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Effect of Intensive Winter Management, Partial Season Grazing, and Sorting on Performance and Economics of a Long Yearling Steer Production System[1]

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ABSTRACT

A 2-yr study (200 steers/yr) was conducted to evaluate effects of grazing management and sorting by BW at feedlot entry on performance and economics of yearling steers. At receiving, steers (247 ± 21 kg) were randomly allotted to 1 of 2 treatments: low (0.75 kg/d, NORM) or high (0.90 kg/d, INT) gains during backgrounding. After wintering, NORM and INT grazed native range for 128 and 78 d, respectively. At feedlot entry, steers were randomly allotted to 1 of 2 treatments: sorted by BW (25% heavy, 50% medium, or 25% light; SORT) or unsorted (UNSORT). Heavy, medium, light, and UNSORT steers were fed for 78, 100, 115, and 92 d, respectively. At feedlot entry, NORM was 10 kg heavier than INT ($P < 0.01$); however, final BW was not different ($P = 0.52$). Compared with INT, NORM had increased ($P < 0.01$) marbling scores; however, NORM had smaller LM area ($P < 0.01$). At the end of the winter period ($P < 0.01$) and at harvest ($P < 0.01$), NORM was more profitable. However, INT was more profitable at the end of summer grazing ($P < 0.01$). Sorting increased final BW ($P = 0.02$) due to increased days fed ($P < 0.01$). Sorting reduced overweight carcasses by 8.1 percentage units ($P < 0.01$). Sorting produced no significant difference in profitability ($P = 0.13$). In this study, management of steers before feedlot entry affected subsequent performance and profitability. Additionally, SORT increased final BW and reduced overweight carcasses but did not change profitability.

Key words: backgrounding, sorting, yearling steer

INTRODUCTION

Weight is a major economic driver in beef production (Feuz, 2002; Shain et al., 2005; Tatum et al., 2006). Additionally, weight gain that can be achieved with cheaper resources, such as low quality forage and corn by-products, creates potential to produce more profit in the cattle industry (Griffin et al., 2007). Research on wintering systems that develop yearling steers has shown that steers supplemented 2.27 kg/head daily of wet corn gluten feed (**WCGF**) gained 0.68 kg/d and had lower slaughter breakevens than steers with ADG of 0.23 kg/d during the wintering period (Jordon et al., 2002). Jordon et al. (2001) also used breakpoint analysis to determine that WCGF supplemented in excess of 2.73 kg/head daily did not offer any advan-

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tage in ADG and began to replace forage intake. Additionally, the use of implants in grazing cattle systems can offer advantages in weight gain (Paisley et al., 1999), ultimately increasing profitability in a cattle production system.

Production of overweight carcasses is a concern in long-yearling systems (Griffin et al., 2007). Sorting may be used in production systems to reduce BW variation and overweight carcasses. Additionally, Brethour (2000) used serial ultrasound technology to determine that 25% of cattle are fed too long and 25% of cattle are not fed long enough, based on carcass finish. Initial BW of yearlings entering the feedlot was shown to be a good predictor of final BW (Cooper et al., 1999; MacDonald et al., 2002). Additionally, MacDonald et al. (2006) sorted yearling steers by BW 2 ways and decreased overweight carcasses and increased uniformity; however, profitability was not affected. Therefore, sorting yearlings by BW at feedlot entry could be useful in reducing the number of overweight carcasses produced, providing a management tool for producers to sell cattle early and prevent overweight discounts.

Therefore, the objectives of this study were to 1) compare steer performance and economics of a moderate ADG, season-long grazing system to a high ADG, shorter season production system and 2) compare performance and economics of sorting steers by initial feedlot BW to an unsorted control in a long yearling production system.

MATERIALS AND METHODS

Two hundred medium-framed English-cross steers (247 ± 21 kg) were used in each year of a 2-yr study conducted from November 2001 to December 2003. Steers were purchased in the fall and were vaccinated for respiratory and clostridial diseases, wormed, and allowed a 28-d adaptation period before the beginning of the trial.

Backgrounding System

After receiving, steers were stratified by BW and assigned to 1 of 2 different backgrounding systems. System 1 (**NORM**) steers were allowed to graze corn residue or were fed in a dry lot situation during the winter period, while being fed 2.27 kg/d WCGF (DM-basis). System 2 (**INT**) consisted of a somewhat more intensive winter management including 2 growth promoting implants and supplementation of 2.73 kg/d WCGF (DM-basis) with ionophores included. In addition, summer grazing was utilized in both systems. The INT steers were allowed to graze native range for part of the summer season, whereas NORM steers were allowed to graze native range for the entire summer.

Wintering Period

Steers were managed as 2 groups. Both groups were allowed to graze cornstalk residue from November 29, 2001, until February 28, 2002, in yr 1 and December 3, 2002, until February 28, 2003, in yr 2. After grazing corn stalk residue, steers were placed in confinement pens and fed hay (dry-lotted) until April 20th of each year.

In NORM, steers were supplemented with 2.27 kg/d WCGF (DM-basis) during the entire winter production period, whether grazing corn residue or dry-lotted and fed hay. This level of WCGF is enough to meet protein requirements for maintenance and gain (0.68 kg/d; Jordon et al., 2001) of steers of this size grazing corn residue (NRC, 1996). To achieve greater rates of gain, INT steers were supplemented with 2.73 kg/d of WCGF (DM-basis). During the wintering period, steers were also supplemented with 170 mg/head of lasalocid sodium (Bovatec; Alpharma, Fort Lee, NJ). Additionally, INT steers were implanted at the beginning of the wintering period with Ralgro (Schering Plough, Kenilworth, NJ) and at the beginning of the dry-lotting period with Synovex-S (Fort Dodge Animal Health, Overland Park, KS), whereas NORM steers were not implanted.

Summer Period

After the wintering period, steers from both backgrounding treatments were weighed, implanted with Revelor-G (Intervet, Millsboro, DE), and allowed to graze bromegrass pasture from April 20 until May 15. On May 15 steers were shipped to native Sandhills range and allowed to graze warm season grasses. On July 2 of yr 1 and July 8 of yr 2, INT steers were removed from summer range and placed into the feedlot. However, NORM steers were not placed into the feedlot until August 14 and September 3 in yr 1 and yr 2, respectively. The goal was to have equal feedlot initial BW, but in a shorter amount of time for INT steers because of increased WCGF supplementation, feeding an ionophore, winter implanting, and short-season grazing.

Finishing Period

Steers were adapted to the final finishing diet in 17 d using 4 step-up diets containing 45, 35, 25, and 15% roughage fed for 3, 4, 5, and 5 d, respectively. The final finishing diet contained 40% WCGF, 48% high moisture corn, 7% alfalfa hay, 5% supplement, and contained a minimum of 12% CP, 0.7% Ca, 0.35% P, 0.6% K, and 30 g/ton Monensin (Elanco Animal Health, Indianapolis, IN), and 10 g/ton Tylan (Elanco Animal Health). The goal in the finishing period was to feed steers in either backgrounding or sorting system to the same degree of finish.

Initial and final BW for all periods of the system, except BW at harvest, were based on 2-d consecutive weights following 5 d of limit-feeding a diet of 50% alfalfa and 50% WCGF (DM basis) fed at approximately 2% of BW (DM basis). Body weights for limit feeding were determined based on an animal's initial BW in the specific phase of the growing program and the expected rate of gain during the respective phase of the growing system. Additonally, 2-d weights were used to help reduce the animal's daily variation in weight (Stock et al., 1983). All steers were given a single Synovex-Choice (Fort Dodge Animal Health) at feedlot entry, weighed, and sorted into pens. Final BW was based on hot carcass weight (**HCW**) assuming a constant dressing percent of 63%. Steers were harvested at the same commercial abattoir. On the day of slaughter, HCW and liver scores were collected. Following a 48-h chill, 12th rib fat thickness (**FT**), YG, and QG were collected.

Sorting

In both years after their respective summer grazing periods, steers were weighed and stratified by BW into groups of 25, with each group having similar BW. Steers were then divided into 1 of 2 treatment groups sorted by BW at feedlot entry (**SORT**) or unsorted (**UNSORT**). Steers that were sorted were placed into 1 of 3 sort groups, the heavy sort (25% of cattle, BW = 486 ± 13 kg) contained 6 steers per pen, the medium sort (50% of cattle, BW = 444 ± 16 kg) contained 13 steers per pen, and the light sort (25% of cattle, BW = 404 ± 14 kg) contained 6 steers per pen. Steers that remained unsorted (BW = 445 ± 21 kg) were fed for an average of 92 d. Steers in the heavy, medium, and light groups were fed for an average of 78, 100, and 115 d, respectively. For data analysis, steer performance from the sort groups were combined and analyzed as a pen containing 25 steers.

Variation Analysis

It has been shown that sorting improves carcass weight uniformity (MacDonald et al., 2006). Therefore, it was hypothesized that sorting and marketing steers accordingly would increase carcass weight uniformity. To determine the effects of sorting on carcass uniformity, the SD for initial BW, final BW, HCW, marbling score, YG, FT, and ADG were analyzed. Analysis was performed using a log 10 transformation of the SD of the means of the experimental units.

Economic Analysis

Costs of animal and feed ingredients were calculated using 7-yr average pricing for the month that cattle were bought and the months that feed ingredients were fed. For steer initial cost, average BW of a replicate was multiplied by the USDA Nebraska auction market's 1998 to 2004 average November calf price ($99.87/45kg) for 250-kg feeder steers (Feuz, 2004). Death loss was calculated by using 1.5% death loss in the winter phase, 0.3% death loss in the summer phase, and 0.2% death loss in the finishing phase.

Winter Period

The cost of corn residue was determined at a daily rate of $0.32/steer while steers grazed cornstalk residue. This cost includes $0.12/steer for the rent of cornstalk residue and $0.20/steer yardage. The yardage cost includes the cost of fencing stalk fields and cost of labor to deliver WCGF and water to the cattle.

Costs while steers were in dry lot were calculated using $0.30/d for yardage cost and hay cost of $59.86/metric ton. Yardage costs were assumed to be higher in the dry lot period because steers were dry-lotted in feedlot pens. During dry-lotting steers were managed as one group and hay was delivered to steers in round bales; therefore, hay consumption during the dry lot period was calculated using BW and animal unit month (**AUM**) equivalents. An AUM is defined as the amount of forage an animal unit needs in 30 d (Reece et al., 2001). Typically, a 454-kg steer is considered to be one animal unit (Reece et al., 2001). To determine the animal unit equivalent of the steers used in this study, initial dry lot BW and final dry lot BW were averaged and divided by 454 kg. Typically, an AUM is considered to be 355 kg of air dry forage. To determine the total AUM used during dry lot, the number of days was divided by 30 and multiplied by the animal unit equivalent. The AUM usage was then multiplied by the AUM value to determine the cost of hay consumed during the dry lot period.

Health and processing was charged at a flat rate of $8.33 for NORM during the wintering period. Intensively managed steers were charged an additional $1.83 during the wintering period because of implants used (Ralgro = $1.00/steer; Synovex-S = $0.83/steer). Additionally, intensively managed steers were supplemented 170 mg/steer daily of Bovatec at a cost of $0.015/d.

Steers in NORM and INT were supplemented daily with 2.27 and 2.73 kg/steer (DM basis) of WCGF, respectively, for the entire winter period at a cost of $92.62/metric ton (DM basis). This price is equal to 95% the price of corn (Erickson et al., 2005) when corn is $0.084/kg (as-is). Simple interest was assessed on initial steer cost and health over the entire ownership. Interest was charged using prime interest rate plus 1% (7.6%) for all costs.

Interest was charged on half of the WCGF for the winter period. Additionally, steers were charged interest for half of the yardage for cornstalk grazing, dry lot, and hay usage during the wintering period.

Summer Period

Summer grazing cost was determined using the 7-yr average AUM value of $23.29 for native range (Johnson and Raymond, 1993–2005). To determine the animal unit equivalent of the steers used in this study, the initial and final grazing BW were averaged and divided by 454 kg. To determine the total AUM used during summer grazing, the number of days was divided by 30 and multiplied by the animal unit equivalent. The AUM usage was then multiplied by the AUM value to determine the cost of native range during summer grazing. Steers were assessed $8.33 for summer health cost. Interest was charged for the cost of grazing using prime plus 1% for the cost of the AUM and health cost.

Finishing Period

Finishing cost includes feed ($109.48/metric ton; DM basis) and yardage. Feedlot yardage was assumed to be $0.35/steer daily. Interest was charged on feed and yardage costs for half the finishing period. Slaughter breakevens were calculated by dividing total cost by carcass-adjusted final BW.

Profitability of each system was calculated at the end of each respective period. At the end of the wintering period, INT steer value was determined using the April price for a 364-kg steer ($82.67/45 kg; Feuz, 2004), and NORM steer value was determined using the April price for a 341-kg steer ($85.67/45 kg; Feuz, 2004). Profitability of the wintering period was determined by subtracting initial animal cost and cost of the wintering period from the steer value at the end of the wintering period. At the end of summer grazing, INT steer value was determined using the July price for a 432-kg steer ($83.86/45 kg; Feuz, 2004) and NORM steer value was determined using the September price for a 454-kg steer ($79.00/45 kg; Feuz, 2004). Summer profit was determined by subtracting initial steer value, wintering cost, and summer grazing cost from the steer value at the end of the summer grazing period. Profit at the end of the entire system was calculated 2 ways. First, profit was calculated using 7-yr average live price for the month in which cattle were sold. Steers in NORM were marketed in November at a live price of $75.10/45 kg (Feuz, 2004) and INT steers were marketed in October at a live price of $73.82/45 kg (Feuz, 2004). Profit was calculated by subtracting the total cost of production from the value of the animal. Second, profit was calculated by selling cattle in a value-based beef market that rewards for quality. The grid (Table 1) was calculated using 2 yr of grid prices from the plant where the cattle were sold, averaging the premiums and discounts received for the carcasses. The base for this grid was a carcass with a minimum QG of choice^0 and YG 3. The base price was the average Nebraska dressed fed cattle price of a YG 3, choice^0 for October ($120.01/45 kg) and November ($121.84/45 kg) from 1998 to 2004 (Feuz, 2004) for INT and NORM, respectively. This price was calculated using the Nebraska Dressed Price (1998 to 2004) adjusted by adding the sum of one minus the average Choice grading percent for the month of October and November and multiplying by the choice-select spread for the month of October and November.

Statistical Analysis

Data from the wintering period were analyzed as groups of 25 steers (pen). Steer groups were determined using the feedlot pen to which the steers were assigned. For all periods of the system, individual steer BW were taken. Steers from INT and NORM remained separated in the feedlot because of different arrival dates to the feedlot. When steers were penned in the feedlot, the individual performance measures from the growing periods were averaged by pen. Therefore, performance data for the growing periods were replicated and analyzed by feedlot pen.

Table 1. Premiums and discounts used for grid market analysis[1]

Item	Premiums and discounts, $/45 kg
Prime	8.00
Upper Choice	6.00
Choice	0.00
Select	−8.10
Standard	−15.00
YG 1	3.00
YG 2	3.00
YG 3	0.00
YG 4	−10.00
YG 5	−17.49
Carcass weight > 432 kg	−10.00
Carcass weight > 455 kg	20.00

[1]Grid used for all marketing scenarios.

Performance and economic data were analyzed as a 2 × 2 factorial arrangement of treatments using the mixed procedure of SAS (SAS Inst. Inc., Cary, NC). Year was used as a random variable and backgrounding system and sorting were fixed effects. In all analyses, pen (25 head/pen) was the experimental unit. In this experiment, there were no backgrounding × sorting interactions ($P > 0.05$); therefore, the effects of backgrounding and sorting are presented as main effects. Significance was determined when its probability level was 0.05 or less.

RESULTS AND DISCUSSION

Wintering Period Performance

Steer performance as an effect of backgrounding treatment is presented in Table 2. Initial BW was not different when comparing INT and NORM (246 vs. 247 kg; $P = 0.78$). Over the 2 yr, steers grazed corn stalks for an average of 89 d and were dry-lotted for an average of 49 d. During the wintering period INT steers gained 0.15 kg/d more ($P < 0.01$) than NORM, causing INT steers to be 20 kg heavier ($P < 0.01$) than NORM at the end of the wintering period.

Jordon et al. (2002) found that steers gained 0.68 kg/d when fed 2.27 kg/d of WCGF while grazing corn residue or being fed hay in a dry lot. Additionally, Jordon et al. (2001) reported that steers grazing corn residue had a maximum ADG of 0.85 kg/d when fed 2.73 kg/d WCGF. The increase in gain from Jordon et al. (2001) with increased supplementation is similar to the increase in gain exhibited by INT steers in the current study. Additionally, MacDonald et al. (2006) found that steers fed 2.27 kg/d of WCGF had ADG ranging from 0.64 to 0.67 kg/d while grazing corn residue and being fed

Table 2. Steer performance as a main effect of backgrounding system

Item	Intensive	Normal	SEM	*P*-value
Initial BW, kg	247	246	2	0.78
Grass BW,[1] kg	370	350	2	< 0.01
FINT BW,[2] kg	440	450	1	< 0.01
Final BW, kg	621	623	3	0.52
Wintering period days	138	138	—	—
ADG, kg/d	0.90	0.75	0.01	< 0.01
Summer grazing days	78	128	2	< 0.01
ADG, kg/d	0.89	0.79	0.02	< 0.01
Feedlot performance				
Days fed	101	89	1	< 0.01
ADG, kg/d	1.80	1.95	0.03	< 0.01
DMI, kg/d	12.74	13.11	0.06	< 0.01
G:F	0.142	0.149	0.001	< 0.01

[1]Grass BW = steer BW at the beginning of the summer grazing period.

[2]FINT = BW at the beginning of the finishing period.

hay in a dry lot. Paisley et al. (1999) reported an increase in winter gain of 14.3 to 25.0 kg when comparing implanted steers to non-implanted steers. In this study, the increase in winter gain was 20 kg with the use of implants and increased supplementation.

Summer Grazing Performance

Over the 2-yr period, INT steers summer grazed for an average of 78 d, and NORM steers grazed for an average of 128 d. During summer grazing, INT steers had higher ADG compared with NORM (0.89 vs. 0.79; $P < 0.01$). The goal of removing INT and NORM steers from pasture at different time points was to have equal initial feedlot BW; however, at feedlot entry NORM steers were 10 kg heavier ($P < 0.01$) than INT.

MacDonald et al. (2006) reported summer grazing ADG of 0.78 kg/d with a range of 0.76 to 0.80 kg/d. Additionally, MacDonald et al. (2006) included a partial season summer grazing treatment, in which steers gained 0.80 kg/d on summer pasture. Shain et al. (2005) exhibited a similar range in summer gains from 0.80 to 0.94 kg/d in a similar grazing system that included a combination of grazing bromegrass and warm season grasses in the summer.

Backgrounding Feedlot Performance

At harvest INT steers and NORM steers exhibited similar adjusted final live BW ($P = 0.52$). Intensively managed steers were fed 12 d longer ($P < 0.01$) than NORM to achieve a similar degree of finish and BW at harvest. Steers in NORM consumed 0.37 kg more DM per day ($P < 0.01$), had increased ADG of 0.15 kg/d ($P < 0.01$), and had 4.9% improved G:F compared with INT.

The decrease in performance measures for INT may be a result of increased summer temperatures causing a reduction in feed intake during the feeding period compared with fall feeding of NORM steers. However, these data compare well to MacDonald et al. (2006), who reported increased days on feed and decreased DMI, ADG, and feedlot initial BW when steers were identified for early removal from pasture and fed during the summer.

Backgrounding Carcass Characteristics

Carcass characteristics as a main effect of backgrounding are presented in Table 3. Carcass weights were similar ($P = 0.53$). Fat thickness was greater for NORM compared with INT (1.19 vs. 1.06 cm; $P = 0.03$). Compared with INT, NORM had increased marbling score ($P < 0.01$). However, YG was not different ($P = 0.51$) when comparing NORM and INT. Steers in the normal backgrounding system exhibited more cattle grading choice ($P < 0.01$), with a 21.8 percentage unit increase compared with INT. However, percent of cattle with YG 4 ($P = 0.53$) or higher and percent of overweight cattle ($P = 0.15$) were not different.

Similar to MacDonald et al. (2006), these data did not exhibit any difference in HCW or overweight carcasses when comparing fall- and summer-fed yearling steers. Contradictory to the current study, MacDonald et al. (2006), who did not use a winter implant strategy, did not show differences in FT or marbling score when comparing summer- and fall-fed yearling steers. Additionally, Paisley et al. (1999) showed no effect of

Table 3. Carcass characteristics as a main effect of backgrounding system

Item	Intensive	Normal	SEM	*P*-value
Carcass weight, kg	391	393	2	0.53
12th rib fat thickness, cm	1.06	1.19	0.05	0.03
YG	2.37	2.40	0.04	0.51
Marbling score[1]	478	508	7	<0.01
% Choice	33.1	54.9	6.1	<0.01
% YG 4+	1.1	0.5	0.9	0.53
% Carcasses > 432 kg	3.5	6.5	1.9	0.15

[1]Marbling score = 400 = slight^0, 500 = small^0, etc.

implanting steers in the wintering period on FT and marbling score. Typically, increased days fed leads to increased QG and FT (Bruns et al., 2004; May et al., 1992). Therefore, it seems that implant program in the wintering period and difference in days fed does not explain the difference in FT and quality grade.

Sorting Performance

Sorting performance is presented in Table 4. Prior to feedlot entry, SORT and UNSORT were managed together within their respective backgrounding treatments. Therefore, the effect of sorting can only be determined for the period in which steers were in the feedlot. Initial feedlot BW were not different for SORT and UNSORT ($P = 0.27$). Final BW for SORT was 9 kg heavier than UNSORT ($P = 0.02$) because of increased days fed for SORT compared with UNSORT (98 vs. 92 d; $P < 0.01$). Unsorted steers had 0.15 kg/d greater DMI compared with SORT ($P = 0.02$). Daily gain ($P = 0.59$) and G:F ($P = 0.91$) were not different when comparing SORT and UNSORT.

MacDonald et al. (2006) found that sorting heavy steers out of the pen allowed the lighter steers in the pen to be fed an additional 7 d. By sorting the heavy cattle for market, the lighter cattle can be fed longer, increasing the amount of weight sold without increasing the number of overweight carcasses. MacDonald et al. (2006) also found that sorting cattle numerically increased final live BW by 13 kg, which is slightly greater than the sorting response observed in this study (9 kg). Perhaps differences in final BW can be explained based on sorting technique and differences in the days fed for control and sorted cattle; MacDonald et al. (2006) used a 2-way sort instead of a 3-way sort that was used in the current study.

Sorting Carcass Characteristics

Carcass characteristics as an effect of sorting are presented in Table 5.

Table 4. Steer performance as a main effect of sorting by initial feedlot BW

Item	Sorted	Unsorted	SEM	*P*-value
FINT BW,[1] kg	445	445	1	0.27
Final BW, kg	627	618	3	0.02
Feedlot performance				
Days fed	98	92	1	<0.01
ADG, kg/d	1.87	1.89	0.03	0.59
DMI, kg/d	12.85	13.00	0.06	0.02
G:F	0.146	0.145	0.001	0.91

[1]FINT = BW at the beginning of the finishing period.

Table 5. Carcass characteristics as a main effect of sorting by initial feedlot BW

Item	Sorted	Unsorted	SEM	*P*-value
Carcass weight, kg	395	389	2	0.02
12th rib fat thickness, cm	1.14	1.09	0.05	0.29
YG	2.34	2.40	0.04	0.63
Marbling score[1]	496	489	7	0.37
% Choice	44.4	43.6	6.1	0.90
% YG 4+	0.6	1.0	0.9	0.67
% Carcasses > 432 kg	1.0	9.1	1.9	<0.01

[1]Marbling score = 400 = slight^0, 500 = small^0, etc.

Table 6. Standard deviations of weights and carcass characteristics of sorted and unsorted steers[1]

Item	Sorted	Unsorted	SEM	*P*-value
FINT,[2] kg	31.9	32.2	0.5	0.78
Final BW, kg	28.1	45.1	0.5	<0.01
Carcass weight, kg	17.8	28.5	0.5	<0.01
ADG, kg/d	0.24	0.28	0.48	0.07
Yield grade	0.60	0.59	1.03	0.65
Fat thickness, cm	0.32	0.27	2.76	0.18
Marbling score[3]	61.3	43.3	1.1	0.02

[1]Statistical analysis based on log base 10 of SD. Values reported are transformations from log base 10 values.

[2]FINT = BW at the beginning of the finishing period.

[3]Marbling score = 400 = slight^0, 500 = small^0, etc.

Sorted steers had HCW that were 6 kg heavier ($P = 0.02$) than those for UNSORT. Fat thickness ($P = 0.29$), YG ($P = 0.63$), and marbling score ($P = 0.37$) were not different when comparing SORT and UNSORT. The percentage of steers grading choice or higher ($P = 0.90$) and the percentage of steers with YG 4 or higher ($P = 0.67$) were not different when comparing SORT and UNSORT. However, the percent of cattle that would be considered overweight (HCW ≥432 kg) were reduced by 8.1 percentage units ($P < 0.01$) when comparing SORT and UNSORT.

MacDonald et al. (2006) found an 8-kg increase in HCW for sorted steers; however, this difference was not significant. In agreement with this study, MacDonald et al. (2006) found sorting to have no impact on marbling score, FT, of YG. However, sorting cattle has been shown to negatively affect QG and YG when compared with unsorted cattle (Bruns and Pritchard, 2003). When looking at the reduction of overweight carcasses, MacDonald et al. (2006) did not reduce the percent of overweight carcasses with sorting, whereas in the current study, sorting significantly reduced the percent of cattle that would be considered overweight.

Variation Analysis

Results of the variation analysis are presented in Table 6. There was no difference in initial BW variation. However, the 3-way sorting strategy reduced variation in final live BW ($P < 0.01$) and HCW ($P < 0.01$). The SD for final BW was 28.14 kg for SORT and 45.11 for UNSORT. The SD of HCW was also reduced from 28.5 for UNSORT vs. 17.8 kg for SORT. The SD for ADG tended to be reduced for SORT compared with UNSORT (0.24 vs. 0.28 kg; $P = 0.07$). Standard deviations for FT ($P = 0.18$) and YG ($P = 0.65$) were not affected by sorting. However, the SD for marbling score was increased in sorted steers ($P = 0.02$).

Backgrounding Economics

Initial steer costs were similar for NORM and INT ($541.84 vs. $542.56/head; $P = 0.84$; Table 7). When evaluating winter cost, cost for WCGF supplementation was $18.65/head greater for INT compared with NORM ($P < 0.01$) because of increased level of WCGF supplementation (2.27 vs. 2.73 kg/head daily) and inclusion of an ionophore. Hay cost during the dry lot period was greater for INT compared with NORM ($P < 0.01$) because of increased intake due to energy requirements from increased BW gain during the cornstalk grazing period. Because of increased WCGF supplementation, inclusion of an ionophore, and increased hay consumption during the wintering period, INT steers

Table 7. Economics as a main effect of backgrounding system

Item	Intensive	Normal	SEM	*P*-value
Steer cost, $/head	542.56	541.84	3.57	0.84
Wintering cost, $/head				
WCGF[1]	47.70	29.05	0.12	<0.01
Hay cost	26.52	25.17	0.14	<0.01
Total winter cost	139.58	117.10	0.26	<0.01
Winter steer value[2]	673.64	659.48	3.10	<0.01
Winter P/L,[3,4]	−8.50	0.55	2.62	0.01
Summer cost, $/head				
Grass cost	65.43	99.54	1.38	<0.01
Total summer cost	75.90	109.97	1.39	<0.01
Summer steer value[5]	811.12	781.79	1.11	<0.01
Summer P/L[3,6]	61.41	21.22	4.20	<0.01
Feedlot cost				
Feed cost, $/head	140.06	127.77	1.55	<0.01
Yardage, $/head	35.22	31.21	0.38	<0.01
Interest, $/head	40.06	44.45	0.28	<0.01
Death loss, $/head	14.55	14.17	0.07	<0.01
Total cost[7], $/head	962.23	960.76	4.25	0.74
Economic return				
System COG,[8,9] $/cwt	51.44	50.91	0.60	0.40
Feedlot COG,[8,9] $/cwt	45.88	43.75	0.59	<0.01
Breakeven,[9] $/cwt	70.60	70.18	0.54	0.45
Live value,[10] $/head	1,008.78	1,030.03	5.48	<0.01
Grid value,[11] $/head	999.47	1,029.76	9.05	<0.01
Live P/L,[3] $/head	46.54	69.26	7.50	0.01
Grid P/L,[3] $/head	37.24	69.00	10.14	0.01

[1]WCGF = wet corn gluten feed. Also includes added cost of supplementing ionophores in intensive group.

[2]Winter steer value = sale price if intensive sold for $82.67/45 kg and normal sold for $85.67/45 kg.

[3]P/L = profit or loss.

[4]Profit of steers if sold after wintering period.

[5]Summer steer value = sale price if intensive sold for $83.86/45 kg and normal sold for $79.00/ 45 kg.

[6]Profit if steers sold after summer grazing.

[7]Total cost of production for the entire system.

[8]COG = cost of gain.

[9]Cost presented as $/45 kg.

[10]Live sale price of $73.82/45 kg for intensive and $75.10/45 kg for normal.

[11]Carcass base price of $120.01/45 kg for intensive and $121.84 for normal.

Table 8. Economics as a main effect of sorting

Item	Sorted	Unsorted	SEM	*P*-value
Steer cost, $/head	543.12	541.28	3.57	0.62
Wintering cost, $/head				
WCGF[1]	38.37	38.37	0.12	1.00
Hay cost	25.84	25.85	0.14	0.90
Summer cost, $/head				
Grass cost	82.51	82.46	1.38	0.95
Feedlot cost				
Feed cost, $/head	137.40	130.43	1.55	<0.01
Yardage, $/head	34.32	32.11	0.38	<0.01
Interest, $/head	42.75	41.76	0.28	<0.01
Death loss, $/head	14.39	14.33	0.07	0.47
Total cost,[2] $/head	967.55	955.44	4.25	0.02
Economic return				
System COG,[3,4] $/cwt	51.18	51.17	0.60	0.99
Feedlot COG,[3,4] $/cwt	44.71	44.93	0.59	0.72
Breakeven,[4] $/cwt	70.31	70.47	0.54	0.77
Live value,[5] $/head	1,026.77	1,012.03	5.48	0.02
Grid value,[6] $/head	1,028.93	1,000.31	9.05	<0.01
Live P/L,[7] $/head	59.21	56.59	7.50	0.73
Grid P/L,[7] $/head	61.38	44.87	10.14	0.13

[1]WCGF = wet corn gluten feed.

[2]Total cost of production for the entire system.

[3]COG = cost of gain.

[4]Cost presented as $/45 kg.

[5]Live sale price of $74.46/ 45kg.

[6]Carcass base price of $120.93/45 kg.

[7]P/L = profit or loss.

had increased ($P < 0.01$) wintering period cost of $22.48/head compared with NORM. If steers had been sold at the conclusion of the wintering period, INT steers would have been valued $14.16 greater ($P < 0.01$) than NORM; however, when incorporating initial animal cost and total cost of winter production, NORM steers would have been $9.05/head more profitable ($P = 0.01$) than INT.

During the period of summer grazing, NORM steers grazed 50 d longer than INT steers, leading to increased grass utilization and increased grass cost of $34.11/head ($P < 0.01$). When evaluating cost for the entire summer grazing period, INT steers had $34.07/head lower cost ($P < 0.01$) than NORM. Steer value was $29.33/head greater for INT compared with NORM ($P < 0.01$) if steers were sold at the end of the summer period. When incorporating initial steer cost, wintering period cost, and summer grazing cost and subtracting from steer value at the end of summer grazing, INT steers would have been $40.19/head more profitable than NORM because of a reduction in summer grazing cost and time of marketing, because INT steers would have been marketed at a price of $83.86/45 kg and NORM steers marketed at a price of $79.00/45 kg.

During the finishing period, INT steers had $12.29 greater ($P < 0.01$) feed cost and $4.01 greater yardage cost compared with NORM because of increased days fed. Accrued interest for the entire production system was $4.39/head less ($P < 0.01$) for INT compared with NORM because of a reduction in the number of days owned (317 vs. 355 d). Total cost of production ($P = 0.74$), breakeven ($P = 0.45$), and cost of gain ($P = 0.40$) for the entire system were not different when comparing INT and NORM. However, feedlot cost of gain was lower ($P < 0.01$) for NORM compared with INT because of better G:F throughout the finishing period. When evaluating value at the end of the finishing period, live value and grid value were $21.25 and $30.29 greater ($P < 0.01$), respectively, for NORM compared with INT. Live and grid profitability were $22.72 and $31.76 greater ($P < 0.01$), respectively, for NORM compared with INT. The increase in final animal value is because of time of market and lower cost of gain for NORM compared with INT. In November, when NORM steers were sold, the live steer market was $1.28/45 kg greater compared with the October market in which INT steers were sold.

Sorting Economics

Sorting treatments were not imposed until feedlot entry; therefore, cost of production for SORT and UNSORT (Table 8) were similar for winter and summer grazing periods ($P > 0.97$). Feed costs were $6.97/head greater ($P < 0.01$) for SORT compared with UNSORT. Yardage cost ($P < 0.01$) and interest charges ($P < 0.01$) were $2.21 and $0.99/head greater for SORT vs. UNSORT. The increase in feed cost, yardage, and interest are associated with the 6-d increase in days fed for SORT compared with UNSORT. Increased feed cost, yardage cost, and interest cost led to an increase in total cost of production for SORT compared with UNSORT ($967.55 vs. $955.44/head; $P = 0.02$). However, breakevens ($P = 0.77$) and feedlot cost of gain ($P = 0.72$) were not different when comparing SORT to UNSORT. Live value ($P = 0.02$) and grid value ($P < 0.01$) were $14.74 and $28.62/head greater for SORT than UNSORT, respectively. However, live profit ($P = 0.73$) was not significantly different due to sorting, but grid profit ($P = 0.13$) approached significance, as

SORT was $16.51/head more profitable than UNSORT.

The 9- and 6-kg increase in final BW and HCW, respectively, is the reason that SORT were more valuable in both live markets and grid pricing when compared with UNSORT. Additionally, the 8.1 percentage unit decrease in overweight carcasses helped increase the value of SORT marketed on the grid when compared with UNSORT. However, this increase in value was not realized in profitability because of the increase in the cost relative to the increase in the number of days fed for SORT compared with UNSORT.

IMPLICATIONS

This study illustrates that differences in steer performance and steer profitability can be achieved during all periods of a yearling cattle production system. Normal managed steers were most profitable when retained through the finishing period. Profit for INT was greatest if steers were sold at the end of summer grazing. Sorting increased the amount of weight sold because heavier cattle with potential for overweight discounts were marketed earlier, and lighter cattle were fed longer to achieve greater final BW at harvest time. Ultimately, all cattle are sold on a grid because cattle buyers estimate cattle that would receive discounts in a pen based on plant grids and previous buying experiences. When sorted cattle are sold on the grid and overweight discounts are reduced, there is potential for increased profit.

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