Effect of Mineral Supplementation with or without Monensin and Energy Supplementation on Growth Performance of Wheat Pasture Stocker Cattle

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Story in Brief

Two-hundred thirty-five Angus-crossbred steers (initial BW 563 ± 55 lb) and 18 clean-tilled wheat pastures were used to evaluate different strategies for delivery of monensin, with or without energy supplements, for stocker cattle grazing wheat pasture. The 5 treatments were: (1) negative control (NC), no mineral or any other supplement; (2) free-choice non-medicated mineral (MIN); (3) free-choice R1620 mineral with 1620 g of monensin/ton (R1620); (4) R1620 plus 4.0 lb/steer of soybean hull pellets fed every other day (SH/R1620); and (5) 4.0 lb/steer of an energy supplement formulated to the Green Gold specifications and fed every other day (GRNGOLD). Intake of MIN and R1620 averaged .42 and .16 lb/steer/d. Mineral intake for SH/R1620 averaged .20 lb/steer/d. Mineral supplementation (MIN) improved ADG by .27 lb compared with NC, and R1620 increased ADG by .24 lb compared to MIN. No difference (P=.17) in ADG was observed by including an energy supplement (SH/R1620 and GRNGOLD) compared to R1620. While weight gain of steers fed the GRNGOLD supplement was .15 lb/d greater than the SH/R1620 treatment, this difference was not significant (P=.25). However, compared to MIN, GRNGOLD increased ADG by .46 lb with a supplement conversion of 4.3 lb of supplement per lb of additional gain compared to MIN. Selection between these supplementation strategies will depend on (1) relative costs; (2) labor availability and management; (3) location/accessibility of pastures; (4) forage mass at turnout; (5) desired rate of gain; and (6) subsequent plans for the cattle.

Key Words: Wheat Pasture, Mineral, Energy Supplements, Monensin, Daily Gain

Introduction

The Oklahoma Green Gold supplementation program (Horn, 2001; Horn et al., 2005) is a supplementation program for stocker cattle grazing wheat pasture that was designed to provide: (1) additional fermentable energy and help balance the energy to crude protein ratio of wheat forage; (2) monensin to improve the economics of the supplementation program; (3) to decrease bloat (Branine and Galyean, 1990; Paisley and Horn, 1998); (4) additional calcium; and (5) a means, from a management standpoint, of getting other feed additives into cattle when needed. The target daily level of consumption of this supplement is 2 lb/animal, and it can be fed every-other-day at the rate of 4 lb/animal. In a two year study, Horn et al. (2002) reported increased daily weight gains of .16 (yr 1) and .26 (yr 2) lb by steers given free-choice access to a non-medicated mineral mixture compared with no supplement. Addition of monensin (1620 g per ton) to the non-medicated mineral mixture improved daily gains by .31 (yr 1) and .15 (yr 2) lb per steer. Many by-product energy supplements (i.e., soybean hulls, wheat middlings, corn gluten feed, distiller's dried grains) are readily available for use in stocker programs in Oklahoma. The objective of this study was to compare several different strategies for delivery of monensin and(or) energy supplements to stocker cattle grazing wheat pasture.

Materials and Methods

Study Site and Treatments. Eighteen clean-tilled winter wheat pastures at the Oklahoma State University Wheat Pasture Research Unit near Marshall, OK, were used. All pastures were planted to a single variety (Jagalene) and seeded at 120 lb/ac (2 bu/ac) on Sept. 3 and 4, 2004. Pastures were fertilized according to soil test and N, P, and K were applied in amounts for production goals of 3,000 lb of forage DM/ac and a 50 bu/ac wheat crop. The 5 treatments were: (1) negative control (NC), no mineral or any other supplement; (2) free-choice non-medicated mineral (MIN; ADM Alliance Nutrition, Inc., Quincy, IL); (3) free-choice R-1620 mineral with 1620 g of monensin/ton (R1620; ADM Alliance Nutrition, Inc., Quincy, IL); (4) free-choice R-1620 mineral plus hand-fed soybean hull pellets (SH/R1620); and (5) an energy supplement formulated to the Green Gold specifications (GRNGOLD). Pastures were blocked by location (4 blocks), and treatments were randomly assigned within block with the restriction that no treatments were in adjacent pastures. One block had only three pastures and was assigned the GRNGOLD, SH/R1620, and R1620 treatments. Weight gain of steers was measured from November 5, 2004 to February 4, 2005 (91 d). Steers continued grazing until February 22, when wheat reached the first-hollow stem stage of maturity. Wheat forage standing crop was determined on October 28, December 15, January 25 and February 22 by hand-clipping to ground level 2 ft^2 quadrants at 10 different sites within each pasture.

Cattle. Two hundred thirty-five Angus-crossbred steers (initial BW 563 ± 55 lb) originating from a single ranch in north-central Nebraska (Ainsworth), were used for performance measures. Additionally, 18 steers (1 steer per pasture) were added on December 2, but they were not used in performance calculations. These steers were added to utilize the tremendous amount of forage produced prior to turn-out and during the early part of the grazing season in accordance with forage clipping data. The weighted average stocking rate for all pastures during the 91-d grazing period was 1.42 steers/ac. Upon arrival, steers were fed a Deccox® (Alpharma Inc., Fort Lee, NJ) -containing protein supplement for prevention of coccidiosis and allowed access to native grass traps. At the end of the receiving period steers were stratified by weight and assigned to pastures. At study initiation all steers were implanted with Component® E-S with Tylan® (Vet Life, West Des Moines, IA). Steers were weighed full on November 5 and a 2% pencil shrink was used to determine initial weights. Steers were not shrunk to minimize the risk of bloat upon turn-out onto wheat pastures. On February 4, steers were weighed following an overnight (about 15-h) shrink without feed or water.

Supplements. Free-choice mineral supplements were formulated for cattle on wheat pasture.[1] Formulation of the GRNGOLD supplement is shown in Table 1. The GRNGOLD supplement, as well as soybean hull pellets, were fed at the rate of 2.0 lb/steer/d for the first 5 d following turn-out and 4.0 lb/steer every-other-day thereafter. The soybean hull pellet was composed of 95% loose soybean hulls and 5% cane molasses (as-fed basis). Both energy supplements were fed as 3/16th inch pellets. Consumption of MIN and R1620 were measured weekly. Mineral mixtures were fed in covered feeders (one per pasture), whereas energy supplements were fed in 12 ft long round bottom feeders. If one-sided bunk space was less than 1.0 ft per steer, an additional bunk was used to increase access to supplements. Feed bunks were observed daily,

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[1]ADM Alliance Nutrition, Inc.; Quincy, IL. Guaranteed analysis: Calcium 9.2-11.0%; Phosphorus, 6.0%; Salt, 21.6-25.9%; Magnesium, .3%; Potassium, 0.8%; Zinc, 3840 ppm; Copper, 1120 ppm; Selenium, 26.4 ppm; Vitamin A, 200,000 IU/lb. For the monensin-containing mineral, monensin was included at 1,620 g/ton.

and in no instance were the supplements not completely consumed within 24 h of feeding. Both mineral and bunk feeders were located near the single water source in each pasture.

Table 1. Ingredient composition and nutrient concentrations of GRNGOLD supplement

Ingredient	% as-fed	Nutrient	DM Basis
Soybean Hulls	87.3	NEm, Mcal/cwt	80.2
Cane Molasses	5.0	NEg, Mcal/cwt	53.7
Salt	1.25	TDN, %	73.0
Dicalcium Phosphate, 18.5% P	3.00	Crude Protein, %	10.9
Limestone 38%	3.00	Potassium, %	1.29
Magnesium Oxide	.25	Calcium, %	2.51
Copper Sulfate	.025	Phosphorus, %	.78
Vitamin A-30,000	.10	Magnesium, %	.39
Rumensin 80[a]	.09	Sulfur, %	.15
		Copper, ppm	89
		Iron, ppm	848
		Selenium, ppm	.13
		Zinc, ppm	47.7

[a]Rumensin 80 was added to result in a monensin concentration of 75 mg/lb as-fed.

Statistical Analysis. Individual steer growth performance was averaged by pasture and analyzed as a randomized complete block design using the MIXED procedure of SAS, with pasture location within the field used as the blocking factor. Due to the variability of forage allowances between pastures, lb of forage DM/steer on Jan. 25 was included in the model statement as a covariate. Treatment least squares means were separated using non-orthogonal contrasts that compared (1) NC vs MIN (no supplemental nutrients to a free-choice non-medicated mineral mixture); (2) MIN vs R1620 to compare the addition of monensin to the mineral mixture; (3) R1620 vs SH/R1620 + GRNGOLD (monensin provided in the mineral mixture alone vs providing monensin with(in) an energy supplement); and (4) SH/R1620 vs GRNGOLD. Supplement and mineral intakes are presented as raw means and standard deviations without further statistical analysis.

Results and Discussion

Forage Availability. Forage allowance, expressed as lb DM/steer, during the grazing period is shown in Figure 1. This wheat grazing season was one of extremes relative to available forage. Early in the growing season, and prior to turn-out, forage production was exceptional, with an average forage allowance of 2018 lb DM/steer. Because of the extremely low forage allowances and the physical appearance of the steers and pastures, steer performance after Feb. 4 is not reported. The low forage allowances were the result of many factors, including an especially wet winter and cloudy, cool conditions that were not favorable for wheat forage regrowth. Also, due to the extremely wet conditions, it was not possible to gather steers and adjust stocking rate in a timely manner.

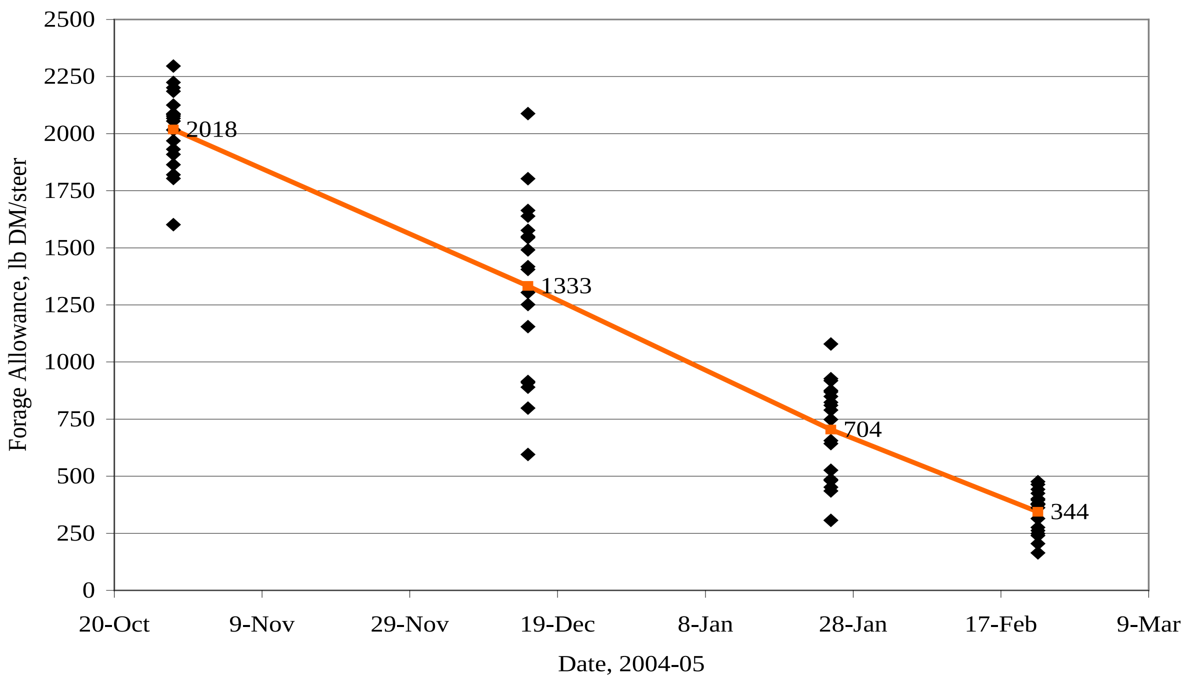

Figure 1. Forage allowance throughout the winter wheat grazing period.

Mineral and Supplement Intake. Intake of the MIN mixture is shown in Figure 2. Due to increasing rate of MIN consumption, MIN was hand fed daily at the rate of .40 lb/steer from January 11 until the end of the study. Overall MIN intake averaged .42 ± .09 lb/steer/d. Intake of the R1620 mineral mixture is shown in Figure 3. There was considerable variation in intake between pastures and throughout the grazing season. In general, intake of R1620 declined as the grazing season progressed. Peak MIN intake occurred on Jan. 4 and was due largely to snow cover that limited access to wheat forage. Addition of monensin to the mineral mixture decreased average daily intake to .16 ± .05 lb/steer (R1620). Monensin consumption averaged 129 ± 44 mg/steer/d for R1620. Intake of R1620 when offered with hand-fed soybean hulls (SH/R1620) is shown in Figure 4 and averaged .20 ± .05 lb/steer/d, which is slightly greater than when R1620 was offered alone. Monensin intake from R1620 averaged 160 ± 36 mg/steer/d (SH/R1620). Daily soybean hull intake was 2.0 lb/steer, and the soybean hull pellets were completely consumed shortly after the time of feeding every-other-day. Intake of R1620 appeared to stabilize around .20 lb/steer/d following the snow storm around Jan. 4. The GRNGOLD supplement was completely consumed throughout the experiment. Therefore, monensin intakes averaged 150 mg/steer/d. This monensin intake was slightly less than the 160 mg that was consumed by SH/R1620 steers.

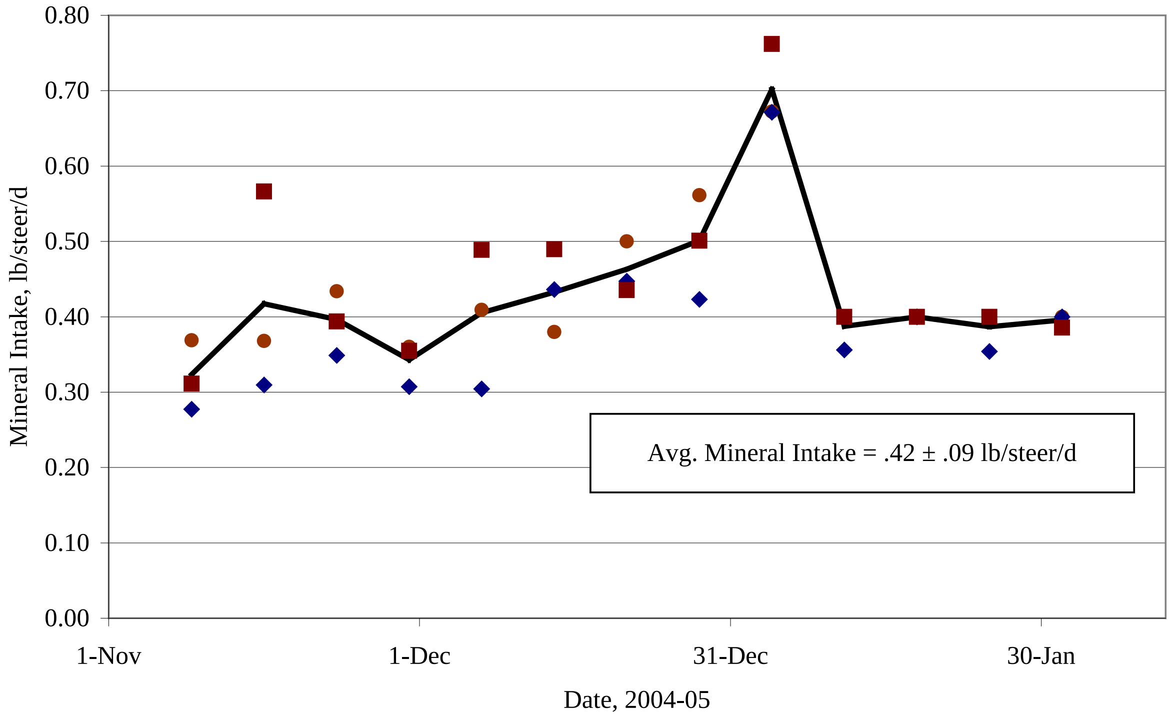

Figure 2. Inake of non-medicated mineral mixture (MIN). Beginnng on January 11, steers were hand fed MIN daily at the rate of .40 lb/steer.

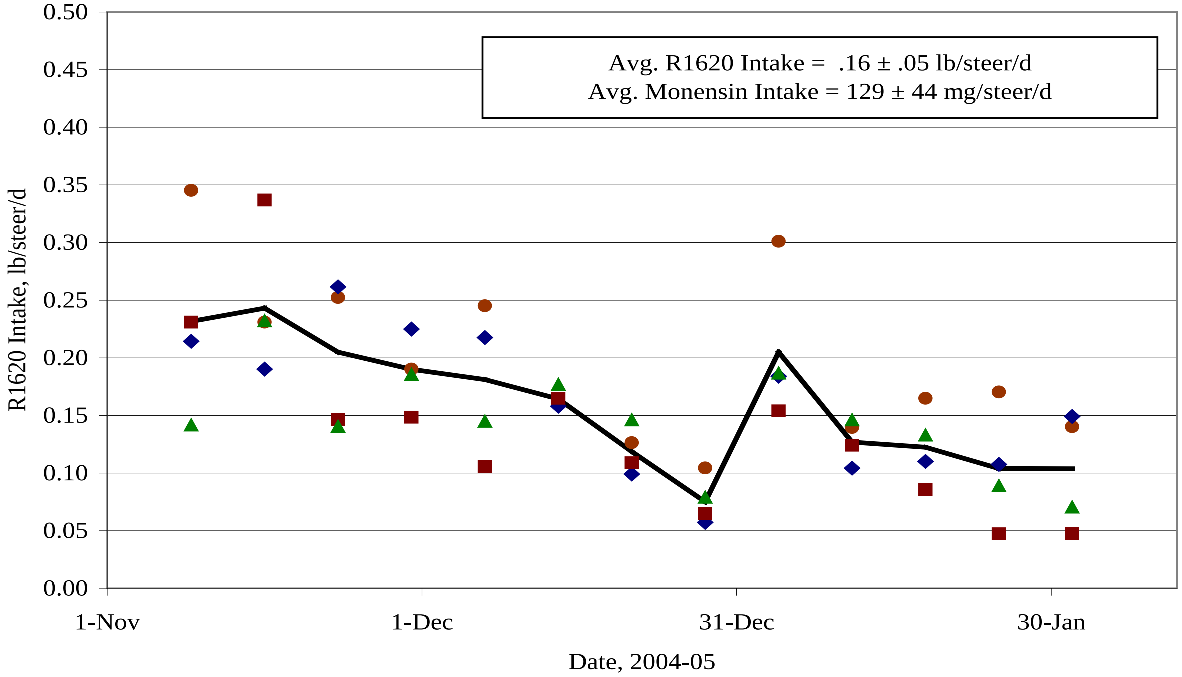

Figure 3. Intake of R1620 when offered alone.

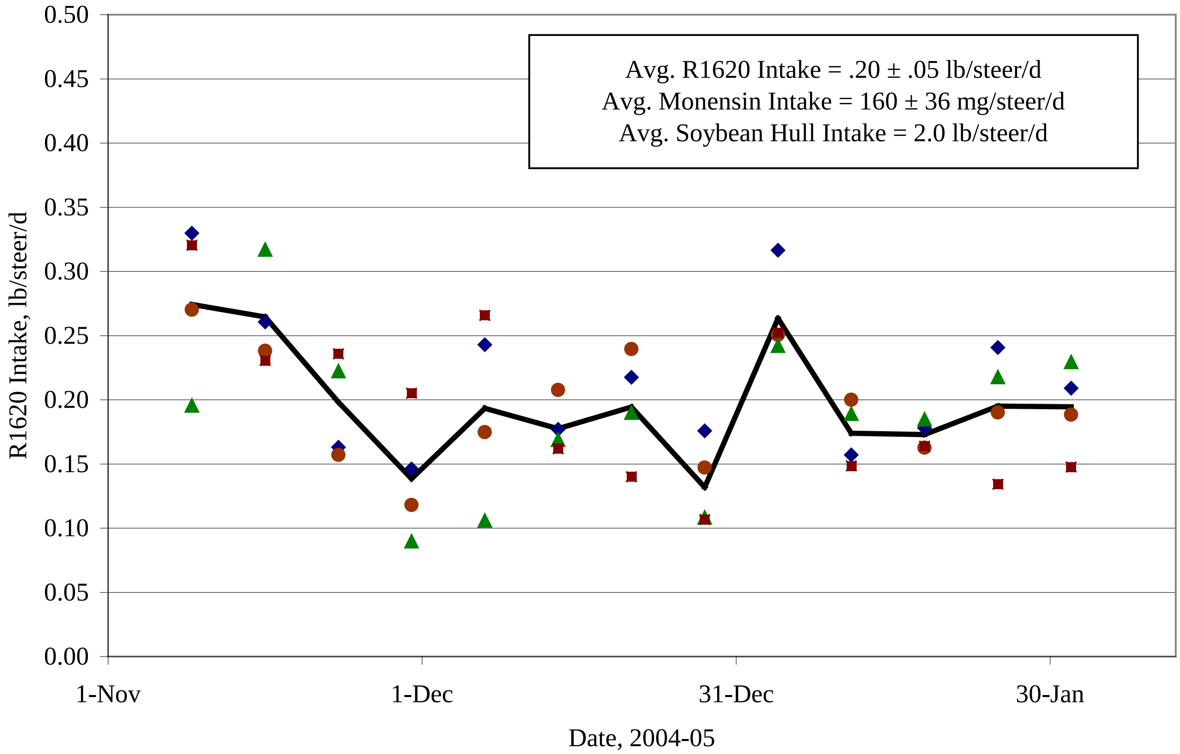

Figure 4. Intake of R1620 when offered with hand-fed soybean hulls.

Animal Performance. Steer growth performance is shown in Table 2. Overall steer gain and steer gain per acre are mathematical functions of the daily gain and statistical interpretation is the same for those response variables. The values are reported, but will not be discussed further. Daily weight gain of NC steers was the lowest that we have ever experienced at Marshall with the exception of the 2000-01 fall/winter grazing period in which forage availability was very limited because of drought. Feeding MIN increased daily gain by .27 lb (P=.08) as compared to NC. Addition of monensin to the free-choice mineral mixture tended (P=.10) to further improve daily gains by .24 lb per steer. Provision of additional energy as soybean hulls or the GRNGOLD supplement (i.e., contrast of R1620 vs average response from the SH/R1620 and GRNGOLD treatments) did not increase weight gain (P=.17) as compared with feeding the R1620 mineral mixture alone. This result is surprising in view of the low forage availabilities during much of the study, and it is probably due to the relatively small number of pastures per treatment and the greater than usual variation in forage availability among pastures. While weight gain of steers fed the GRNGOLD supplement was .15 lb/d greater than the SH/R1620 treatment, this difference was not significant (P=.25). In this study GRNGOLD improved daily gain by .46 lb compared to MIN, which is consistent with the response reported by Horn (2001).

Table 2. Growth performance of steers grazing winter wheat and receiving no supplement (NC), a non-medicated mineral mixture (MIN) a monensin-containing mineral mixture (R1620), a monensin containing mineral mixture and soybean hulls (SH/R1620), and a monensin containing energy supplement (GRNGOLD)[a]

	Treatments[b]						Contrasts[c]			
Item	NC	MIN	R1620	SH/R1620	GRN GOLD	SEM[d]	1	2	3	4
No. of Pastures	3	3	4	4	4					
Initial BW	569	565	559	563	561	3.1				
Final BW	675	677	707	721	717	19.1				
Steer Gain, lb	102	126	148	155	168	9.1	.08	.10	.17	.26
ADG, lb	1.12	1.39	1.63	1.70	1.85	.10	.08	.10	.17	.26
Steer Gain per Acre, lb	144	180	211	221	240	12.8	.07	.10	.17	.26
Supplement Conversion[e]	-	-	-	6.5	4.3					

[a]Least squares means by treatment

[b]NC = negative control; MIN = non-medicated, free-choice mineral; R1620 = free-choice mineral mixture with 1620 g monensin per ton; SH/R1620 = R1620 mineral plus 2 lb/steer/d soybean hulls; GRNGOLD = monensin-containing energy supplement fed at 2 lb/steer/d.

[c]Observed significance levels for comparison contrasts. Contrasts are: 1 = NC vs. MIN; 2 = MIN vs. R1620; 3 =

R1620 vs. SH/R1620 + GRNGOLD; and 4 = SH/R1620 vs. GRNGOLD.

[d]Most conservative standard error of the mean.

[e]Calculated as lb of supplement per lb of additional gain over steers receiving MIN.

Supplement Conversion. Supplement conversions (expressed as lb of soybean hulls or GRNGOLD per lb of increased weight gain over steers fed MIN) are shown at the bottom of Table 1. Offering monensin in a free-choice mineral with alternate day feeding of soybean hulls (SH/R1620) resulted in a higher (less desirable) supplement conversion than feeding GRNGOLD (6.5 vs 4.3, respectively). While an explanation for this difference is not readily apparent, it may be related to differences in day-to-day variation in monensin intake between the two treatments and an improved synchrony of monensin and additional fermentable energy reaching the rumen environment for the GRNGOLD supplementation program.

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