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EVALUATION OF GRAZING OR REDUCED FEEDING FREQUENCY SUPPLEMENTATION SYSTEMS FOR WINTERING COW-CALF PAIRS

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ABSTRACT

In a 2-yr study, grazing and reduced feeding frequency winter nutritional management systems for cow-calf pairs were evaluated in Shorter, Alabama. Diet treatments included (i) rotational grazing (RG) of a winter-annual mixture of oat (*Avena sativa* L.), ryegrass (*Lolium multiflorum* Lam.), and crimson clover (*Trifolium incarnatum* L.), (ii) 50:50 soyhull/corn gluten feed pellets, fed every other day at 1% BW per day, plus free-choice bermudagrass hay (reduced frequency – RF), and (iii) free-choice (FC) whole cottonseed and bermudagrass hay. Objectives of this study were to evaluate the effects of winter diet on cow body condition score (BCS) and performance, and compare economic inputs for each nutritional management system. Cow BCS was greater for RG; calf ADG was not different among diets. Treatment RG was more digestible and had greater crude protein concentration than other diet treatments. Treatment RG was the costliest nutritional management system and would require additional calendar grazing days (>104 total grazing days) to decrease costs relative to the other feeding options evaluated in this study.

INTRODUCTION

Beef cattle production is a major enterprise in Alabama, and grazed forages comprise the basis for beef cattle nutrition programs in the Southeast. Cattle producers typically feed hay and supplemental feedstuffs for 90 to 120 days to maintain cows during the winter when fresh forages may not be available for grazing (Prevatt et al., 2018). Relying on conserved forage resources and supplemental feeds can increase production input costs including feed costs and labor needs. Alternative management systems could provide grazing or reduced labor options during this time of year to offset those costs (Beaty et al., 1994; Mullenix and Rouquette, 2018).

Winter annual mixtures containing small grains, annual ryegrass (*Lolium multiflorum* Lam.), and annual clovers (*Trifolium sp.)* may provide more early-season forage availability compared to ryegrass alone, reducing the need for supplementation during this time period (Gunter et al., 2002; Mullenix and Rouquette, 2018). Other feeding strategies that may decrease labor needs for the winter months may include feeding free-choice byproducts or bulk feeding, which reduce the need for daily hand-feeding supplemental feedstuffs. Whole cottonseed is a high-energy cotton byproduct that is easily accessible in the Southeast and can be an economical way to supplement beef cattle (Jacobs and Mullenix, 2019). Mixtures of pelleted soy hulls and corn gluten feed are also commonly used in the Southeast and are a readily accessible feed resource in most parts of Alabama. This combination of byproducts is low in nonstructural carbohydrates and high in digestible fiber and ruminally degradable protein, allowing it to be fed less frequently without negative effects on digestion (Drewnoski et al., 2011). Previous studies have reported that steer performance does not differ when feeding this mixture at 2% of body weight (BW) every other day as opposed to 1% of BW daily (Drewnoski et al., 2011).

The three nutritional management strategies evaluated in this study are commonly asked about and utilized by Alabama cattle producers in the winter months. Objectives of this study were to evaluate the effects of winter diet on cow body condition score (BCS) and calf performance, and compare the economic inputs for each nutritional management system.

METHODS

All procedures and experimental protocols were approved by the Auburn University Institutional Animal Care and Use Committee (Protocol No. 2017-3193).

RESEARCH SITE AND EXPERIMENTAL DESIGN

A 2-year experiment was conducted during the 2017 – 2019 growing seasons at the E.V. Smith Research Center in Shorter, AL (32°26'31.3"N latitude, 85°53'51.1"W longitude). During the fall, nine 5-ac paddocks were assigned one of three nutritional management treatments with three replications per treatment in a completely randomized design. Treatments included rotationally grazed winter annuals (diet RG), reduced frequency feeding of a pelleted 50%

soybean hulls and 50% corn gluten feed mixture (SH:CGF) plus *ad libitum* hay (diet RF), and free-choice supplementation of whole cottonseed (WCS) plus *ad libitum* hay (diet FC).

FORAGE ESTABLISHMENT FOR RG DIET

For RG paddocks, 'RAM' oat (*Avena sativa* L.) was planted at 90 lb/ac using a no-till drill, and 30 lb/ac 'Dixie' crimson clover (*Trifolium incarnatum* L.) and 20 lb/ac 'Marshall' ryegrass (*Lolium multiflorum* Lam.) were broadcast in three 5-ac paddocks on Oct 26, 2017 and Oct 23, 2018. On Feb 2, 2018, 100 lb N/ac was applied using 17-17-17 fertilizer. During seedbed preparation in 2018, 17-17-17 fertilizer was applied at 350 lb/ac for a rate of 59 lb N/ac. An additional 41 lb N/ac was applied on Feb 20, 2019 to achieve the seasonal target 100 lb N/ac. Fertilizer applications were based on conventional best management practices for the region. Paddocks were split into two subplots with temporary electric fencing to facilitate rotational grazing and initially stocked with 3 cow-calf pairs. Cow-calf pairs were rotated between subplots every 14-d during the study, following rotational stocking guidelines for cool-season annuals (Ball et al., 2015). Put-and-take animals (cow-calf pairs) were added or removed as additional grazers every 14-d to manage excess forage to a target height of 10-in. Grazing was initiated on Jan 23, 2018 and Jan 28, 2019. The trial was terminated on Apr 5, 2018 after 73 grazing days in Yr 1 and Apr 23, 2019 after 86 grazing days in Yr 2, when canopy height was less than 4-in and forage mass in RG paddocks could no longer support 3 tester cow-calf pairs.

FEED SUPPLEMENTATION MANAGEMENT

Diets RF and FC were assigned to drylot paddocks which consisted of dormant warm-season annual mixed grass sod. In RF paddocks, cows were provided 50:50 SH:CGF at 1% of their body weight (BW) per day plus free-choice access to 'Tifton 85' bermudagrass (*Cynodon dactylon* (L.) Pers.) hay. The amount of supplement was doubled and fed every other day to reflect a bulk feeding, reduced frequency management scenario. When bulk feed was provided to cattle in this treatment, a total of 28 pounds per head of 50:50 SH:CGF was provided. This practice was chosen to address the feasibility of bulk feeding a commonly used commodity supplement during the winter months and reflects a question that is often received by Extension agents as a way to reduce time spent supplementing beef cattle during the winter. In FC paddocks, WCS and 'Tifton 85' bermudagrass hay were provided free choice for cow-calf pairs. Feed troughs were filled with an average of 220 lb of WCS at every refill which occurred every 3 to 4 days throughout the trial. Cows consumed an average of 9.7 lb/hd/d of WCS. Hay was provided free-choice in both RF and FC treatments. Bales were 4 × 5 ft rolls which were placed in ring feeders every 21 d. Bermudagrass hay averaged 9.6% crude protein (CP) and 50.8% total digestible nutrients (TDN) on a DM basis. Nutrient concentrations of each feedstuff were 17.2% CP and 75.9% TDN and 21.8% CP and 99.4% TDN for 50:50 SH:CGF and WCS on a DM basis, respectively. The length of the feeding period each year matched the length of the grazing season, with 73 and 86 day feeding periods for Yr 1 and Yr 2, respectively.

RESPONSE VARIABLES

FORAGE MASS AND NUTRITIVE VALUE

Forage production of winter annuals was measured using a double-sampling method (Wilm et al., 1944) every 14-d. In RG paddocks, seventy forage heights were recorded from both the pre- and post-graze sides of each 5-ac paddock using a FILIPS rising plate meter (Agriworks, Ltd., Feilding, New Zealand). Five calibration samples were taken from both the pre- and post-graze subplots of 3 paddocks assigned to the RG treatments by recording forage heights and clipping forage from a 1-ft^2 quadrat to a stubble height of approximately 2 in. Samples were placed in cloth bags and transported to Auburn University Ruminant Nutrition laboratory. Samples were oven-dried at 122º F for 48 hr and weighed to determine forage mass. Dried, air-equilibrated samples were ground in a Wiley Mill (Thomas Scientific, Swedesboro, NJ) to pass a 0.04-in screen, and final concentration of dry matter (DM) was determined by oven-drying at 212º F according to procedures of AOAC (1990). Forage concentration of N was determined by the Kjeldahl procedure (AOAC, 1990), from which crude protein (CP) was calculated as N × 6.25. Forage *in vitro* true digestibility (IVTD) was determined according to the Van Soest et al. (1991) modification of the Tilley and Terry (1963) procedure using the DaisyII incubator system (Ankom TechnologyTM, Macedon, NY).

ANIMAL PERFORMANCE

Twenty-seven commercial Angus × Hereford cow-calf pairs were stratified by body weight and randomly assigned to treatments in each year of the study. Three pairs were placed on each paddock (n = 3). After a 7-d adaptation period on their respective treatments, cows and calves were weighed again to obtain an initial BW (mean weights of 1367 ± 112 lb and 223 ± 35 lb for cows and calves, respectively). Every 28-d during the trial, cows and calves were weighed unshrunk, and cows were assigned a body condition score at each weigh date. Average cow body weight and calf ADG were monitored for the duration of the trial.

STATISTICAL ANALYSIS AND ECONOMIC EVALUATION

Winter annual forage mass and nutritive value, supplement nutritive value, cow weight, cow body condition score (BCS), and calf weight and ADG were analyzed using the MIXED procedure in SAS 9.4 (SAS Institute, 1994) for completely randomized design. Independent variables for forage mass, nutritive value, and performance data included date, nutritional management treatment, and date × nutritional management treatment interaction. Pen and year were random variables. Treatment means were separated using the PDIFF option of the LSMEANS procedure (SAS Institute, 1994) and were determined to be significant when $\alpha = 0.05$.

An economic evaluation was completed to determine Total Cost per Pair per Day (TCPD). The evaluation considered seed, fertilizer, and establishment costs for RG, feed and hay costs for RF and FC, and labor costs associated with delivering feed and rotating grazing pairs.

RESULTS AND DISCUSSION

SEASONAL FORAGE MASS AND NUTRITIVE VALUE OF WINTER ANNUALS

Seasonal forage mass, CP, and TDN concentration of RG is presented in Figure 1. Average forage production every 14 d was 1,431 ± 469 lb DM/ac. A study in Arkansas evaluating cow-calf performance on a mixture of wheat (*Triticum aestivum* L.) and annual ryegrass reported slightly greater forage mass monthly averages of 1,595 ± 596 lb/ac during the winter and 1,888 ± 328 lb/ac during the spring (Beck et al., 2016). In the current study, total seasonal forage dry matter availability was 13,093 lb DM/ac on average. Mckee et al. (2017) reported similar seasonal forage availability (14,096 lb DM/ac) in Yr 1 of a grazing study using a small grain, ryegrass, and clover mixture in northern Alabama. The mixture provided 68 and 57 days of grazing, in Yr 1 and Yr 2, respectively, in the study by Mckee et al. (2017). Winter annuals in the current study provided 73 days of grazing in Yr 1 and 86 d in Yr 2. Longer grazing seasons for winter annuals can be expected in the central region of Alabama depending on planting date and efficiency of use. Number of grazing days in the current study may have been increased with an earlier planting date or more intensive grazing management.

Concentration of CP fluctuated in grazed winter annuals ($P = 0.0036$) throughout the season, but never fell below 13% on a DM basis. Total digestible nutrients declined ($P < 0.0001$) throughout the season to no less than 71% on a DM basis. Values of CP and TDN concentration fall within ranges of reported values for cool-season annuals (Ball et al., 2015). Beck et al. (2016) reported 25.0 ± 2.1% CP and 69.8 ± 3.2% TDN for wheat and ryegrass from January through April. Both of these nutritive value parameters indicate that RG provided high amounts of digestible energy throughout the growing season and a diet which meets the requirements of a 1322-lb beef cow of average milking ability (NRC, 2016).

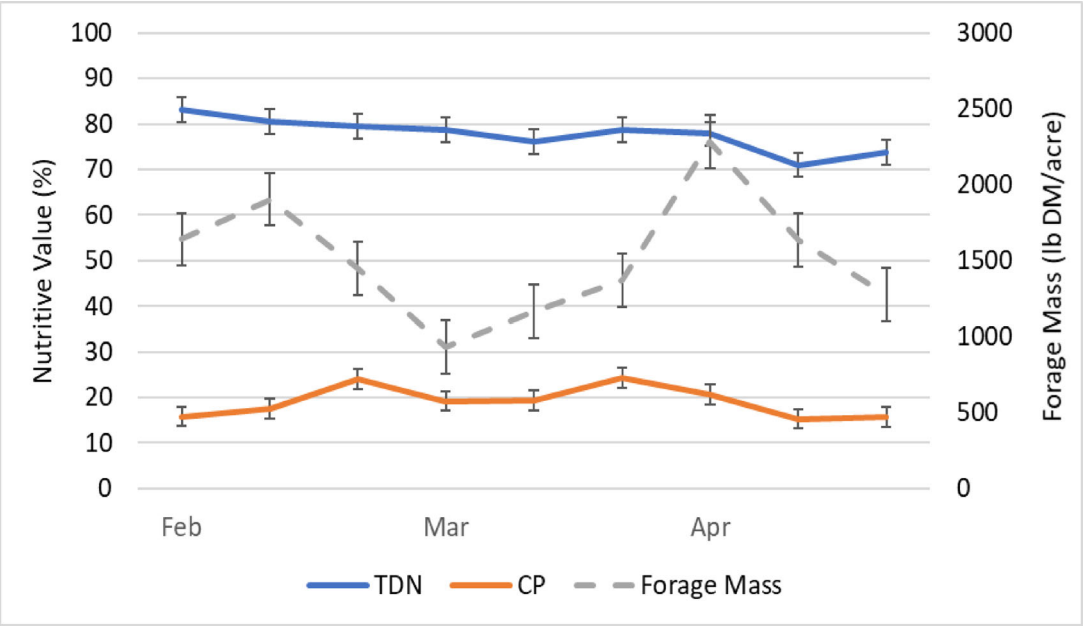

Figure 1. Seasonal forage production (lb DM/acre) and CP and TDN concentrations (% DM basis) of oat, ryegrass, and clover mixture over two-years in Shorter, AL. For TDN, SEM = 2.7. For CP, SEM = 2.2. For forage mass, SEM = 155.8

NUTRITIVE VALUE OF DIETS

Nutritive value of diet as influenced by nutritional management system is presented in Table 1. Differences were observed for TDN ($P < 0.0001$) and CP ($P < 0.0001$) concentrations of the diets used in each respective management system scenario. Concentration of TDN was greatest for RG, intermediate for RF, and least for FC. Poor hay quality contributed to lower TDN values for RF and FC. The daily TDN requirement for a 1322-lb cow of average milking ability is 55.5% (NRC, 2016). While RG and RF met this requirement, the calculated diet value for FC system was less than animal nutrient requirements; however, cow performance was not negatively impacted by diet in this study. Winter annuals in RG had the greatest CP concentration, while RF and FC did not differ. Cows in the RF group consumed an average of 14 lb/hd/d of 50:50 SH:CGF along with free-choice hay, although the feed was delivered every other day (28 lb/feeding). This strategy was similar to that in a study by Drewnoski et al. (2011), where 600-lb steers were fed either hay only, hay plus daily feeding with 6 lb/day of a 50:50 soybean hull:corn gluten feed blend, or hay plus the same total amount of the same blend 3 times a week (14 lb/feeding). In the study, there were no ADG differences in steers feed daily or three times per week (Drewnoski, 2011). Cows consumed an average of 9.7 lb WCS/hd/d in the FC system. This value agrees with a study by Hill et al. (2009) where non-lactating, non-pregnant beef cows consumed 9.0 lb WCS/hd/d. Because of the high fat content of WCS, the recommended feeding level is no more than 0.5% BW, as excess fat in the diet may interfere with fiber digestion (Hill et al., 2009). While intake of WCS in the current study was above the recommended feeding level, negative impacts were not observed. However, feeding WCS free-choice may become cost prohibitive and intake may be erratic if cows are allowed to consume large amounts with no regulation (Hill et al., 2009).

Table 1. Mean values of total digestible nutrients (TDN) and crude protein (CP) for each diet treatment. Values are expressed on percent dry matter basis (% DM).

Diet	TDN[1]	CP
-	----------%----------	--
Rotational Grazing of Cool-Season Annuals[2]	78.1[a]	19.0[a]
Reduced Frequency Feeding[3]	59.4[b]	12.0[b]
Free Choice Whole Cottonseed[4]	53.5[c]	11.3[b]
Standard Error of Mean	1.4	1.0

[1]For rotational grazing, TDN was calculated by subtracting 11.9 from IVTD value (Van Soest, 1994).

[2] Winter annual mixtures of oat, ryegrass, and crimson clover; rotated every 14 d.

[3] 50:50 SH:CGF at 1% of BW per day + free-choice hay; fed every other day.

[4] Free-choice whole cottonseed + hay.

ANIMAL PERFORMANCE

Nutritional management strategy effects on animal performance are presented in Table 2. Cow BCS was greatest (P = 0.0014) on RG. Calves nursing cows on RG and FC performed similarly to each other, with calf BW being the lowest when their dams were on RF (P = 0.0041). Calf BW differences may have been a function of gut fill difference on weigh dates. Calf ADG was not different (P = 0.0706) among nutritional management strategies, indicating that all diets supported adequate lactation for calf growth. Calf ADG in the current study was greater than that of calves nursing cows grazing winter-annuals as supplement in Arkansas where calf ADG ranged from 2.05 to 2.11 lb/d (Gunter et al., 2012). Cattle on RG and FC are pictured in Figure 2 and Figure 3, respectively.

Table 2. Mean values of cow body condition score (BCS), calf (BW), and calf average daily gain (ADG, lb/d) as influenced by diet treatment.

Diet	Cow BCS	Calf BW	Calf ADG
-	-	lb	lb/d
Rotational Grazing of Cool-Season Annuals[1]	6.3[a]	344[a]	3.1
Reduced Frequency Feeding[2]	6.0[b]	322[b]	2.6
Free Choice Whole Cottonseed[3]	6.0[b]	353[a]	2.8
Standard Error of Mean	0.1	5	0.1

[a-b] Within a column, means differ (P < 0.05).

[1] Winter annual mixtures of oat, ryegrass, and crimson clover; rotated every 14 d.

[2] 50:50 SH:CGF at 1% of BW per day + free-choice hay; fed every other day.

[3] Free-choice whole cottonseed + hay.

Figure 2. Cow-calf pairs grazing winter annual mixture.

Figure 3. Cows and calves on free choice treatment. A trough full of whole cottonseed is in the foreground.

COST ANALYSIS

Treatment RG had the greatest Total Cost per Pair per Day for Yr 1 of the trial at $7.02, followed by RF at $4.86, and FC at $4.73. Treatment RG had the greatest TCPD for year 2 of the trial at $5.38, followed by RF at $4.86, and FC at $4.73. Both FC and RF were static throughout trial, while TCPD decreased linearly (R = 0.9723) as number of grazing days increased for RG. Treatment RG becomes the low-cost feed option (with FC and RF inputs remaining constant) if trial days were extended to 121 days in Yr 1 and 104 days in project Yr 2. Figure 4 illustrates that a cool-season annual forage growing season that is longer than the number of days of grazing supported in this study may lower TCPD for RG.

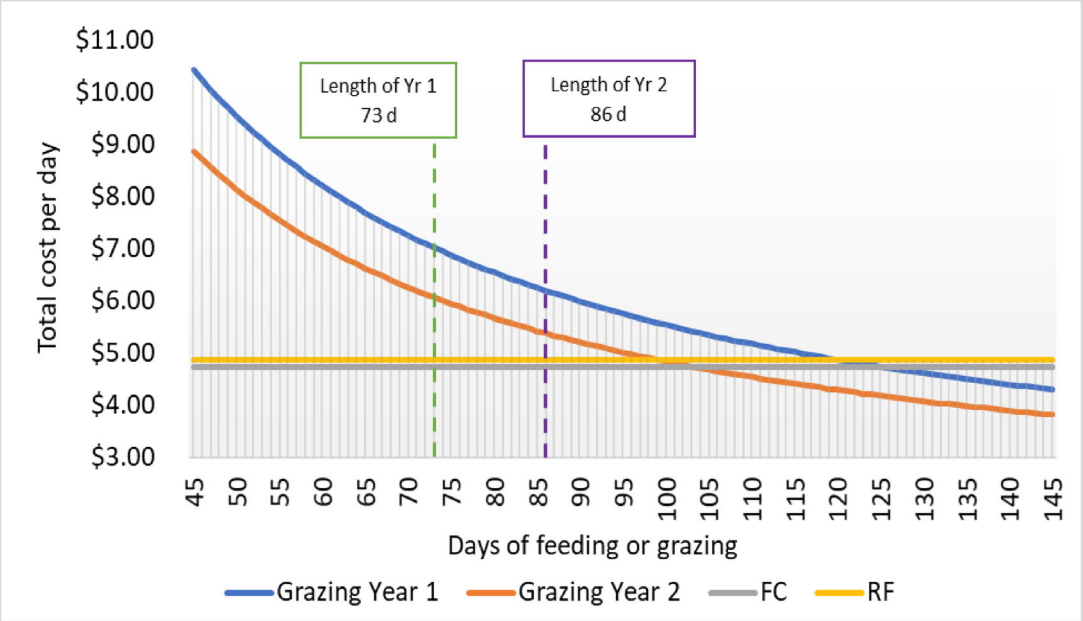

Figure 4. Total cost per day of each nutritional management strategy over the grazing or feeding season.

CONCLUSIONS

Reducing labor or feed costs are priorities for profitable beef cow-calf systems in the Southeast. Nutritional management strategies such as extending the grazing season, reducing feeding frequency, or feeding in bulk can accomplish this goal during the winter management season. This study indicates that rotational grazing of winter annuals, feeding fiber-based supplements that are low in non-structural carbohydrates every other day as opposed to daily, or bulk feeding whole cottonseed with access to hay are all viable options in terms of nutritive value and cattle performance. Rotational grazing of winter annuals provided the costliest option given the limited days of grazing; however, with better grazing management, such as strip grazing or more paddocks for rotation, and more days of grazing, it could become the least cost option. Implementing more intensive grazing methods which improve forage dry matter use efficiency may increase number of grazing days. Targeting an early fall planting window in the Southeast US and using forage mixtures which increase growth distribution potential in the late fall and early winter months may provide strategies for reaching more calendar days of grazing per year. Producers should consider available feed sources, land area, and labor availability to determine which winter nutritional management system would fit best into their operation.

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