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EFFICACY OF A SELF-FED SMALL SUPPLEMENT FOR PREPARTUM COWS GRAZING DORMANT PINON-JUNIPER RANGELAND

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ABSTRACT: A 3-yr study was conducted at the Corona Range and Livestock Research Center, NM to evaluate efficacy of small amounts of a self-fed protein-mineral supplement for BW and body condition score (**BCS**) maintenance in prepartum Angus and Angus-cross cows grazing dormant pinon-juniper/blue grama range. Cows were supplemented with 1) a 36% CP supplement (**CON**) composed mostly of oilseed meals fed 3 times/wk; 2) a supplement comprised of 25% feather meal, 25% blood meal, 27% minerals, 19% salt and 4% distillers dried grains (40% CP, **SMP**), or 3) manager fed cows CON at discretion (**VAR**) based on perceived environmental stress. This treatment (VAR) functioned as a negative control. Supplementation periods were 27 d (yr 1), 62 d (yr 2) or 93 d (yr 3). Across years, mean supplement consumption was 0.63, 0.23, and 0.04 kg/d for CON, SMP, and VAR. Supplementation occurred in November, December, and/or January and terminated two weeks prior to initiation of calving. Year impacted BW and BCS measures (P < 0.01), but no treatment X year interactions were noted (P > 0.33). Feeding CON or SMP had minimal impact on BW change (0.5 kg and 2.1 kg respectively), while cows fed VAR lost (-12.3kg) BW (SE ± 3.9, P = .06). Initial BCS of cows was similar among treatments (5.0, 4.9, and 5.0 ± 0.1 for CON, SMP, and VAR). Feeding CON or SMP resulted in minimal changes in BCS (-0.1 score) while VAR treated cows lost 0.4 BCS score (P = 0.10). Mean feed costs ($/cow) were 10.08, 4.70, and 0.60 for CON, SMP and VAR. In this study, cows required supplemental nutrients to maintain BW and BCS, and SMP was utilized most efficiently for this purpose. Relative to VAR, SMP efficiency was 1.1 (weight difference:consumption) while CON efficiency was 0.3. Improved efficiency resulted in substantial reductions in the cost of cow maintenance.

Key Words: beef cows, prepartum, supplementation

Introduction

Previous studies have demonstrated that low amounts of supplemental protein, particularly sources high in undegraded intake protein (**UIP**), may enhance the efficiency of nitrogen utilization (Sawyer et al., 1998; Coomer et al., 1993). Additionally, nutrient restriction increases the efficiency of nitrogen utilization in cows (Freetly and Nienaber, 1998). The use of a supplement based on small quantities of high UIP ingredients combined with salt and minerals was demonstrated to maintain ruminal function with low quality forage diets (Sawyer et al., 2000) and this same supplement exhibited controlled and consistent consumption patterns by cows grazing desert range (Stalker et al., 2002). The objective of this study was to field validate these previous findings by evaluating the efficacy of a small package size, self-fed protein supplement for maintaining body weight and body condition score (**BCS**) of gestating cows grazing dormant rangeland forage.

Materials and Methods

This study was conducted over a three-year period at New Mexico State University's Corona Range and Livestock Research Center, 12 km east of Corona, NM. Elevation at the study site is 1900 m. Annual precipitation averages 400 mm, with approximately 70% of annual precipitation occurring from May to October. Rangeland at his site is characterized as a pinon-juniper woodland, with a moderate to dense overstory of one-seed juniper (*Juniperus monosperma*) and pinon pine (*Pinus edulus*). Herbaceous vegetation is predominately blue grama (*Bouteloua gracilis*) with minor components of wolftail (*Lycurus phleoides*), sideoats grama (*Bouteloua curtipendula*), threeawn (*Aristida spp.*), sand dropseed (*Sporobulus cryptandrus*), and black grama (*Bouteloua eriopoda*) as described by Knox (1998).

Each year, gestating Angus and Angus-cross cows ranging from 2.5 to 8.5 years old were utilized in this study. Cows were stratified by breed and weight at weaning and randomly assigned to one of six replications or sub-herds, such that sub-herds contained the same proportion of Angus and crossbred cows. Each sub-herd was then randomly assigned to one of six pastures containing at least 260 ha. Treatments were then randomly assigned to each pasture, resulting in 2 sub-herd replications/treatment within each of the three years.

Treatments were supplementation strategies designed to be reflective of commonly applied practices, rather than as fixed protocols. Reflecting this approach, and due to variation in annual forage conditions and grazing constraints, the duration of the supplementation period varied by yr. In yr 1, supplements were fed for 27 d; in yr 2, 62 d, and in yr 3, 93 d. In all yrs, strategies were designed so that supplementation ended 2 wks prior to the expected initiation of parturition in the herd based on breeding season dates. Under management conditions in this study, the prepartum supplementation period ended the first wk in February each year.

A positive control strategy (**CON**) was developed based on a hand-fed, 36% CP pellet. Under this strategy, supplement was delivered to cows 3 times weekly. This strategy reflects common practice when prepartum supplementation is applied in this region. The CON supplement was composed of 57 % cottonseed meal, 10% soybean meal, 1.2 % urea , 21% wheat middlings, 9% molasses and fortified with trace minerals and Vitamin A. The CON supplement was priced at $26.46/100 kg ($240/ton). Consistent with the annual variation in forage conditions, the feeding rate for CON varied by year. When prorated to a per day feeding rate, CON was supplied at 953 g/d (Year 1), 757 g/d (Year 2), or 454 g/d (Year 3). Cows receiving CON had ad libitum access to a salt-mineral supplement.

A negative control strategy was also developed. This strategy allowed for brief and intermittent supplementation due to periods of environmental stress, such as snow cover, and is best described as variable supplementation (**VAR**). This strategy relied on managerial discretion to supply feed when required, but with the directive to minimize usage of supplemental feed. The VAR strategy utilized the same supplement formulation at the same cost as CON, and when supplied, was always fed twice weekly, prorated to 454 g/d. Cows receiving VAR were fed for the equivalent of 9.5 d in yr 1, 8 d in yr 2, and 0 d in yr 3. The very low amount of supplement input with this strategy allows it to be considered a negative control. Cows receiving VAR had ad libitum access to a salt-mineral supplement.

To meet experimental objectives, a strategy utilizing a small package size, self-fed supplement (**SMP**) was developed based on previous findings (Sawyer et al., 2000; Stalker et al., 2002). This supplement was formulated to contain 40% CP and was composed of 25% feather meal, 25% blood meal, 27% minerals, 19% salt and 4% distillers dried grains. The mineral portion of the SMP supplement was designed to provide the same level of mineral intake as the ad libitum supplement supplied to cows receiving CON and VAR treatments. The SMP supplement was priced at $35.69/100 kg ($323.75/ton). Target intake rate of this supplement was 200 g/d. Cows actually consumed 281 g/d of supplement in yr 1, 172 g/d in yr 2, and 249 g/d in yr 3. The mean intake across years for SMP (weighted by duration of supplementation period) was 230 g/d. For clarity, feeding rate, duration of supplemental feeding periods, and total consumption are shown for each supplementation strategy by year in Table 1.

Cows were weighed and body condition scores (BCS) were assigned on a 1-9 scale (1 = emaciated, 9 = obese) at weaning (October) of each year, at the initiation of the supplementation period (January, December, and November for years 1, 2 and 3, respectively), and at termination of the supplementation period (February). Feed deliveries were recorded and feed remaining (SMP) was recorded for each strategy to validate consumption rates.

Response data were analyzed as a completely randomized design with a 3 X 3 factorial treatment arrangement using General Linear Models procedures of SAS v.9 (SAS Institute, Cary, NC, USA). Year and supplementation strategy served as factors in the model. Treatments were applied per pasture, and therefore pasture was used as the experimental unit for all responses. Responses are expressed on a per cow basis for clarity. When model effects were significant ($P < 0.10$), means were separated using Fisher's Least Significant Difference.

Table 1. Feeding rate, duration of the supplementation period, and total amount of supplement fed to cows receiving different supplemental feeds during three years.

Item	CON	SMP	VAR
Year 1			
Rate, g/d	953	281	454
Duration, d	27	27	9.5
Total fed, kg	25.7	7.6	4.3
Year 2			
Rate, g/d	757	172	454
Duration, d	62	62	8
Total fed, kg	46.9	10.7	3.6
Year 3			
Rate, g/d	454	249	0
Duration, d	93	93	0
Total fed, kg	42.2	23.2	0

Results and Discussion

No significant year by supplementation strategy interactions were observed. The lack of interactions indicates that despite variation in duration and rate of supplementation among years, cows responded to these strategies consistently across years. Additionally, the lack of interaction indicates that any differential responses due to annual variation in feeding rate or supplementation duration would be wholly explained by main effect terms.

Year had significant impacts on measured responses (Table 2). Yearly differences in BW recovery from weaning to initiation of supplementation justify the variation in annual strategies. In years 1 and 2, cows gained weight from weaning until the initiation of supplementation, indicating that supplemental nutrients were not required during that time. In year 3, cows apparently lost weight from weaning to the initiation of supplementation, justifying the earlier intervention and longer duration of supplemental treatments during that year. Additionally, when pooled across supplementation strategies, cows either maintained (years 1 and 3) or lost BW (year 2) during the supplementation period. This indicates that cow nutrient requirements were not being met by forage alone, and again, that the timing of intervention was appropriate within each year. Differences in BW at the beginning of supplementation (initial BW) among years are reflected in cow body condition score at the beginning of the supplementation period.

While not a primary objective of this experiment, the observations derived from year effects regarding the suitability of supplementation strategies is potentially important. Whitson et al. (1982) clearly demonstrated that the use of protein supplements increases the financial stability of range cow-calf operations. However, purchased feed inputs are among the highest variable costs incurred by such operations, and are related to ranch profitability

(McGrann et al., 2004). The results of this study suggests that strategic implementation of supplemental feeding can successfully resolve these apparently conflicting effects. Strategic application of supplements in accordance with forage conditions and availability, rather than by calendar date, successfully mitigated BW loss. Mitigation of BW loss should reduce production variability and thus increase operational stability, and achieving this goal with minimum inputs optimizes the variable cost function.

Table 2. Year effects on measures of cow body weight and condition score.

Item	Yr 1	Yr 2	Yr 3	SE[a]	P
Body Weight Responses					
Wean BW, kg[b]	442[e]	486[f]	542[g]	17	<0.01
Initial BW, kg[c]	474[h]	573[i]	530[j]	14	<0.01
Final BW, kg	472[h]	558[i]	536[i]	14	<0.01
Change[d], kg	-2.2[h]	-15.1[i]	6.3[h]	3.9	0.01
Change, %	-0.4[e]	-2.5[f]	1.4[e]	0.8	0.02
Body Condition Responses					
Initial BCS	4.4[h]	5.4[i]	5.0[j]	0.1	<0.01
Final BCS	4.3[h]	5.4[i]	4.7[j]	0.1	<0.01
BCS change	-0.2[e]	0.0[f,h]	-0.4[g,i]	0.1	0.01

[a]n = 6
[b]Cow weight at weaning in October
[c]Cow weight at initiation of supplementation period
[d]Cow weight change (Final – Initial)
[e,f,g] Means differ, P < 0.10
[h,i,j] Means differ, P < 0.05

Table 3 depicts the effects of different supplementation strategies on cow responses across years. Cows assigned to different strategies had similar BW at weaning (P = 0.98), and gained weight from weaning until the beginning of supplementation, so that BW at the initiation of supplementation was also similar among treatments (P = 0.78). Supplementation strategy influenced weight change during the supplementation period whether expressed as absolute weight change (P = 0.06) or as a percentage of initial BW (P = 0.09). Cows receiving CON or SMP exhibited similar BW changes, neither of which were different from zero, essentially reflecting BW maintenance. Cows receiving VAR lost BW during the supplementation period. These results indicate that nutrient limitations existed during this period, and that these deficiencies were corrected by provision of either CON or SMP. Weight changes are reflected in BCS changes. Supplements affected BCS change (P = 0.10), with cows receiving CON or SMP exhibiting minimal BCS reduction during the supplementation period, while cows receiving VAR lost condition.

It is well established that BCS at parturition is related to the duration of the postpartum interval and to conception rate in beef cows (Houghton et al., 1990). In this study, cows entered the supplementation period in moderate body condition, a level that has been suggested to maintain adequate reproductive performance.. Additionally, it has been demonstrated that cows that are on a negative plane of nutrition as they approach parturition have reduced reproductive success compared to those at maintenance or on increasing planes of nutrition, even when initial BCS is similar (Selk et al., 1988; Wiltbank et al., 1962). If mitigation of BW and condition loss prepartum reduces the risk of production failures, then strategic supplements would be effective at minimizing this form of production risk.

Table 3. Body weight and body condition responses of gestating cows to different supplementation strategies.

Item	CON	SMP	VAR	SE[a]	P
Body Weight Responses					
Wean BW, kg[b]	488	492	490	17	0.98
Initial BW, kg[c]	522	521	534	14	0.78
Final BW, kg	522	523	521	14	0.99
Change[d], kg	-0.2[e]	1.8[e]	-12.6[f]	3.9	0.06
Change, %	0.1[e]	0.5[e]	-2.2[f]	0.8	0.09
Body Condition Responses					
Initial BCS	5.0	4.9	5.0	0.1	0.49
Final BCS	4.9[e]	4.9[e]	4.6[f]	0.1	0.12
BCS change	-0.1[e]	-0.1[e]	-0.4[f]	0.1	0.10
Total Feed Consumed, kg	38.2	13.7	2.6	--	--

[a]n = 6
[b]Cow weight at weaning in October
[c]Cow weight at initiation of supplementation period
[d]Cow weight change (Final – Initial)
[e,f,g] Means differ, P < 0.10

In this study, both CON and SMP were effective at maintaining cow BW and condition during late gestation. However, the supplements were used with different efficiencies. Efficiency of supplement utilization can be expressed as the difference in BW change between supplemented and unsupplemented groups (i.e., relative to VAR) per unit of supplement fed. Using this calculation, CON was used with an efficiency of 0.32 kg BW spared/kg supplement fed. SMP supplement was used with an efficiency of 1.05 kg BW spared/kg supplement consumed, a 228% increase in apparent utilization efficiency. Efficiency of these supplements can also be evaluated on the basis of quantity of CP consumed, rather than quantity of total supplement, to accommodate differences in supplement composition. On a CP basis, CON spared 0.90 kg BW/kg CP supplied; SMP spared 2.63 kg BW/kg CP supplied, a 192% difference.

These enhancements in utilization efficiency are consistent with previous reports. Sawyer et al. (1998) demonstrated that 40 g of CP/d from a blood meal:feather meal combination was as effective at promoting nitrogen retention as 160 g CP from urea or cottonseed meal. When blood meal and feather meal were combined with a salt-mineral mix (Sawyer et al., 2000), ruminal function and microbial CP production were maintained relative to 160 g CP from cottonseed meal alone, resulting in higher apparent utilization efficiency with the small package supplement. These efficiency enhancements may be a result of improved N recycling (Coomer et al., 1993), increased ruminal N scavenging (Russell and Strobel, 1987), or increased efficiency of whole body N metabolism due to nutrient restriction (Freetly and Nienaber, 1998). Regardless of the mechanism, the results of this study demonstrate a greater utilization efficiency for the small-package supplementation strategy.

Increased utilization efficiency resulted in decreased feed costs of maintenance for cows fed SMP relative to CON despite higher per unit feed costs for SMP. Applying the unit feed costs for CON, SMP and VAR to the total consumption pooled across years results in per cow costs of $10.08, $4.70, or $0.60/cow, respectively. Because cows receiving VAR failed to maintain BW, SMP was the most economical strategy for BW maintenance in this study. This cost comparison does not include additional charges for labor and equipment that might be associated with any of the feeding strategies employed. Conceivably, application of these charges would further separate CON and SMP.

Implications

Strategic supplementation was effective for maintenance of BW and BCS in prepartum gestating cows. Use of a self-fed, small package supplement was equally effective as use of a traditional hand-fed, oilseed-based supplement. The small package supplement was used with higher efficiency and was more cost effective. Although either supplement might serve to mitigate production risk through reduced weight and condition losses, the small-package supplement was more efficacious at optimizing the cost of risk reduction.

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