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CASE STUDY: Stocker and Feedlot Performance of Beef Heifers Sired by Braunvieh and Wagyu Bulls from Angus-, Brahman-, Senepol-, and Tuli-sired Dams[1]

W. A. Phillips,*[2] PAS, J. W. Holloway,† B. Warrington,† and B. C. Venuto*
*USDA-ARS, Grazinglands Research Laboratory, El Reno, OK 73036; and †Texas AgriLife Reseach, Uvalde, TX 78801

ABSTRACT

Female beef calves not retained within the cow-calf enterprise are sold and moved through the same production phases as male calves to produce finished beef. The objective of this study was to compare the stocker and feedlot performance of beef heifers of different tropically adapted breed types. Calves were sired by Braunvieh (yr 1) and Wagyu (yr 2) bulls. Dams were Angus × Angus, Brahman × Angus, Senepol × Angus, and Tuli × Angus. Calves were born in the spring and weaned in the fall and shipped from Texas to Oklahoma for growth and finishing. Data were analyzed as a randomized complete block design using the GLM procedure. Year was confounded with breed of sire and was considered fixed. Year × dam breed was used as the error term. Rate of gain during the posttransit recovery period (0.57 ± 0.15 kg) and during the winter (1.05 ± 0.08 kg) and spring (0.31 ± kg) stocker phases were not different ($P > 0.10$) among the 4 dam breed types. At the end of the winter grazing period (approximately March 20), mean BW within each breed group was greater than 330 kg; at these BW, heifers could be exposed to bulls to create replacement females. Heifers not sold as replacements could be finished on pasture, using a combination of intensive early stocking management, followed by ad libitum access to an energy-dense ration on pasture in a self-feeder. Heifers from Angus × Angus and Tuli × Angus cows had greater ($P < 0.05$) marbling scores and QG than heifers from Brahman × Angus and Senepol × Angus dams when finished on the farm. In conclusion, heifer calves from dams with 0 or 50% tropically adapted breeding gained enough BW as stockers to be bred in March and marketed as replacement females. Heifer calves not sold as replacement females can be retained and finished on the farm to produce finished beef.

Key words: tropically adapted breed, heifer, beef cattle, stocker, carcass trait

INTRODUCTION

Female beef calves not retained within the cow-calf enterprise are sold and moved through the same production phases as male calves to produce finished beef. Because female beef calves grow at a slower rate and are not as efficient in converting DM into carcass BW as male calves, they can be purchased at a lower cost per kilogram of BW (Langemeier et al., 2001; Troxel et al., 2002). However, female beef calves have more postweaning marketing opportunities than steer calves. If a moderate rate of BW gain (>0.7 kg) is achieved during the winter, heifers purchased in the fall can be sold as replacement females in the spring (Clanton et al., 1983; Bagley, 1993; Beck et al., 2005). Stocker calves grown on winter wheat pasture gain BW at a moderate rate, and differences in rate of BW gain between female and male beef calves are small (Phillips et al., 2004).

[1] Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty of the product by the USDA and does not imply approval to the exclusion of other products that may be suitable.

[2] Corresponding author: bphillip@grl.ars.usda.gov

Therefore, wheat pasture stocker producers could purchase female calves in the fall to decrease animal costs ($/calf) and to increase their marketing options (St. Louis et al., 2003; Beck et al., 2005). Cow-calf producers in the southern United States use the Brahman breed to incorporate genetic adaptability to heat stress into their cow herds, but the Brahman have the potential for poorer feedlot ADG (Phillips et al., 2001), marbling scores (Boyles and Riley, 1991; Phillips et al., 2001), and carcass quality (Sherbeck et al., 1996; Riley et al., 2003) as compared with calves with little or no Brahman breeding. To improve the overall value of calves from southern cow herds while maintaining tropical adaptability, non-Brahman tropically adapted breeds, such as Senepol and Tuli, are being evaluated. Stocker and feedlot performance data comparing heifer calves with Brahman, Senepol, and Tuli breed composition are not available. Therefore, the objective of this study was to compare the stocker and feedlot performance of beef heifers from Senepol- and Tuli-sired dams to Brahman- and Angus-sired dams.

MATERIALS AND METHODS

This experiment was conducted over a 2-yr period at the USDA-ARS Grazinglands Research Laboratory near El Reno, Oklahoma (35°32′ N, 98°2′ W). All procedures used in this study followed the recommendations of the Consortium (1988) and were approved by the USDA-ARS Grazinglands Research Laboratory Animal Care and Use Committee. Calves born in yr 1 were sired by Braunvieh bulls, and the calves born in yr 2 were sired by Wagyu bulls. Dams were Angus × Angus (**AA**), Brahman × Angus (**BA**), Senepol × Angus (**SA**), and Tuli × Angus (**TA**) and ranged in age from 5 to 9 yr. Calves were reared at the Texas AgriLife Research Ranch near Kline, Texas (29°02′ N, 100°14′ W). Calves were born in the spring and reared on mixed-brush rangeland that consisted primarily of *Acacia*, *Prosopis*, *Setaria*, *Helaria*, and *Bouteloua* spp. Calves were weaned in the fall (average calendar date = November 15) and heifers calves (mean age = 268 d) were transported 800 km to El Reno, Oklahoma. Immediately after arrival, calves were individually weighed, placed in a pasture, given ad libitum access to warm-season grass hay, and allowed to recover from the stress of transit before beginning the stocker phase of the study.

Each year during the stocker phase of the study, calves were managed as a single group, and wheat was the primary forage resource for grazing. During the winter phase (December through mid-March) of yr 1, no wheat pasture was available because of a drought. Therefore, calves were confined to a dormant warm-season grass pasture with ad libitum access to warm-season grass hay and a self-feeder containing a diet of 63.5% ground corn, 18.0% ground alfalfa hay, 10% cottonseed meal, 5% molasses, 2% limestone, 0.8% sodium bicarbonate, 0.7% magnesium oxide, and 44 mg monensin/kg of the diet. Magnesium oxide was used to limit intake of the mixed diet to a target level of 1% of BW. The mixed diet was formulated to contain 14% CP, 1.86 Mcal/kg NE_m, and 1.20 Mcal/kg NE_g. The combination of hay and mixed diet was calculated to yield an ADG (0.8 to 1.0 kg) similar to that anticipated if winter wheat pasture had been available. In yr 2, calves grazed wheat pastures during the winter phase of the study as a single group at a stocking rate of 2.5 calves/ha.

At the end of the winter phase, calves were individually weighed and the stocking rate was increased to 4.7 heifers/ha. Calves were managed as a single herd and grazed annual cool-season grasses, predominantly winter wheat and *Bromus* sp., until the finishing phase began in June of each year. At the end of the spring stocker period, calves were individually weighed on 2 consecutive days, stratified by dam breed, and randomly assigned to 1 of 2 Bermudagrass (*Cynodon dactylon*) pastures at a stocking rate of 6.4 heifers/ha. After 43 d of grazing, approximately 80% of the standing forage had been removed, and a self-feeder containing a high-energy diet was placed in each pasture. Heifers remained on pasture with ad libitum access to the high-energy diet, which contained 12.3% CP, 2.06 Mcal/kg NE_m, and 1.34 Mcal/kg NE_g. In yr 1, the finishing diet contained 35 mg monensin/kg (Rumensin, Elanco Animal Health, Indianapolis, IN) and 11.5 mg tylosin/kg (Tylan, Elanco Animal Health). In yr 2, the diet contained 33 mg lasalocid/kg (Bovatec, Alpharma Animal Health, Bridgewater, NJ). Dietary DM was determined weekly by drying a sample in a forced-air oven at 60°C for 72 h.

Before entering the finishing phase of the study, heifers were treated for internal parasites (Ivomec Plus, Merial, Rathway, NJ) and were implanted with 200 mg testosterone and 20 mg estradiol (Synovex-H, Fort Dodge Animal Health, Overland Park, KS). Heifers were considered finished when the fat thickness over the 12th to 13th rib was ≥10 mm, which was estimated visually by experienced personnel. The day before slaughter, calves were removed from the pasture, weighed individually, and shipped the next morning to Amarillo, Texas (350 km), for processing. Hot carcass weight, LM area, fat thickness over the 12th to 13th rib, marbling score (300 = slight, 400 = small, and 500 = modest), quality score (11 = Select, 12 = Low Choice, and 13 = Choice), and YG were collected on each carcass by the Cattleman's Carcass Data Service (West Texas A&M University, Canyon, TX).

Data were analyzed as a randomized complete block design using the GLM procedure (SAS Institute Inc., Cary, NC). The study could be conducted for only 2 yr, and a different breed of sire was used each year. Therefore, year was confounded with breed of sire. The combination of year and breed of sire was considered as fixed and was used as a block. The GLM model was Y = block, breed of dam, and block × breed of dam. Block × breed of dam was used as the error term. When a significant *F*-test ($P <$ 0.10) was observed, differences among

Table 1. Least squares means and SE for heifer arrival and final BW and ADG during the postarrival recovery period and winter, spring, and winter plus spring (overall) portions of the stocker phase

	Breed of dam[1]			
Item	AA	BA	SA	TA
Arrival BW, kg	230 ± 5.7[c]	265 ± 4.2[a]	255 ± 6.3[ab]	243 ± 4.4[bc]
Final BW, kg	354 ± 6.6	379 ± 5.6	380 ± 8.5	365 ± 5.5
ADG, kg				
Recovery phase, 34 d	0.62 ± 0.04	0.53 ± 0.03	0.55 ± 0.05	0.58 ± 0.03
Winter phase, 85 d	0.93 ± 0.03	0.82 ± 0.02	0.90 ± 0.03	0.89 ± 0.02
Spring phase, 81 d	0.33 ± 0.03	0.31 ± 0.02	0.25 ± 0.04	0.35 ± 0.02
Overall, 166 d	0.64 ± 0.02	0.59 ± 0.02	0.59 ± 0.03	0.63 ± 0.02

[a–c]Means in the same row with different superscript differ, $P < 0.05$.

[1]Breed of dam = Angus × Angus (AA), Brahman × Angus (BA), Senepol × Angus (SA), and Tuli × Angus (TA) dams; sired by Braunvieh (yr 1) and Wagyu (yr 2) bulls.

means were determined by using the least significance difference procedure. All means are presented as least squares means ± SE.

RESULTS AND DISCUSSION

Lifetime performance and efficiency of the F_1 dams used in this study were reported by Holloway et al. (2005). In general, BA dams weaned heavier calves than SA and TA dams. The BA dams had greater BW, but they were not as productive or as efficient as TA dams. The TA dams had less BW, matured earlier, and were more reproductively efficient than BA dams. The TA dams proved to be well adapted to the mixed-brush rangeland and semiarid conditions of south Texas, whereas SA dams were poorly adapted. It was concluded that if TA dams were used, cow herd productivity and efficiency could be improved in comparison with using BA dams. Heifers used in this experiment were born over a 76-d calving period and at weaning had a BCS of 4.6 ± 0.25 (scale of 1 to 9) and a frame score of 5.1 ± 0.54 (scale of 1 to 9). Body condition score and frame score were not different ($P > 0.10$) among the 4 breed types used in this experiment.

Stocker Performance

Heifer calves from BA cows had greater ($P < 0.05$) BW at arrival than heifer calves from AA cows (Table 1). Heifer calves from SA and TA cows were intermediate in arrival BW in comparison with the other 2 dam-breed groups. By the end of the winter and spring stocker periods, BW were similar ($P = 0.17$) among dam-breed types. Calves from BA dams were heavier at arrival because they expressed more positive maternal heterosis than the calves from SA or TA dams (Thrift et al., 1997). Senepol are considered to be tropical *Bos taurus* and Tuli are Sanga type, and when crossed with Angus will not produce the level of heterosis that can be achieved when *Bos indicus* are crossed with Angus (Cundiff et al., 1999; Jenkins and Ferrell, 2004). In the present experiment, the contribution of tropically adapted breeds to the genetic makeup of the calf was 25%. As a result, winter ADG was improved over that reported for purebred tropically adapted calves grazing winter wheat pasture in Oklahoma (Phillips et al., 2006).

During the winter phase of yr 1, no wheat pasture was available. In lieu of wheat pasture, calves had ad libitum access to a mixed diet in a self-feeder and warm-season grass hay. Heifers consumed an average of 5.7 kg/d (as is) of mixed diet and an estimated 2.0 kg of hay. Average daily gain during this period was 1.03 kg, which was greater ($P < 0.01$) than the 0.74 kg/d observed during the winter phase of yr 2. Providing a mixed diet plus ad libitum access to hay can be used to reduce the production risk associated with uncertainty of fall wheat forage production (Phillips et al., 2006).

The winter stocker ADG observed in the present experiment falls within the range (0.8 to 1.2 kg) expected for stocker calves grazing winter wheat pasture from November through March in central Oklahoma (Mader et al., 1983; Horn et al., 1995; Hersom et al., 2004). Daily BW gains during the spring portion of the winter wheat grazing season (March to May) should equal or exceed ADG during the winter (Phillips and Albers, 1999). In this experiment, spring ADG were lower than winter ADG because the spring grazing season was extended to take advantage of other annual cool-season grasses (*Bromus* sp.) and forbs that were present in the wheat pastures. This technique has been used in other experiments at this location (Phillips et al., 1991, 2001, 2004) to increase calf BW before entering the feedlot, to reduce the time needed for finishing, to alter the final marketing date, and to lessen the finishing feed cost. Delaying the beginning of the finishing period to June also allowed warm-season grass pastures to accumulate biomass so that intensive early grazing could be used to finish cattle on grass rather than in confinement (Phillips et al., 2004). Other reports also have shown reduced spring ADG when the grazing season is extended and no differences in spring ADG among nontropically and tropically adapted breeds (Phillips et al., 2004, 2006). These data also demonstrate the need for high-quality forages to fill the forage gap between the end of the winter wheat grazing season and the beginning of the perennial warm-season grass season. Northup et al. (2009) have successfully used perennial cool-season grasses to fill this void.

At the end of the winter grazing period (average calendar date March 20), AA, BA, SA, and TA heifers had BW of 331, 354, 352, and 340 kg (pooled SE = 8), respectively. These observed BW are approximately 70% of the anticipated mature BW for these breed types of a 5.5-yr-old cow (Holloway et al., 2005). By the end of the winter grazing period, heifers were heavy enough to be exposed to bulls to create bred heifers to be sold later as replacement females (Granger et al., 1990; Bagley, 1993; Beck et al., 2005). However, Beck et al. (2005) reported that the high N content of cool-season annuals could reduce reproductive performance. Therefore, heifers should be shifted to a diet containing less N before entering a breeding season.

Calf sire breed and year were confounded in this study, so no clear comparisons could be made between Braunvieh-sired (yr 1) and Wagyu-sired (yr 2) heifer calves. Heifers used in yr 1 were heavier ($P < 0.01$) at arrival (265 vs. 232 kg) and had greater ($P < 0.05$) winter ADG (1.04 vs. 0.74 kg) than heifers used in yr 2. Braunvieh bulls were used in yr 1, and these heifers had greater ($P < 0.01$) overall ADG (0.68 vs. 0.54 kg) but less ($P < 0.01$) spring ADG (0.26 vs 0.35 kg) than the Wagyu-sired heifers used in yr 2.

Feedlot Performance

Initial and final BW were not different ($P > 0.10$) among the 4 dam-breed groups (Table 2). Average daily gain during the first 38 (yr 1) and 48 (yr 2) d of the finishing period, when calves were consuming only Bermudagrass, was 33% less than when calves were consuming a combination of Bermudagrass and the mixed diet from the self-feeder (Table 2). At the beginning of the finishing period, pastures had 2,400 ± 294 kg forage DM/ha available for grazing. Therefore, forage availability did not limit ADG during the grass-only period. Gain was less because nutrient density in the Bermudagrass was less as compared with the mixed diet. Although heifers had less ADG during the grass-only period, BW gain was 242 kg/ha (6.4 head/ha × 43 d × 0.88 kg/d). Intensive early stocking can be used by managers of warm-season grass pastures to increase the amount of beef produced per unit area. Under this management strategy, calves are able to harvest as much of the forage as possible during the early part of the grazing season, when forage quality is high. When compared with season-long grazing of warm-season grasses, intensive early stocking can produce more BW gain per hectare (Phillips and Coleman, 1995; Phillips et al., 2003).

Hot carcass weight, dressing percentage, LM area, fat thickness, and YG were not different ($P > 0.10$) among the 4 dam breeds (Table 2). However, heifers from AA and TA cows had greater ($P < 0.05$) marbling scores and QG than heifers from BA and SA dams. Huffman et al. (1990) reported lower marbling scores for steers containing 50 or 75% Brahman breeding as compared with steers with only 25% Brahman breeding and concluded that increasing the percentage of Brahman breeding decreased marbling. Chase et al. (2001) reported that SA and TA bulls had lower shear force values than BA bulls, but produced less carcass weight. In general, Tuli-sired calves are early maturing, with less mature BW but greater marbling scores than Brahman-sired calves (Herring et al., 1996). However, in some cases BA steers have been reported to have higher marbling scores than SA and TA steers (Phillips et al., 2004). In the present study, calves were only 25% Brahman, 25% Senepol, or 25% Tuli. Lower marbling scores were observed in calves from BA and SA dams as compared with calves from AA and TA dams.

Heifers finished in yr 1 were sired by Braunvieh bulls, whereas the heifers finished in yr 2 were sired by Wagyu bulls. Heifers finished in yr 1 had greater ($P < 0.10$) a carcass weight (325 vs. 303 kg) and LM area (90 vs. 79 cm^2) than heifers finished in yr 1. However, in yr 2 heifers sired by Wagyu bulls had a greater ($P < 0.10$) dressing percentage (61.6 vs. 60.0), marbling score (small^{60} vs. small^{30}), fat thickness (1.44 vs. 1.12 cm), and YG (2.92 vs. 2.23) than heifers sired by Braunvieh bulls (yr 1). Because initial BW of heifers fed in yr 2 was less (346 vs. 392 kg) than the initial BW in yr 1, heifers in yr 2 were fed longer ($P < 0.01$) as compared with yr 1 (132 vs. 127 d), but ADG was not different ($P > 0.10$) between yr 1 and 2 (1.21 vs. 1.10 kg). Heifers fed in yr 1 produced greater ($P < 0.10$) hot carcass weights (325 vs. 303 kg) than heifers fed in yr 2 because final BW was greater ($P < 0.05$; 538 vs. 492 kg).

Braunvieh cattle originated in Switzerland and have been used in developing composite beef breeds (Gregory et al., 1994). The Wagyu is a Japanese breed and is used to produce heavily marbled carcasses (Wertz et al., 1998). It would be anticipated that the Braunvieh-sired calves would have a greater BW and daily growth rate than Wagyu-sired calves, but that Wagyu-sired calves would produce carcasses with greater marbling (Myers et al., 1999; Arango et al., 2002; Kuber et al., 2004). Although breed of sire was confounded with year, differences in carcass characteristics observed between yr 1 and 2 were probably due to the breed of sire.

During the finishing period, the average amount of DM consumed per heifer was 865 ± 18 kg and feed efficiency was 124 g BW gain/kg DM. In previous experiments with BA, SA, and TA steer calves, calves finished on pasture consumed more feed and had greater feed efficiencies than those observed in the present experiment

Table 2. Least squares means and SE for heifer BW, number of days in the finishing phase, ADG during 2 phases (grass only and grass + feed) of the finishing phase, and carcass traits

	Breed of dam[1]			
Item	AA	BA	SA	TA
Final BW, kg	497 ± 8.2	515 ± 6.6	538 ± 11.3	511 ± 6.8
Days to finish, d	128 ± 2.0	126 ± 1.6	126 ± 2.6	128 ± 1.7
ADG,[2] kg				
Grass only	0.79 ± 0.06	0.94 ± 0.05	0.95 ± 0.08	0.84 ± 0.05
Grass + feed	1.28[b] ± 0.06	1.16[c] ± 0.05	1.49[a] ± 0.08	1.33[b] ± 0.05
Overall	1.11 ± 0.04	1.08 ± 0.02	1.29 ± 0.05	1.15 ± 0.03
Carcass traits				
Hot carcass weight, kg	303 ± 4.9	314 ± 3.9	328 ± 6.7	310 ± 4.0
Dressing percent, %	60.95 ± 0.31	61.04 ± 0.25	60.51 ± 0.43	60.69 ± 0.26
Marbling score[3]	486[a] ± 18	395[b] ± 15	424[b] ± 25	470[a] ± 15
QG	12.4[a] ± 0.2	11.5[b] ± 0.2	11.8[b] ± 0.3	12.3[a] ± 0.2
YG	2.60 ± 0.13	2.59 ± 0.11	2.54 ± 0.18	2.57 ± 0.11
LM area, cm^2	83.2 ± 2.1	82.6 ± 1.7	88.1 ± 2.9	85.5 ± 1.7
Fat thickness, cm	1.30 ± 0.07	1.19 ± 0.06	1.29 ± 0.10	1.34 ± 0.06

[a–c]Means in the same row with different superscripts differ, $P < 0.05$.

[1]Breed of dam = Angus × Angus (AA), Brahman × Angus (BA), Senepol × Angus (SA), and Tuli × Angus (TA) dams; sired by Braunvieh (yr 1) and Wagyu (yr 2) bulls.

[2]Grass only = ADG during the intensive stocking phase of the finishing period (38 d in yr 1 and 48 d in yr 2); grass + feed = ADG from the placement of the self-feeder in the pasture after the intensive stocking phase until the end of the finishing phase.

[3]Slight^{00} = 300, small^{00} = 400, and modest^{00} = 500 (e.g., 450 = small^{50}).

(Phillips et al., 2004). Langemeier et al. (2001) reported that heifers consumed less feed (9%), had slower ADG (11%), and had poorer feed efficiencies (3%) than steers. As result, the cost of BW gain would be greater for heifers than steers. However, if large discounts for carcass nonconformance can be avoided, carcasses from heifers will have the same value as those from steers. Tatum et al. (2006) determined that carcass weight was the most important driver of carcass value ($/head) when the spread between Choice and Select QG was low.

IMPLICATIONS

The majority of beef calves produced on southern US cow-calf farms do not remain on the farm of origin for postweaning development. Instead, they are sold and transported to a more temperate environment for growth and development on pasture before entering a feedlot for finishing. By purchasing heifer calves instead of steer calves to graze winter wheat pasture, producers can reduce the cost ($/kg) paid for calves but increase the number of postweaning marketing opportunities. Body weight gain for heifer calves during the stocker phase is similar to that anticipated for steer calves. By March, heifer calves could be marketed as replacement females, sold as stockers for spring grazing, or placed in a feedlot for finishing. Producers can retain ownership of heifer calves not sold as replacement females, and by using intensive early stocking on warm-season grasses, followed by ad libitum access to a high-energy diet, can produce a finished carcass with less feed grain input as compared with traditional confinement feeding. Tuli × Angus dams can replace Brahman × Angus dams in cow herds in southwest Texas to increase reproductive efficiency without reducing postweaning calf performance. In addition, the carcass quality of calves finished on the farm will be improved.

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