range in Louisiana. Treatments consisted of feeding cottonseed cake (41% crude protein) at 3 rates per cow-year: high—555 lb, fed yearlong; medium—432 lb, fed between October 1 and May 31; and low—312 lb, fed between November 1 and March 31. Daily allowances ranged from 0.5 to 3.0 lb/cow.

Calf crop, weaning weight, calving date, and market price of calves were unaffected by treatment. High-treatment cows averaged significantly heavier than those receiving medium or low rations. Cow weights were greatest in November, lowest in April. Among 8 components of cow blood evaluated in spring, summer, and fall during the initial 3 years, only plasma vitamin A was significantly affected by treatment. Plasma vitamin A for the medium treatment group, though lower than for other groups, exceeded the minimum requirement during all seasons. Hemoglobin and hematocrit values for whole blood and levels of iron, protein, phosphorus, calcium, magnesium, and carotene in plasma were unaffected.

Judged by reproductive performance and levels of blood constituents, the low ration was adequate for cows grazing yearlong on southern forest range.

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