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Steers wintered at reduced gains compensated 17% and 48% in years 1 and 2, respectively. Increased forage intake, as a percentage of body weight, explained the compensation.

Summary

Data were collected to determine effect of winter gain on forage intake and summer and finishing performance of yearling steers. Steers wintered at reduced gains compensated 17 and 48% over two years. Intake, as a percentage of body weight, was increased for compensating steers. Steers gaining faster in winter had a reduced breakeven ($67.01 vs 70.05/cwt) and were more profitable ($5.79 vs -31.32/head) compared to slower gaining steers. Growing animals at faster (1.50 - 1.65 lb/day) compared to slower (0.45 - 0.55 lb/day) rates of winter gain is superior unless 65%-70% compensation is achieved.

Introduction

Feeding beef cattle near maintenance, especially during the winter when harvested feeds are required, is often encouraged by studies that indicate cattle will increase gain during the next phase of production. However, conclusions regarding mechanisms surrounding the increased gain are ambiguous. Reduced maintenance requirements, increased feed intake, and/or changes in the composition of tissues are most commonly implicated. On lush forage, a reduction in maintenance energy requirements and an increase in forage intake relative to body weight are likely key factors. Perhaps increasing intake, as a percentage of body weight, dilutes the maintenance energy requirements sufficiently to account for at least some of the compensation typically observed.

The objectives of this research were to evaluate the effect of winter gain on subsequent forage intake and summer and finishing performance of yearling steers. Additionally, slaughter breakeven and profitability were evaluated.

Procedure

Two years of data were collected. In year one, 80 medium-framed British-breed steers were allowed a 28-day receiving and weaning acclimation period and allotted randomly to one of eight feedlot pens (10 head/pen). In year two, 64 medium-framed British-breed steers were allowed a 28-day receiving and weaning period and allotted randomly to one of eight feedlot pens (eight head/pen). A feedlot pen was then assigned randomly to treatment. The treatment arrangement was a $2 \times 2 \times 2$ factorial with year, rate of winter gain, and summer location as factors. In the winter of year one, 40 steers (four feedlot pens) were assigned to a 'slow' rate of winter gain (SLOW), while the remaining 40 steers (four feedlot pens) were assigned to a 'fast' rate of winter gain (FAST). In years one and two, following the winter period, two pens from both the FAST and SLOW winter treatments were assigned to graze either native warm-season Sandhills range near Stapleton, Neb., or smooth bromegrass near Mead, Neb. Following summer grazing, steers were placed in the feedlot for finishing.

All steers were implanted with Compudose before summer grazing, and re-implanted with Revalor-S at the onset of finishing. Steers were slaughtered when visual appraisal indicated they had reached 0.5 in fat thickness over the 12th rib. Initial and final weights for all periods of the system were based on two-day consecutive weights following five days of limit feeding 50% alfalfa and 50% wet corn gluten feed at 2% of body weight (DM basis). Slaughter weights were calculated assuming a common dressing percentage (63%). Hot carcass weights were taken at slaughter, and fat thickness at the 12th rib, quality grades, and USDA yield grades were recorded following a 48-hour chill. Slaughter breakeven and profit/loss were calculated in order to determine which treatment was economically superior.

Wintering Period

In each of the two years, steers were managed in two groups. Group 1 (SLOW) grazed corn residues and were supplemented with 1.8 lb/head/day of a sunflower meal-based supplement for approximately 98 days (Phase I). For the remainder of the winter period, steers on the SLOW treatment were allowed ad-libitum access to grass hay and a mineral supplement for 65 days (Phase II). For the FAST treatment, steers grazed corn residues and received 5.0 lb/head/day (DM basis) of wet corn gluten feed with a mineral supplement for 98 days. For the remainder of the winter period, steers received ad-libitum grass hay and 5.0 lb/head/day (DM basis) of wet corn gluten feed with a mineral supplement for approximately 65 days.

Summer Period

In year one, twenty steers from each of the FAST and SLOW treatments were shipped to either native warm-season grass pastures near Stapleton, Neb. or grazed smooth bromegrass near Mead, Neb. In year two, methods were the same; however, each treatment contained

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16 head of both FAST and SLOW steers. In both years, steers were on pasture for 123 days.

Finishing Period

In both years, steers were adapted to the final finishing diet in 21 days using four step-up diets containing 45%, 35%, 25%, and 15% roughage. Diets were fed for three, four, five, and five days, respectively. The final diet (7.5% roughage) was formulated to contain a minimum of 12% CP, 0.7% Ca, 0.35% P, 0.6% K, 30 g/ton Monensin, and 10 g/ton Tylosin (DM basis).

Intake Determination

Procedures in years 1 and 2 were similar. Alteration of procedures between years will be noted, otherwise it should be assumed they were similar.

Year 1. Forage intake of 40 steers (20 steers/location, 10 steers/treatment) was measured in two four-day periods in May, two four-day periods in June, and two five-day periods in August. Fecal grab samples were collected for five days following administration of an intraruminal slow-release Cr bolus. Steers were allowed five to six days following administration of the bolus before fecal grab sampling was initiated in an attempt to assure that a steady state of chromium release was present.

Forage diet samples were collected in year one using two ruminally fistulated steers at the Sandhills location, and three steers at the bromegrass location. Forage diet samples were collected on days two and four of the respective intake period.

Year 2. Forage intake of 32 steers (16 steers/location, eight steers/treatment) was measured in two seven-day intake periods. The first intake period was conducted in May and the second intake period was in July. Fecal grab samples were collected for five days following administration of the intraruminal slow-release Cr bolus. Steers were allowed five to six days following administration of the bolus before fecal grab sampling was initiated in an attempt to assure that a steady state of chromium release was present.

Forage diet samples were collected using three ruminally fistulated steers at each location. Forage diet samples were collected on days two and four of the respective intake period.

Because each year had a different number of intake periods, the two intake periods in May for year 1 were averaged and analyzed as period 1 for year 1. The May intake period in year 2 was analyzed as period 1 for year 2. The two June and two August intake periods in year 1 were averaged and analyzed as period 2 for year 1. The July intake period in year 2 was analyzed as period 2 for year 2.

Forage intakes were measured using an orally dosed intraruminal continuous Cr-releasing bolus. At each location, five steers were used in a total fecal collection to validate the release rate of the Cr bolus. Steers were dosed with intraruminal continuous Cr-releasing devices from the same batch as those administered to steers used for intake determination. Steers were then fitted with fecal collection bags for total fecal collection to determine a correction factor for fecal output. Intake was then estimated by dividing fecal output by indigestibility of the forage diet.

Economic Analysis

Differences between systems in input costs will be noted, otherwise it should be assumed that inputs were similar. For initial steer cost, average weight of a pen was multiplied by the USDA 1992-1999 average October calf price ($82.57/cwt.) for 500-550 lb feeders. Health and processing for the winter period were charged at $8.33/head. Simple interest was charged on initial animal cost and health for the entire ownership period. All interest charges discussed herein were based on a simple 9.8% rate.

The two treatments were charged a stalk charge of $0.12/head/day during phase I. Interest was charged for half of the stalk grazing period and for half the supplements plus the remainder of ownership.

During phase II, all steers were fed grass hay ad-libitum. Intake of the groups was monitored for cost calculations (12.3 and 15.3 lb/head/day [as-is] for FAST and SLOW, respectively). Grass hay was priced at $40.00/ton (as-is). Interest was charged on all feed ingredients for both treatments for half of phase II plus the remainder of ownership. Stalk yardage was charged at $0.12 and 0.10/head/day for FAST and SLOW, respectively. Yardage charge differences were the result of increased feeding costs associated with wet corn gluten feed compared to the SLOW group. In addition, drylot yardage was charged at $0.24 and 0.22/head/day for FAST and SLOW, respectively. Interest was charged on drylot yardage for half of the respective period plus the remainder of ownership. Total winter costs, including 1% death loss, were the sum of steer purchase price with the appropriate health, feed, yardage, and interest charges.

For summer costs, grazing was charged at the rate of $0.50/head/day and interest was charged for half of the grazing period plus the remainder of ownership. Total summer costs included $8.33/head for health, 0.5% death loss, and the appropriate grazing and interest charges for the summer period.

Finishing costs included both feed and yardage. For feed, DM intake for a pen was determined and a diet cost of $115.14/ton (DM basis) applied. Feedlot yardage was applied at $0.30/head/day. Interest was charged on feed and yardage costs for half of the feeding period. Total steer cost was the sum of steer, winter, and summer costs, plus finishing costs which included health ($8.33/head), 0.5% death loss, feed, and yardage costs. To calculate slaughter breakeven, total cost was divided by slaughter weight.

For all supplemental ingredients, prices were generally determined based on actual prices paid for those ingredients by the University of Nebraska Feed Mill over the period of one year with a 5% handling fee. Supplemental ingredients included all ingredients used in the winter protein and mineral supplements, and the supplemental ingredients used in the finishing diet. Wet corn gluten feed and high-moisture corn were charged on an equal dry basis, and price was determined using 10-year average corn price for Nebraska of $2.48/bushel (as-is). A

Table 1. Steer performance and carcass data.

Item	Year 1 FAST	Year 1 SLOW	Year 2 FAST	Year 2 SLOW
Winter				
Days	163	163	163	163
Initial wt., lb	499	495	539	548
ADG, lb[a]	1.69[b]	0.68[c]	1.52[b]	0.20[c]
Summer				
Days	123	123	123	123
Initial wt., lb[a]	772[b]	609[c]	785[b]	576[c]
ADG, lb[a]	1.10[b]	1.32[c]	1.14[b]	1.96[c]
Finishing				
Days	85	112	101	101
Initial wt., lb[a]	906[b]	772[c]	928[b]	823[c]
ADG, lb[d]	4.53	4.16	4.18	4.03
DM intake, lb/d[d]	31.5	28.6	29.7	28.2
Feed/gain	6.94	6.90	7.09	6.99
Slaughter wt., lb[ae]	1296[b]	1236[c]	1353[b]	1228[c]
Carcass				
Wt., lb[a]	816[b]	779[c]	851[b]	772[c]
Yield grade	2.66	2.82	2.72	2.57
Fat depth, in	0.48	0.50	0.52	0.49
Quality grade[f]	19.3	19.1	19.5	19.2

[a]Year × treatment interaction ($P < 0.05$).
[bc]Means within a year and within a row with unlike superscripts differ ($P < 0.05$).
[d]Significant winter treatment effect ($P < 0.05$).
[e]Calculated from hot carcass weight adjusted to a common dressing percentage (63).
[f]High Select = 18, Low Choice = 19, Average Choice = 20.

10% shrink, processing, and handling fee was applied to corn and wet corn gluten feed. Alfalfa in the finishing diet was priced based on 10-year average price in Nebraska of $60.59/ton (as-is) along with a $10.00/ton markup for grinding, handling, shrink, etc.

Results

Animal Performance and Carcass Data

Animal performance and carcass data are presented in Table 1. For the winter period, a year x treatment interaction ($P < 0.05$) was detected for ADG. In year 1, steers on the FAST treatment gained 1.69 lb/day compared to 0.68 lb/day for SLOW. In year 2, steers on the FAST treatment gained 1.52 lb/day compared to 0.20 lb/day for SLOW. The interaction may be explained by the differences in wintering conditions, meaning that steers on the SLOW treatment in year 2 were likely consuming lower quality corn residues (less downed corn in the fields) compared to steers on the SLOW treatment in year 1. A year × treatment interaction ($P < 0.05$) also was found for initial grass weight, which is a residual effect of the winter ADG interaction. The absolute weight difference between FAST and SLOW steers was 163 lb in year 1, and 209 lb in year 2, meaning sufficient weight differences were established in the winter period which allowed for the subsequent evaluation of compensatory growth on grass.

In terms of ADG on grass, another year x treatment interaction ($P < 0.05$) was found. In year 1, steers on the SLOW treatment gained faster ($P < 0.05$) compared to FAST. Gains were 1.32 and 1.10 lb/day for SLOW and FAST, respectively. Likewise in year 2, steers on the SLOW treatment gained faster ($P < 0.05$) compared to FAST (1.96 vs. 1.14 lb/day, respectively). Steers on the SLOW treatment made more compensatory growth in relation to the FAST treatment in year 2 compared to year 1. In year 2, steers on the SLOW treatment were more severely restricted compared to year 1. Steers on the SLOW treatment in year 1 compensated 17% in relation to FAST, whereas in year 2, steers on the SLOW treatment compensated 48% in relation to FAST.

For feedlot initial weight, a year × treatment ($P < 0.05$) interaction was found. The year × treatment interaction resulted from the additional compensation made by the SLOW steers in year 2 compared to year 1. In terms of feedlot performance, steers on the FAST treatment gained more ($P < 0.05$), consumed more feed ($P < 0.05$), but were equal in terms of feed efficiency (gain per lb of feed consumed) compared to steers on the SLOW treatment. For slaughter weight, a year × treatment interaction ($P < 0.05$) was again found. The slaughter weight difference between steers on the FAST and SLOW treatments in year 1 was less (59 lb) compared to year 2 (125 lb). In year 1, steers on the SLOW treatment had more days on feed in relation to FAST. In year 2, steers on the SLOW and FAST treatments were fed the same number of days.

In terms of carcass weight, a year × treatment ($P < 0.05$) interaction was found. The interaction for carcass weight simply reflects the same interaction in slaughter weight. No differences were found between FAST and SLOW treatments for fat depth, yield grade, or quality grade.

Forage Intake Data

Forage intake data are presented in Tables 2 and 3. Table 2 represents forage quality and matches within location, year, and period. In May in year 1, forage CP and OM digestibility were high; however, by July CP and OM digestibility had substantially declined. The same trend was evident in year 2; however, the decline in forage quality was not as great. Table 3 shows the forage intake data for treatments by period. No treatment differences were found in daily forage intake (lb/steer). For intake expressed as a percentage of body weight, a period × treatment ($P < 0.05$) interaction was found. In both intake periods, steers on the SLOW treatment consumed more OM as a percentage of body weight compared to steers on the FAST treatment, however, the difference was greater in May. An effect of location was found for both forage intake and intake as a percentage of body weight. Steers at the Sandhills location consumed more forage (16.7 lb/day;

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P < 0.05) compared to steers at the Mead location (11.7 lb/day). The increase in forage intake corresponded to increases in steer performance (P < 0.05) at the Sandhills location (1.69 lb/day) compared to the Mead location (1.08 lb/day); however, no interactions were detected between location and treatment for forage intake. Compensation by the SLOW treatment in relation to FAST was similar between locations. Despite differences in performance and forage intake due to the type of forage grazed, forage intake differences and compensation results were similar on different forages. By increasing DM intake (as a percentage of body weight) compensating animals consume more feed/unit of body weight, thereby diluting maintenance energy costs and allowing more energy for gain which supports our hypothesis.

The cattle weights and gains and forage qualities were used in the 1996 NRC Model to estimate the response to higher intakes as a percentage of body weight by the compensating cattle. Condition score was maintained constant at 5. In order to obtain the 1.12 lb/day gain of the cattle, it was necessary to increase intake in the model to 16 lb/day. This suggests our estimates of intake were about 2 lb/day low. The compensating cattle (SLOW) were predicted to gain 1.60 lb/day by the model — they gained 1.64 lb/day. This further supports our hypothesis that the higher intake as a percentage of body weight by compensating cattle explains compensation on grass.

Economic Analysis

Data from the economic analysis are presented in Table 4. Year × location interactions were evident for both slaughter breakeven (P < 0.05) and profit/loss (P < 0.05). Despite the interactions for slaughter breakeven and profit/loss, it is desirable to express breakeven and profitability in terms of treatment differences over the period evaluated as this is real in terms of producer profitability over time. Steers on the FAST treatment had a lower (P < 0.05) slaughter breakeven ($67.01/cwt.), compared to SLOW ($70.05/cwt.). For profit/loss, the FAST treatment

Table 2. Crude protein and in vitro OM disappearance of diet samples and OM intakes.

	Year 1		Year 2	
Item	Bromegrass	Warm/Season	Bromegrass	Warm/Season
May				
CP, %	20.7	14.6	20.0	13.2
IVOMD[a], %	69.0	70.4	69.5	60.9
OM intake				
lb/day[b]	11.4	18.7	11.4	14.9
% BW[c]	1.83	2.77	1.83	2.41
July				
CP, %	15.9	10.9	15.6	9.8
IVOMD[a], %	51.4	62.0	56.2	59.8
OM intake				
lb/day[b]	10.8	18.3	12.8	15.1
% BW[d]	1.64	2.42	1.86	2.14

[a]IVOMD = in vitro OM disappearance.
[b]SEM = .46.
[c]SEM = .079
[d]SEM = .078.

Table 3. Summer forage OM intake[a] and OM intake as a percentage of body weight[b]

Item	FAST	SLOW	SEM
May			
OM intake, lb	14.2	14.0	.46
% of BW[c]	1.93[d]	2.50[e]	.079
July			
OM intake, lb	14.7	13.7	.46
% of BW	1.89[d]	2.13[e]4	.078

[a]Forage OM intake is calculated from fecal output corrected by total fecal collection.
[b]Period × treatment interaction (P < 0.05).
[c]% of BW = Percentage of body weight.
[de]Means within row with unlike superscripts differ (P < 0.05).

Table 4. Costs and slaughter breakevens.

Item	FAST	SLOW
Steer costs, $/head	428.79	429.66
Health	25.00	25.00
Interest	46.22	47.86
Total	500.01	502.52
Winter costs, $/head		
Stalks	45.39	30.78
Drylot	57.35	37.39
Interest	7.98	5.53
Total	110.72	73.70
Summer costs, $/head		
Grazing	61.50	61.50
Interest	2.55	2.86
Total	64.05	64.36
Finishing costs, $/head		
Feed	169.09	174.14
Yardage	27.90	31.88
Interest	2.51	2.97
Total	199.49	208.98
Death loss, $/head	13.03	12.80
Total costs, $/head	887.30	862.36
Slaughter wt., lb[ab]	1324	1232
Break, $/cwt.[cd]	67.01[e]	70.05[f]
Profit/loss, $/head[d]	5.79[e]	-31.32[f]

[a]Year × treatment interaction (P < 0.05).
[b]Calculated from hot carcass weight adjusted to a common dressing percentage (63).
[c]Slaughter breakeven.
[d]Year × location interaction (P < 0.05).
[ef]Means within a row with unlike superscripts differ (P < 0.05).

improved profits ($5.79/head) compared to SLOW ($-31.32/head).

Production costs for steers on the SLOW treatment were less than costs for steers on the FAST treatment (Table 2). However, steers on the FAST treatment had lower slaughter breakevens and increased profitability. Correlation coefficients were obtained which indicated that slaughter weight tended to be negatively correlated ($P = 0.0867$) with slaughter breakeven and positively correlated ($P = 0.1041$) to profit/loss. Slaughter weight accounted for 20% and 18% of the variation in slaughter breakeven and profit/loss, respectively. In the absence of more compensatory gain and compounded by reduced feedlot performance, steers on the SLOW treatment were lighter at slaughter, and therefore contained less saleable weight in relation to the steers on the FAST gaining treatment.

Because compensation on grass is highly variable, calculations were made to determine how much compensation would be required to numerically equalize breakevens for the SLOW treatment compared to FAST. Because feedlot performance was similar for FAST and SLOW cattle, it was assumed to be the same for the compensating animals regardless of percent compensation. Approximately 65% compensation would be required on grass for the SLOW treatment to have a similar breakeven compared to FAST.

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