Effect of Protein Delivery Method for Steers Grazing Tobosagrass

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ABSTRACT

The effect of delivery method of protein supplementation on winter weight gain, and subsequent spring performance of steers was determined at the Texas Tech Experimental Ranch, in Garza County, Texas. One of the objectives of this research was to determine if the form of supplementation influences winter gain. We also evaluated protein and mineral intake. Cubes (36% crude protein) and blocks (37% and 20%) were fed during the winter season to cross-bred steers grazing tobosagrass (*Hilaria mutica*) range. Average daily gain (ADG) for the control steers was 0.40 lb/hd/day during the winter while spring gain was 1.54 lb/hd/day. Winter ADG for steers supplemented with cubes (36%) CP was 0.88 lb/hd/day while ADG in spring was similar to the control with 1.50 lb/hd/day. The winter ADG for steers supplemented with blocks were 0.40 and 0.73 lb/head/day, respectively for 37%, and 20% CP blocks, while the spring ADG was 1.42 and 1.75 lb/hd/day, for steers fed with 37%CPB and 20%CPB, respectively. We found no compensatory gain in the spring on tobosagrass rangeland. Heavier steers at the conclusion of winter supplementation remained the heaviest at the end of the spring. Protein blocks were consumed at a relatively low and variable rate during the first four weeks of feeding, increasing later to the target amount. Source of supplementation also affected the mineral intake. The source of supplementation should be determined by desired response coupled with economic and management considerations.

KEYWORDS: Winter supplement, Mineral supplement, Compensatory gain, Beef, cattle, Spring grazing.

Tobosagrass (*Hilaria mutica*) is a major forage species that occurs from the Rolling Red Plains of west-central Texas through New Mexico and Arizona and into south to north-central Mexico (Stubbendieck et al. 1986). Tobosagrass is often associated with mesquite *(Prosopis* spp.) throughout its range. Tobosagrass grows primarily during the spring and summer. Culms that are not grazed or burned off remain alive and most new leaves arise as tillers from buds at elevated internodes. Such tillers are small and do not grow with the vigor of tillers arising from lateral buds at the base of culms near or beneath the soil surface.

Tobosagrass is low in palatability for livestock. Accumulation of old growth from perennial stems tends to discourage grazing. Britton and Steuter (1983) reported rapid declines in crude protein and dry matter digestibility with maturation. Crude protein in

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mature tobosagrass can drop below 5% (Nelson et al., 1970) which is an unacceptable nutritional level (NRC, 1996). During the dormant period in the Rolling Plains of Texas, tobosagrass crude protein was 4.5%, and digestibility 35% (Britton and Pitts, 1988).

Protein is the nutritional component most often deficient on rangelands during the winter. Inadequate dietary protein suppresses forage intake and digestion (McCollum and Galyean, 1985) and reduces the efficiency of metabolizable energy utilization (McCollum and Horn, 1990). Protein supplementation during the dormant season enhances weight gain and production from grazing livestock (Villalobos et al., 1997). Bohman et al. (1961) observed increases in average daily gain and intake for steers wintered on native grass hay supplemented with either cottonseed meal or alfalfa. Smith and Warren (1986) reported weight gain in steers supplemented with cottonseed meal. Supplementation programs depend on the assumption that animals consume a targeted quantity of supplement. One of the main factors that affect supplement intake is the supplement delivery method. The labor cost and frequency of supplementation is of considerable concern to producers. Feeding blocks under range conditions has the potential to reduce labor and equipment costs, but also presents a number of challenges. Some animals consume large amounts of supplements, while others consume very little. In practical herd feeding situations, it is difficult to separate the noncosumers until a potentially irreversible loss in condition or weight has occurred (McCollum and Horn, 1990). When evaluating the efficacy of supplements, an analysis that includes the performance of livestock and supplement refusals must be included (McCollum and Horn, 1990).

Despite extensive research on livestock supplementation, there is relatively little information available on the effects of the presentation or delivery method of protein supplementation on performance, supplement, and mineral intake on tobosagrass dominated rangeland. The objectives of this study were: (1) evaluate the effect of the supplementation forms on steers winter gain; and (2) determine the effect of winter feeding on spring gain, as well as the effect of source of supplementation on mineral intake and monitoring the block intake.

EXPERIMENTAL PROCEDURES

Study Area

Research was conducted at the Texas Tech Experimental Ranch during the dormant and growing season of 1994. The ranch lies on the edge of the Rolling Red Plains in Garza County, 16 miles southeast of Post at a mean elevation of 2400 ft. The area is dominated by clay flat range sites with gently sloping Stamford Clay soils (fine, montmorillonitic, thermic typic Chromusterts) (Richardson et al., 1965).

Perennial vegetation is dominated by tobosagrass with alkali sacaton (*Sporobolus airoides* [Torr.] Torr.) in depressions. Associated species include buffalograss (*Buchloe dactyloides* Nutt.) and plains pricklypear (*Opuntia polycantha*), with an overstory of honey mesquite (*Prosopis glandulosa* var. *glandulosa* Torr.).

The climate is warm and temperate; temperature ranges from a daily minimum of 27°F in January to a daily maximum temperature of 95°F in July. Periods of drought are frequent. Approximately 50% of the annual precipitation (19 inches) occurs from April through July (Richardson et al., 1965).

Response of steers grazing dormant tobosagrass to winter protein supplementation was evaluated using 159 crossbred *Bos taurus* x *Bos indicus* steers with a mean initial live weight of 365 lb/hd. Steers were randomly allocated to each of 4 treatments. Treatments were control (CON); 37% crude protein blocks (37 CPB), 20% crude protein blocks (20 CPB), and 36% crude protein cubes (36 CPC) (Table 1). Cubes (36 CP) were fed three times a week at a rate of 2 lb/steer/day. The target intake of the block with 37% CP was 2 lb/steer/day and 4 lb/steer/day from blocks with 20% CP.

Table 1. Nutritional composition of supplements and minerals (% dry matter basis)

ITEM	20% Block[1]	37% Block[2]	36 Cubes[3]	Mineral Block
Crude protein	20.0	37.0	36.0	
Total digestible nutrients	65.0	59.0	74.8	
Fiber	9.0	8.0	12.0	
Calcium	1.0	1.0	0.9	11.5
Phosphorous	1.2	1.3	1.3	7.5
Salt	12.5	13.5	0.0	42.0
Potassium	1.2	1.2	1.6	0.0
Magnesium	0.3	0.3	0.4	0.5
Sulfur	0.2	0.3	0.4	0.0

1 = 20% (Natural)
2 = 37% (22.5% natural, 14.5% from urea)
3 = 36% (1% from urea)

On their arrival, steers were held in a small pasture of dormant old world bluestem. Cattle were watched closely for signs of sickness and were given the supplement. Steers were moved to the tobosagrass study site after 2 weeks.

Stocking rate for each pasture was based on standing crop at the start of grazing trial and estimated yield for the current year assuming removal of 50% of available forage. Forage yield was estimated by randomly clipping 10, 0.25 m^2 quadrants in each pasture at the end of the growing season. An attempt was made to maintain similar forage allowances in all pastures. Pasture areas were 235, 223, 167, and 204 acres.

Supplementation began on, 11 January, 1994, and continued until 4 April 1994. Individual steer weights were recorded at the beginning of the supplementation, on 11 January, at the end of the supplementation on 5 April, and letter on 7 July 1994. Live weights were obtained following an overnight period without water and feed. Mineral and protein blocks were weighed weekly to determine intake. We allowed 1 block of mineral and protein for every 3 to 4 steers.

Gain, mineral, and block intake were analyzed as a completely randomized (CRD) design. Least Significant Different (LSD) at 0.05 significance level was used for mean comparison. The use of animals as experimental units provided a conservative analysis because the animals were group-fed rather than individually fed. Group-feeding results in greater variation among animals within treatments as a result of uncontrolled and varied feed consumption by individuals. Hence, any significant differences observed among treatments are valid. A potential weakness of the analysis is the inability to discern smaller differences that would have been statistically significant with controlled, individual feeding (Pitts et al. 1992).

RESULTS AND DISCUSSION

Average daily gain (ADG) during winter was different (P=0.05) between sources of supplementation (Fig. 1). Steers on the 36CPC and 20CPB treatments had a similar (P=0.05) gain; ADG of these animals was greater (P=0.05) than gain of animals in CON and 37CPB groups. During the winter, groups on 37CPB and CON gained the least with an ADG of 0.40 and 0.58 lb/hd/day, respectively.

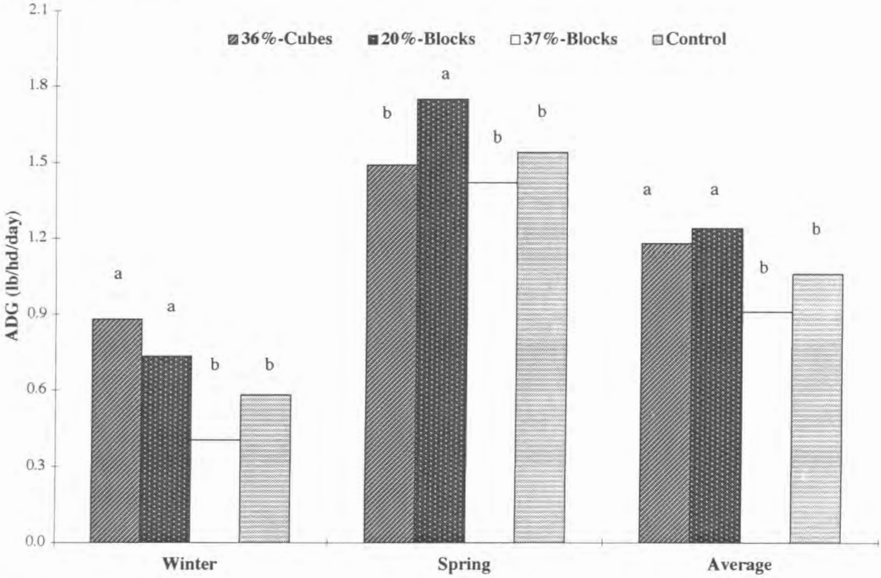

Figure 1. Average daily gain (ADG) of steers fed 4 sources of protein supplementation while grazing dormant tobosagrass. Means followed by the same letters are not significantly different (P=0.05).

During the spring season, ADG was higher for steers that were fed 20CPB during the winter (P=0.05) (Fig. 1). ADG was similar for steers on 37CPB, 36CPC and control, respectively. In this case, the winter weight differences were minimized but maintained at the end of the grazing season. The total gain (winter+spring) was different (P=0.05) among treatments (Fig. 1). The steers that were heaviest after winter, remained heaviest at the end of the spring; however, the weight margins varied. At the end of the grazing season, the steers that were in the 20CPB group gained 86.0 and 26.0 lb/hd more (P=0.05) than those that were in the 37CPB and CON treatments, respectively. In contrast, at the end of spring, steers in the 36CPC gained 81.0 and 21.0 lb/hd more (P=0.05) than those that were in the 37CPB and CON groups. This indicates that no compensatory gain was shown for this kind of vegetation. Usually spring gains are more closely related to rainfall quantity and distribution (Villalobos et al., 1997). In this year spring rainfall was below the long term average, and was well distributed during the winter months (Fig. 4).

The primary objective of this research was to determine if supplementation source influences spring gain. We found no compensatory gain in the spring on tobosagrass rangeland. Heavier steers at the conclusion of winter supplementation remained the heaviest at the end of the spring. Our results agree with (Villalobos et al., 1997), here no differences in compensatory gain was observed using different levels of cottonseed cubes.

Supplement Intake

Cubes were hand-fed, allowing close control of supplement allowance. Steers required about 30 minutes to consume their portion of supplement per day. No refusals on the cube consumption were observed. In contrast, both types of protein blocks were consumed at relatively low and variable rates during the first four weeks of feeding (Fig. 2). As a result, crude protein intake from the 20CPB averaged only 0.42 lb/hd, less than 48% of the target amount, and 46% less protein than from 36CPB. Steers on 37CPB treatment had an average of 0.55 lb/hd/day of protein, 26% less intake than the amount targeted, and 24% less than steers fed with cubes. Livestock exposed to new feeds often exhibit neophobia, or a cautious sampling or rejection of the feed that is not related to palatability (Launchbaugh, 1995). Neophobia is characterized by a period of low feed intake, followed by increased consumption leading to a relatively stable level of intake. The neophobic eating pattern exhibited by feedlot cattle lasts less than 2 weeks (Hicks et al., 1990). In our study, even if blocks were fed two weeks before the initial weight was taken, livestock showed this neophobic effect and the level of supplement consumption was below target levels. Acceptance of supplements increased substantially after 5 weeks of study (Fig. 2), and intake increased to supplement target. Similar variability in supplement intake has been demonstrated in cows fed traditional supplements (Huston et al., 1987). Langlands and Bowles (1976) found that animals refused to consume liquid supplement offered in roller lick tanks. Langlands and Donald (1978) reported a refusal of molasses-urea supplement in a study using yearling heifers. The variation in supplement consumption for these studies was 40% (Langlands and Bowles, 1976), and 37% (Langlands and Donald 1978) for the supplement target. Coombe and Mulholland (1983) found that mean supplement intake as a percentage of the target supplement intake was 41% for blocks, 76% for molasses-urealiquid, and 80% for molasses. Over the 10-week experimental period, target supplement intake was never achieved with block supplement, whereas target consumption was reached by weeks 4 and 5 for molasses-urea liquid supplements. Our results agree with these findings. Steers on the 20% blocks consumed 52% below the target consumption during the first 4-week, and with the 37% block consumed 74% of the target amount.

Blocks can be classified as self-fed supplement which theoretically should increase an animal's opportunity to consume the supplement. Conversely, cubes are hand-fed, which allows close control of supplement allowance. Therefore, cubes and blocks may differ in two characteristics that can affect the efficiency of the supplementation program. First, steers can eat cubes faster than blocks. Therefore, animals supplemented with cubes may require less time to consume their portion of supplement per day and may have more time available to graze. Second, cubes are usually fed on the ground, 2 to 3 times a week. The distribution of the cubes over a large area allows both dominant and subordinate animals to have simultaneous access to the feed and to obtain their allowance of supplement. Dominant animals may prevent subordinate animals from gaining access to the blocks, reducing the efficiency of the supplement. If the consumption of supplement occupies a significant part of the time available for grazing, it may conflict with utilization of the forage available. If competition between animals for access to the blocks is intense, steers may waste grazing time trying to obtain the supplement that is monopolized by dominant animals. We observed this phenomenon with the block treatments. Because cubes allow a high intake rate, most of the feed given at each feeding event is consumed. In this case, supplementation does not interfere with grazing activities. The final result, in terms of weight gain per head and profit will depend on the supplement cost and labor to deliver the supplement.

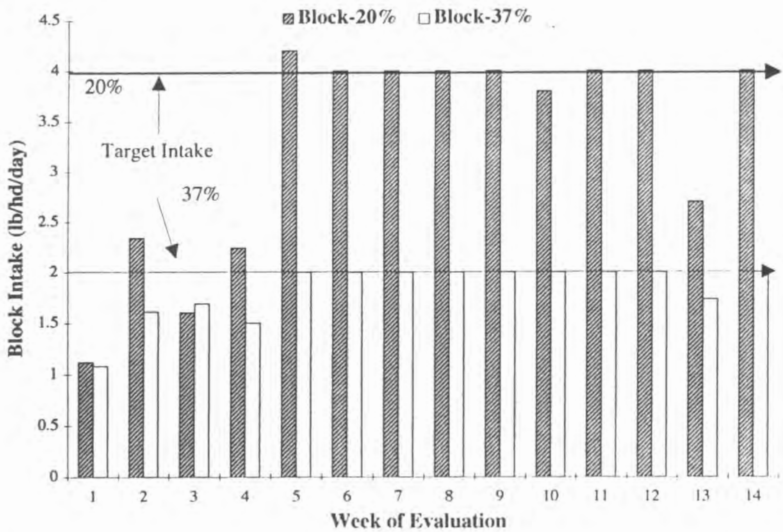

Figure 2. Total protein block intake (lb/hd/day) of steers fed 2 sources of protein while grazing tobosagrass range.

Mineral Intake

Mineral intake for all treatments decreased from the beginning of supplementation, and increased as soon as supplementation was stopped during April (Fig. 3). At each month of evaluation, steers in the CON group had a higher ($P<0.05$) mineral intake than other treatments (Fig 3). Control steers had the highest ($P<0.05$) mineral intake with an average of 0.21 lb/hd/day, followed by steers on the 36% cubes (Fig. 3). The lowest ($P<0.05$) intake was detected for the steers fed 37% blocks. During March, similar to February, intake was higher ($P<0.05$) for the control and steers fed with 36% cubes. Mineral intake was lowest for the three feeding treatment in April. During May, the control group and steers fed with cubes had a higher ($P<0.05$) mineral intake than the other groups. The last month of evaluation intake was similar for the three groups that were under feeding conditions and control steers had the highest intake with an average of 0.07 lb/hd/day.

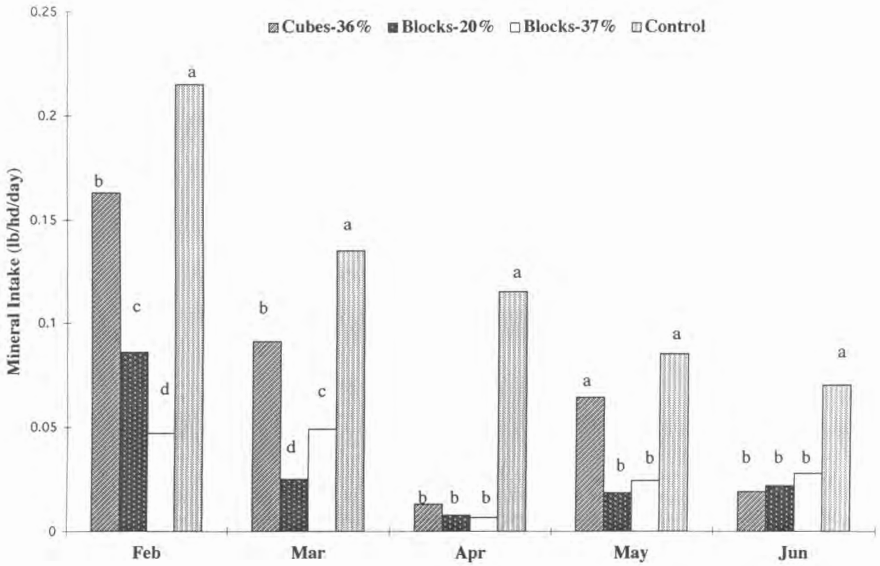

Figure 3. Total mineral intake (lb/head/day) of steers fed 4 sources of protein supplementation while grazing dormant and spring season on a tobosagrass range. Means followed by the same letters are not significantly different (P=0.05).

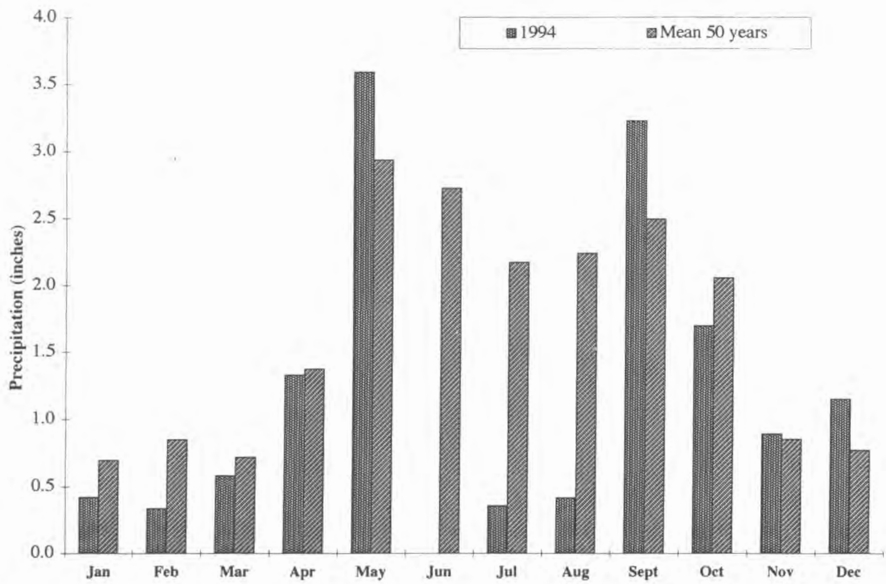

Figure 4. Precipitation at the Texas Tech Experimental Ranch during 1994 and long term average. Average precipitation is taken from the Garza County Soil Survey.

A great deal of variation exists in the consumption of blocks for protein and mineral supplementation. High levels of competition for blocks generally increases the proportion of non-feeders, whereas low levels of competition occur with cubes. Supplement delivery method has the potential to alter competition, reduce the time of consumption of supplement and possibly to improve the effectiveness of a supplement program.

Results indicate that protein supplementation is beneficial to steers grazing tobosagrass rangelands during the winter. Consequently, steers with greater weights during winter remained heavier in spring. The source of supplementation should be determined by expected response coupled with economic and management considerations.

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