Recent Results in Stocker Cattle Research: Effects of Backgrounding Programs on Subsequent Performance of Grazing Calves[1]

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Abstract

In two trials, 250 weaned beef calves were fed in dry-lot for a 102-d period (Trial 1) or a 67-d period (Trial 2), before grazing of stockpiled endophyte-infected tall fescue (Trials 1 and 2) or interseeded winter annuals (Trial 1). Backgrounding programs for Trial 1, included: bermudagrass hay (*ad libitum*) plus a 20% CP supplement for ADG of 1.25 lb (**HAY**); or program-fed in dry lot for ADG (lb/d) of 0.5 (**LOW**), 1.25 (**MODERATE**), or 2.0 (**HIGH**). In Trial 2, two treatments were fed primarily bermudagrass hay with either a rice-bran-based supplement (**DRY**) or a molasses-based self-fed liquid supplement (**MOL**) and two treatments were program fed one of a high-concentrate diets containing either a dry protein supplement (**CON**) or molasses-based protein supplement (**CONMOL**). Adjustments were made to feeding levels of experimental diets throughout the backgrounding period in order to equalize animal performance across dietary treatments. Calves were reallocated to either stockpiled tall fescue or cool-season annuals, on January 5 in Trial 1 and December 21 in Trial 2. Dry-lot gains (lb/d) were 1.17, 0.59, 1.14, and 1.60 for HAY, LOW, MODERATE and HIGH, respectively in Trial 1. Dry-lot gains in Trial 2 were 1.20, 1.01, 1.28, and 1.30 for DRY, MOL, CON and CONMOL, respectively. In both trials, cost of gain in the dry-lot was lower for program-fed calves than hay-fed calves. Pasture ADG for the first 35-d period was higher for program-fed than hay-fed calves. Calves in the groups fed HAY gained weight similarly to MODERATE calves, but had reduced pasture performance early in the grazing season, indicating a possible backgrounding carry-over effect on pasture. In Trial 1, the overall best economic performance was with the HIGH treatment with a gross margin ($/animal) of 99.00 compared to 64.00, 86.00, and 94.00 for HAY, LOW and MODERATE, respectively. In Trial 2, program-fed calves were $18.50/animal more profitable than hay-fed calves.

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Introduction

If sold at weaning in the fall, calves from spring-calving cowherds generally bring seasonally lower prices because of a large supply and low demand in the market. Profitability can be improved by retaining the calf crop through the winter in dry-lot and utilizing high-quality forages in the spring and early summer. Programmed feeding of high-concentrate diets to calves is an alternative to feeding hay. Questions arise as to what effects feeding these high-concentrate diets may have on grazing performance because of factors such as body composition changes, and(or) adverse ruminal effects. The purpose of this experiment was to determine the effect dry-lot diet and level of performance has on subsequent grazing performance and enterprise profitability.

Materials and Methods

Trial 1: On September 24, 1998, 154 weaned beef calves (initial BW= 400) from the Southwest Research and Extension Center cowherd were weighed after a 16-h shrink and divided into four treatments with two pens per treatment. Treatments included: bermudagrass hay (*ad libitum*) plus a 20% CP supplement for ADG of 1.25 lb (**HAY**); or programmed-feeding in dry lot for ADG (lb/d) of 0.5 (**LOW**), 1.25 (**MODERATE**), or 2.0 (**HIGH**). At weaning, the calves were treated for parasites (Ivomec plus), vaccinated for bovine respiratory disease complex (Cattlemaster 4), and with a seven-way *Clostridial* plus *H. somnus* (Vision 7 with somnus). The original program-fed diet was intended to contain 10% rice hulls and 10% cottonseed hulls as roughage sources, but intake problems were encountered during the step-up phase, with calves sorting feed ingredients and leaving rice hulls. Rice hulls were removed from the final diet. Composition of the final program-fed diet and the supplement fed to HAY treatment is shown in Table 1. The bermudagrass hay used in this trial was analyzed to contain 10% CP, 0.56 Mcal/lb of NEm, and 0.30 Mcal/lb of NEg.

The calves were removed from the program-fed diets on January 4, and weighed on January 5, 1999 following a 16-h shrink. Forty steers and 40 heifers were allocated by previous treatment and gender to stockpiled endophyte-infected tall fescue (K-31) for a supplementation trial. On May 5, the calves were removed from tall fescue and sent to a commercial feedlot (Neil's Custom Cattle Feeding, Welch, OK). The remaining cattle were placed on wheat/ryegrass interseeded into bermudagrass and used on a stocking rate x grazing system study. On August 19, the calves were removed from bermudagrass pastures and sent to a commercial feedlot (Neil Custom Cattle Feeding).

Trial 2. On October 14, 1999, 96 weaned calves from the Southwest Research & Extension Center cowherd divided into four treatments with two replications per treatment. At weaning, the calves were treated for parasites (Cydectin), vaccinated for bovine respiratory disease complex (Triangle 4) and with a seven-way *Clostridial* plus *H. somnus* (Vision 7 with somnus). In order to test the effect of differing backgrounding diets on subsequent grazing performance, two treatments were fed primarily bermudagrass hay with either a rice-bran-based supplement (**DRY**) or a molasses-based self-fed liquid supplement (**MOL**) and two treatments were program-fed high-concentrate diets with either dry protein supplement (**CON**) or molasses-based protein supplement (**CONMOL**). Adjustments were made to feeding levels throughout the backgrounding period in order to equalize animal performance. The program-fed diets are

shown in Table 2. Rice bran was used as the dry supplement for DRY diets and was analyzed to contained 15.3% CP, 0.86 Mcal/lb of NEm and 0.57 Mcal/lb of NEg. Rice bran normally contains around 12 to 15% fat, when program-fed calves exhibited signs of excess fat in their diet the rice bran was analyzed for fat concentration and it was found to contained 21% fat. Rice bran level was reduced in the program fed diets from 44.9 and 36.6% to 22.5 and 18.75% for CON and CONMOL, respectively. Hay was analyzed to contain 11% CP, 0.44 Mcal/lb of NEm and 0.20 Mcal/lb of NEg. The molasses-based supplement was offered free choice in lick-wheel tanks and the concentration of CP and P was adjusted to restrict intake. The initial liquid supplement contained 18% CP, 49% TDN, 1% P and 60% DM (as-fed basis). When excessive liquid supplement levels were consumed the CP concentration was increased to 26%.

On December 21, the calves were removed from dry-lot, shrunk for 16-h, weighed, and placed on eight pastures of stockpiled endophyte-infected tall fescue (K-31). The steers were allocated to pastures by treatment, so each treatment was represented in each pasture. Calf weights were recorded after the first 14 d of grazing and at 28-d intervals after a 16-h shrink. At the end of January, near record snowfall amounts restricting grazing for nearly 10 d, during this time bermudagrass hay was fed to the calves on pasture.

Statistical Analysis: For Trial 1, statistical analysis of cattle performance during the fall/winter dry-lot, grazing, and finishing periods was conducted by ANOVA. Least-square means were separated by predicted differences for the dry-lot period and contrasts for the grazing and finishing periods. For Trial 2, the effects of backgrounding treatment during the fall dry-lot period and grazing was analyzed by ANOVA as a completely randomized design with a 2 X 2 factorial arrangement of treatments. Backgrounding pens were considered the experimental units. Effects of dry-lot diets for the dry-lot and grazing periods were detected using contrasts.

Economic Analysis: Cost analysis for the dry-lot period, assumed $85.00/ton of hay, which is based on the average current cost of high-quality grass hay including freight, $106.00/ton of corn, $108.00/ton of corn gluten feed, $78.00/ton of rice bran, $200.00/ton of liquid supplement, $10.00/ton milling charge and $0.30/animal daily charge for management, labor, and other overhead. The cost of feed ingredients was based on the 10-yr average price of corn ($2.41/bushel). The current price relationship between corn and byproduct feeds, plus a delivery charge of $10.00/ton and $20.00/ton distributor markup was used to determine the cost of the byproducts used in the trials. For the economic analysis, the diet cost for Trial 1 was assumed to be $115.00/ton for the program-fed diet and $166.00 for the supplement fed to HAY treatments. For Diets in Trial 2 were assumed to cost $110.00/ton for CON, $120.00/ton for CONMOL, $150.00 for DRY, and $200.00 for MOL. The break-even analysis and determination of enterprise profitability was calculated by subtracting cost of gain from a $79.00/cwt value of gain then multiplying by amount of gain. Value of gain was determined using the 10-yr average price at Oklahoma City National Stockyards of 400 lb steers in September ($85.86/cwt) and 665 lb steers in April ($83.12/cwt).

Results and Discussion

Trial 1. There were no interactions ($P > 0.15$) between grazing trial treatments and dry-lot treatments, so data was analyzed across all grazing treatments, showing only the effects of dry-lot treatment. Cattle BW, feed DMI, cost of gain, and performance during the dry-lot phase are shown in Table 3. At the end of the dry-lot feeding period, HIGH calves had the heaviest BW ($P < 0.05$), MODERATE and HAY did not differ ($P = 0.35$), and LOW was the lowest ($P <$

0.05). Average daily gain for the HIGH treatment was, as planned, higher than other treatments over the entire dry-lot period. Gains of the HIGH cattle were lower than planned during the step-up period as a result of lower than expected DMI of the diet containing rice hulls. After corrections were made to the diet, consumption of the diet was adequate to meet the prescribed gain. The HAY and MODERATE treatment had similar ($P = 0.78$) ADG over the entire dry-lot period. Feed efficiency (feed:gain) for the entire feeding period was best for the HIGH treatment and was poorest ($P < 0.05$) with LOW or HAY treatments. Considering the cost of feed ingredients for this trial, dry-lot cost of gain was higher ($P < 0.01$) for HAY than the program-fed groups, and HIGH the least ($P < 0.01$). Total cost per animal for the dry-lot period was lowest ($P < 0.01$) for LOW followed by MODERATE, HIGH, and HAY, respectively.

Performance during the subsequent grazing period is shown in Table 4, there was no pasture treatment x dry-lot treatment interactions ($P > 0.30$) so grazing performance is shown across pasture treatments. During the first grazing period, program-fed calves gained more ($P = 0.01$) BW than HAY calves, and MODERATE calves gained more ($P = 0.01$) than HAY calves. There was also a significant ($P = 0.01$) program-fed linear effect indicating that initial pasture performance decreased as performance increased in dry-lot. Pasture ADG for the entire cool-season grazing period was not different ($P = 0.23$) for program-fed compared to HAY calves, but the programmed-feeding linear effect was still significant ($P < 0.01$). There was a 56% compensation of BW difference between LOW and HIGH by the beginning of May. In a compilation of several Nebraska studies, Klopfenstein et al. (1999) reported a range of compensation in grazing calves from 19 to 88% after calves were fed to differing rates of gain through the winter. Conclusions were that compensatory gain on grass is variable and hard to predict, but is usually around 50 to 60% with full-season grazing.

The highest gross return ($/animal) was with the HIGH treatment (program-fed linear effect, $P = 0.17$) at $99.00, even though pasture ADG was the lowest. Higher overall BW gains and improved feed efficiency during the dry-lot period with the HIGH treatment was able to spread out input costs over more pounds of gain compared to the other treatments. The lowest gross return was with the HAY treatment (HAY vs program fed contrast, $P = 0.01$) at $64.00.

Performance of calves retained on bermudagrass pasture after grazing cool-season grasses was not affected by dry-lot treatment (data not shown; $P > 0.17$). Overall cost of gain was lower ($P = 0.04$) for program-fed compared to HAY calves and profitability tended ($P = 0.16$) to be higher for program-fed calves. Feedlot in-weight of calves that were sent to a commercial feedlot after grazing fescue tended to be higher for HIGH than other program-fed treatments (program-fed linear effect, $P = 0.17$). There was also a significant ($P = 0.05$) program-fed linear effect on hot carcass weight and feedlot out-weights. Fat thickness increased and marbling score decreased with increased performance during backgrounding (program-fed linear effect, $P < 0.05$). Feedlot performance and carcass characteristics of calves were not affected ($P > 0.09$) by backgrounding treatment and(or) grazing.

Trial 2. The performance of calves during the dry-lot phase is shown in Table 5. At the end of the dry-lot phase there was no statistical difference in BW, although calves on hay-based diets tended ($P = 0.08$) to be lighter than program-fed calves. The ADG of calves during dry-lot was lower for calves fed hay-based diets compared to program-fed calves ($P < 0.05$). This fact is the result of a tendency for lower ($P < 0.09$) performance of MOL treatment calves compared to other treatments. This lower performance may have been the result of low digestible energy concentration of the hay in which the liquid supplement could not adequately compensate. The calculated feed:gain ratio (lb:lb) was lower ($P < 0.05$) for program-fed treatments compared to

hay-based treatments. This leads to higher ($P = 0.05$) dry-lot cost of gain for hay-based treatments.

The performance of calves grazing the stockpiled tall fescue is shown in Table 6. During the first 14-d grazing period calves from hay-based treatments lost weight, while calves from program-fed treatments gained weight with a net difference of 1.61 lbs/d ($P < 0.05$). The calves from liquid-based treatments gained 0.50 lb more/d ($P < 0.05$) than calves from dry treatments. Body weight of program-fed calves was higher ($P < 0.05$) than calves fed hay-based diets at the end of the first grazing period in January and tended ($P = 0.12$) to have greater BW at the end of grazing in May. Dry-lot diets had no effect ($P = 0.52$) on overall pasture ADG, but was program-fed calves held a numerical advantage of 0.10 lb/d. The profitability of the cattle was improved ($P < 0.12$) by an average of nearly $18.50/animal by programmed-feeding in the dry-lot during the winter.

Implications

This research shows that programmed-feeding of a high-concentrate diets to calves in dry-lot during the fall and winter, may have advantages in gain and economic performance during subsequent grazing periods over calves fed diets based on hay plus supplement. The inclusion of a molasses-based protein supplement during the dry-lot period was shown to increase the performance of calves during the transition period at the onset of grazing. The best overall economic performance was found with the dry-lot treatment with the highest rate of gain, indicating the importance of spreading input costs over more pounds of gain, and the importance of gain over the entire ownership period, rather than only during grazing.

Literature Cited

Klopfenstein, T., D. J. Jordan, I. Rush, and T. Milton. 1999. Predicting amount of compensatory gain. Nebraska Beef Cattle Report. MP 71-A:26-30.

Table 1. Composition of program-fed diets, and supplement used during dry-lot period (Trial 1)

Ingredient	Program-fed diet	Supplement
	----------%, DM basis----------	
Corn	44.3	
Corn Gluten Feed	44.3	89.1
Cottonseed Hulls	10.0	---
Farmland R-1500	1.4	9.8
Urea	0.3	1.1
Calculated Composition		
Crude Protein	15.8	21.6
NEm, Mcal/lb	0.92	0.83
NEg, Mcal/lb	0.53	0.48

Table 2. Composition of program-fed diets used during dry-lot period (Trial 2)

Ingredient	CON I[a]	CON II	CONMOL I	CONMOL II
	----------% DM----------			
Rice bran	42.8	22.7	38.9	18.9
Corn	42.3	61.9	38.9	58.9
QLF 34/6[b]			9.0	9.0
Cottonseed hulls	10.0	10.0	10.0	10.0
Urea	1.3	1.8	---	---
Mineral premix	3.6	3.6	3.2	3.2
Composition				
% Crude Protein	15	15	15	14
NEm (Mcal/lb)	0.80	0.81	0.79	0.83
NEg (Mcal/lb)	0.52	0.53	0.51	0.54
Percentage of fat	12.4	8.5	10.8	7.2

Diets fed before rice bran level was reduced in order to reduce fat content of diet is denoted with the roman numeral I and after rice bran level reduction denoted with II. CON treatment was program fed high concentrate diets without molasses based protein supplement. CONMOL treatment was program fed high concentrate diets including molasses-based protein supplement.

[b]Quality Liquid Feed 34/6: contained 34% CP (6% from natural protein sources), 0.51 Mcal/lb of NEm, 0.36 Mcal/lb of NEg, and 60% DM.

Table 3. Effect of fall/winter growing diets on BW, ADG, cost of gain of calves (Trial 1)[a]

Item	Program-fed			
	HAY	LOW	MODERATE	HIGH
Body Weight, lb				
9/25/98	403	398	394	401
1/5/99[c]	518	454	507	561
ADG[c]	1.17	0.59	1.14	1.60
Feed:gain, lb/lb[bcd]	14.2	19.1	8.91	7.45
Cost, $/animal[bcd]	$105.00	$72.00	$83.00	$96.00

[a]Cost of gain determined assuming hay cost of $85.00/ton, $1.76/bushel corn, $80.00/ton corn gluten feed, $10.00/ton milling charge, and $0.30/animal daily charge. Program-fed diets cost $90.00/ton and supplement fed to HAY treatment cost $146.50/ton.

[b]Contrast: HAY vs program-fed diets ($P < 0.05$)

[c]Contrast: program-fed linear effect ($P < 0.05$).

[e]Contrast: MODERATE vs HAY effect ($P < 0.05$)

Table 4. Effect of winter growing treatment on subsequent performance on cool-season grass pasture of calves (Trial 1)

Item	HAY	Program-fed LOW	MODERATE	HIGH
Body Weight, lb				
January[ab]	518	454	507	561
May	705	683	700	731
Pasture ADG				
Period 1, 1/5 to 2/16[abc]	0.36	1.48	0.92	0.60
Overall Pasture ADG[b]	1.53	1.85	1.61	1.42
Pasture Cost of Gain, $/cwt[b]	$38.00	$30.00	$36.00	$41.00
Overall Cost of gain, $/cwt[ac]	$60.00	$51.00	$50.00	$50.00
Gross Margin[d], $/animal[ac]	$64.00	$86.00	$94.00	$99.00

[a]Contrast: HAY vs program-fed ($P = 0.05$)

[b]Contrast: program-fed linear effect ($P = 0.05$).

[c]Contrast: MODERATE vs HAY effect ($P < 0.05$)

[d]Calculated by subtracting cost of gain from a $79.00/cwt value of gain then multiplying amount of gain. Value of gain was determined using the 10-yr average price at Oklahoma City National Stockyards of 400 lb steer in September ($85.86/cwt) and 665 lb feeder steer in April ($83.12/cwt).

Table 5. Effect of dry-lot diet on performance and cost of backgrounding calves (Trial 2)

Item	Treatment			
	DRY	MOL	CON	CONMOL
Body Weight, lb				
10/14/1999	466	466	466	463
12/21/1999	551	535	553	552
ADG, lb/d[a]	1.20	1.01	1.28	1.30
Feed:gain, lb/lb[a]	12.7	15.9	11.8	11.8
Cost, $/animal[abc]	$74.00	$74.00	$71.00	$76.00

[a]Contrast: hay-based diets vs program-fed ($P < 0.05$).
[b]Contrast: dry diets vs liquid supplemented diets ($P < 0.05$).
[c]Contrast: dry/liquid vs hay/program-fed Interaction ($P < 0.05$).

Table 6. Effect of dry-lot diet on subsequent performance of calves grazing stockpiled tall fescue (Trial 2)

Item	Treatment			
	DRY	MOL	CON	CONMOL
Body Weight, lb				
12/21/1999	551	535	553	552
1/5/2000[a]	527	521	555	561
4/4/2000[a]	659	648	676	679
Pasture ADG				
Period 1, 12/21 to 1/5[ab]	-1.47	-0.97	0.14	0.64
Overall Pasture ADG	1.05	1.08	1.17	1.22
Overall cost of gain, $/cwt	$65.00	$71.00	$61.00	$63.00
Gross Margin[c], $/animal[a]	$34.00	$21.00	$46.00	$46.00

[a]Contrast: hay-based vs program-fed diets ($P < 0.05$).
[b]Contrast: dry diets vs liquid supplemented diets ($P < 0.05$).
[c]Calculated by subtracting cost of gain from a $79.00/cwt value of gain then multiplying the amount of gain. Value of gain was determined using the 10-yr average price at Oklahoma City National Stockyards of 400 lb steers in September ($85.86/cwt) and 665 lb feeder steers in April ($83.12/cwt).

Table 7. Input Costs of Different Systems for Utilizing Autumn Growth of Tall Fescue[1]

Item	Hay	2 week	Daily
Days of Grazing	-	50	85
Days of Hay Feeding	120	70	35
Cost of Standing Forage, $	980	980	980
Cost of Hay Cutting, $	1246	-	-
Cost of Purchased Hay, $	1512	1891	946
Hay Feeding Cost			
Labor, $	360	210	108
Equipment, $[2]	508	296	152
Cost of Allocating Grazing/Checking			
Labor, $	-	68	340
Equipment, $	-	23	117
Cost of Minerals, $	192	192	192
Total Cost for 32 head, $	4797	3660	2835
Daily Cost per head, $	1.25	0.95	0.74

[1] Example system with 10 ha pasture and 2227kg/ha available forage Dec 1, and 32 animals requiring 6.8 kg/d DMI of autumn fescue growth as hay or pasture, or purchased hay for a 120 d wintering period. Assumes purchased hay cost of $.088/kg, mineral cost of $.44/kg, labor cost of $8/hr. Hay making and equipment costs are taken from NCSU enterprise budgets. Cost of standing forage is based on N at $.66/kg and N efficiency of 15 kg DM/kg N. Other assumptions include; Hay harvest efficiency, .90; Hay storage loss, 5%; Hay feeding loss, 15%; Grazing utilization efficiency, .85 for daily and .50 for 2wk.

[2] Includes both ownership and operating costs