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Summary with Implications

This study retrospectively evaluated the effect of cow size on cow-calf performance and post-weaning steer feedlot performance of cows at the Gudmundsen Sandhills Laboratory, Whitman. Cows were categorized at small, medium, or moderate within cow age from 13 years of data. Small cows had decreased reproductive performance, weaned smaller calves, and produced steer progeny with smaller carcass weights. In this dataset and under the environmental and management conditions at Gudmundsen Sandhills Laboratory, overall productivity of the cowherd decreased as cow size decreased with 1,150 to 1,200 lb cow being the most productive cow size.

Introduction

Optimizing cow herd production efficiency is a combination of feed inputs and output. In doing so, ranch efficiency requires an understanding and managing for genetic potential (i.e., cow size, milk production) and how it fits within the given environment and environmental constraints. Mature cow size of the herd has long been debated on what the optimal cow size for a given environment is. Cow size has traditionally been utilized in selecting cows to fit their environmental conditions. Cow size studies; however, are often limited in duration and size, done as simulation studies, or usually end at weaning. In semi-arid and limited resource environments, small to moderate size cows have been suggested to be more efficient than and as productive as larger cows. However, within environments, there may be a limitation where selection for moderation in the cow herd may limit overall production. Therefore, the objectives of this study was to retrospectively analyze cow size data to determine the effects cow size in the Nebraska Sandhills on cow performance, calf performance, and post-weaning performance of feedlot steers.

Procedure

The University of Nebraska–Lincoln Institutional Animal Care and Use Committee approved all procedures used in this experiment. Cow performance data were collected from 2005 to 2017 at the Gudmundsen Sandhills Laboratory (Whitman, NE) from March (n = 3,448) and May (n = 934) calving herds.

Cows utilized in this study were Husker Red (5/8 Red Angus, 3/8 Simmental) and ranged from 2 to 11 yr of age. To correct for differences in BCS at weaning, cow body weight at weaning was adjusted to a common body condition score of 5. Cow size groups were then determine by taking the average adjusted BW within each age and stratifying to groups as small (< 1 standard deviation from mean within age), medium (within 1 standard deviation from mean with age), or moderate (> 1 standard deviation from mean with age). Grouping cow size within age was conducted to normalize data within age of cows so that younger cows would not automatically fall into small cow size and confound results by cow age. Cow size treatment groups were stratified within age to eliminate young cows not yet at mature BW from being miscategorized into the small category. In addition, young cows were left in the dataset to determine if cow age interacts with cow size on productivity. Cow BW at weaning ranged from 642 to 1745 lb with only 3% of cows over 1250 lb at weaning over the years.

Over the years, calf management varied slightly depending on research. In general, calves were vaccinated at 2 mo of age with an infectious bovine rhinotracheitis, parainfluenza-3 virus, bovine respiratory syncytial virus, and bovine viral diarrhea type I and II vaccine (BoviShield 5, Zoetis, Florham Park, NJ). Calves were also weighed, branded, and male calves were castrated. Cow-calf pairs then grazed native upland range pastures. At weaning, calves were weighed and vaccinated against bovine rotavirus-coronavirus clostridium perfringens types C and D and *Escherichia* (Bovine Rota-Coronavirus Vaccine, Zoetis, Florham Park, NJ). After weaning, March-born steer calves (n = 1,186) were placed in a drylot and consumed ad libitum hay for 2 weeks post-weaning after which they were transported to West Central Research and Extension Center (WCREC), North Platte. After weaning, May-born steers (n = 386) grazed subirrigated meadow with 1 lb of supplement or received ad libitum hay with 4 lb of supplement until approximately 1 yr of age then relocated to WCREC.

At feedlot entry, all steer calves were implanted with 14 mg estradiol benzoate and 100 mg trenbolone acetate (Synovex Choice, Zoetis) and transitioned over 21 d to a common finishing diet of 48% dry rolled corn, 40% corn gluten feed, 7% prairie hay, and 5% supplement. From 2005 to 2010, steers were pen fed for the finishing period after the arrival at WCREC. Starting in 2011, steers were placed in a GrowSafe feeding system (GrowSafe Systems Ltd., Airdrie, Alberta, Canada) approximately 2 wk after arrival at WCREC. All steer BW was measured on 2 consecutive days before feedlot entry. In addition, from 2011 to 2017, steers were weighed again 10 d after acclimating to the GrowSafe feeding system. The average of the 2-d BW following acclimation was considered the initial feedlot entry BW used in measuring feedlot performance (BW change, DMI, and ADG) was calculated from the average BW. Approximately 100 d before slaughter, calves were implanted with 28 mg estradiol benzoate and 200 mg trenbolone acetate (Synovex Plus, Zoetis). March-born steer calves were managed similarly during finishing as the May-born calves; however, steer calves were fed as a group in drylot pens. Each year, steers were slaughtered at

Table 1. Effect of cow size on cow-calf performance in the Nebraska Sandhills

Measurement	Cow Size[1] Small	Medium	Moderate	SEM	*P*-value
Cow BW, lb					
Calving	961[a]	1,080[b]	1,187[c]	6	< 0.01
Breeding	947[a]	1,065[b]	1,178[c]	6	< 0.01
Weaning	882[a]	1,025[b]	1,187[c]	5	< 0.01
Cow BW change, lb					
Calving to weaning	-72[a]	-54[b]	0[c]	5	< 0.01
Cow BCS[2]					
Calving	4.8[a]	5.1[b]	5.3[c]	0.06	< 0.01
Breeding	5.2[a]	5.4[b]	5.6[c]	0.02	< 0.01
Weaning	4.9[a]	5.1[b]	5.2[c]	0.03	< 0.01
Pregnancy rate, %	86[a]	92[b]	97[c]	3	< 0.01
Calf BW, lb					
Birth	72[a]	76[b]	79[c]	0.6	< 0.01
Breeding	226[a]	235[b]	240[c]	2	< 0.01
Weaning	460[a]	483[b]	498[c]	3	< 0.01
205-d	425[a]	452[b]	474[c]	3	< 0.01
Cow size weaned[3], %	52.5[a]	47.7[b]	42.9[c]	0.4	< 0.01
Calf ADG, lb/d					
Birth to breeding	2.03[a]	2.12[b]	2.13[b]	0.02	< 0.01
Birth to weaning	1.78[a]	1.87[b]	1.94[c]	0.01	< 0.01

[abc]Within a row, means with differing superscript letter differ ($P < 0.05$).

[1]Cow size determined by adjusting cow BW at weaning to a BCS 5.

[2]Scale of 1 (emaciated) to 9 (extremely obese).

[3]Calculated by dividing calf weaning BW by dam weaning BW.

a commercial facility (Tyson Fresh Meats, Lexington, NE) when estimated visually to have 0.5 in fat thickness over the 12th rib. Carcass data were collected 24 h post slaughter and final BW was calculated from hot carcass weight (HCW) based on average dressing percentage of 63%.

Data were analyzed using the PROC MIXED and GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). Models included the effect of cow size, cow age, calving season, and calf sex for all appropriate data. Cow age was used as a blocking term. Data are presented as LSMEANS and *P*-values ≤ 0.05 were considered significant and tendencies were considered at a $P > 0.05$ and $P \leq 0.10$.

Results

Cow Performance Results

Cow BW at pre-calving, breeding, and weaning were greater as cow size increase ($P < 0.01$; Table 1), expected due to the experimental design. Moderate cows maintained BW from calving to weaning; whereas, small and medium sized cows lost BW ($P < 0.01$). In addition, BCS was lower ($P < 0.01$, Table 2) for small-sized cows at pre-calving, pre-breeding, and weaning. Pregnancy rates increased with increasing cow size ($P < 0.01$) with the lowest pregnancy rates in small cows. The increase in BW loss and decrease in pregnancy rate in small-sized beef cows may be due to an imbalance of genetic potential for milk production and ability to consume enough forage to support that milk production level. Although milk production level will increase forage intake, cow size will have larger impact on forage intake. Therefore, milk production in the small-sized cows may have been too great for the nutritional environment of the Sandhills, resulting in greater BW loss and decreased reproductive performance.

Calf BW at birth, breeding, weaning, and 205-d weight increased ($P < 0.01$, Table 1) as cow size increased. Calf ADG from birth to breeding was lower ($P < 0.01$) in calves from small-sized dams, where offspring from medium- and moderate-sized cows having similar ADG to breeding. Overall ADG from birth to weaning was greater ($P < 0.01$) in calves from moderate-sized cows. Although, as a percent of cow size, small-sized beef cows did wean a greater ($P < 0.01$) percentage of their BW compared with their larger counterparts, which is expected. In general, small cows tend to be more efficient at weaning a larger percentage of their BW than larger cows.

Post-weaning Steer Performance

Steer feedlot entry BW increased ($P < 0.02$, Table 2) as dam size increased. Steer BW at reimplant tended ($P = 0.07$) to increase with increased dam size. In addition, final BW was greater ($P < 0.01$) for steer from moderate cows with no difference in finishing BW between steers from small and medium cows. Although finishing steer BW were lighter from smaller cows, small cows did have steers with a finishing feedlot BW approximately 1.5 times their mature BW. Feedlot ADG, DMI, and G:F were not different ($P \geq 0.52$) among steers from dams with increasing cow size. Similar to final BW, HCW increased ($P < 0.01$) in steers from moderate dams with no difference between steers from small and medium cows. Marbling score and yield grade were not different ($P > 0.39$) regardless of dam size. However, LM area and back fat thickness were different ($P < 0.05$) in steers from differing sized dams. Steers from small cows had decreased LM area compared to their counterparts with no difference between steers from moderate- or medium-sized cows. On the other hand, back fat thickness was greater for steers from small cows compared with steers from moderate- and medium-sized cows.

Conclusion

Cow size can have a big impact on cow-calf productivity in the Sandhills. As size increased, productivity of the cows and offspring increased linearly. However, it is important to note cows in this study were very moderate with few cows over 1,250 lb. Larger cows than cows in this study may have different results than reported here

Table 2. Effect of cow size on steer progeny feedlot performance

	Cow Size[1]				
Measurement	Small	Medium	Moderate	SEM	*P*-value
Feedlot performance, lb					
Entry BW	656[a]	667[b]	693[c]	15	0.02
Reimplant[2] BW	1,027	1,042	1,068	22	0.07
Final BW	1,399[a]	1,413[a]	1,469[b]	22	< 0.01
ADG, lb/d					
Entry to reimplant	4.07	4.04	3.91	0.30	0.71
Reimplant to final	3.75	3.81	3.83	0.18	0.74
Overall	3.91	3.95	3.88	0.13	0.66
Dry matter intake, lb					
Entry to reimplant	27.52	27.33	27.87	0.98	0.79
Reimplant to final	27.51	27.50	27.97	0.94	0.88
Overall	27.45	27.42	27.83	0.88	0.89
Gain:Feed					
Entry to reimplant	0.1485	0.1486	0.1366	0.0107	0.52
Reimplant to final	0.1377	0.1398	0.1354	0.0050	0.54
Overall	0.1463	0.1476	0.1421	0.0067	0.66
Carcass characteristics					
HCW, lb	881[a]	890[a]	925[b]	14	< 0.01
Marbling[3]	506	506	505	16	0.99
LM area, in^2	14.07[a]	14.22[b]	14.41[b]	0.12	0.05
Back fat, in	0.60[a]	0.55[b]	0.53[b]	0.03	0.01
USDA yield grade	3.06	2.95	2.98	0.14	0.39

[abc]Within a row, means with differing superscript letter differ ($P < 0.05$).

[1]Cow size determined by adjusting cow BW at weaning to a BCS 5.

[2]Approximately, 100 d prior to slaughter.

[3]Marbling: Small^{00} = 400, Small^{50} = 450, Modest^{00} = 500.

depending on the environmental conditions and constraints. In addition, this study does not take into account forage intake by cow size. As cow size increases, forage intake will increase. Due to the decrease in forage intake, cow herd size could be increased and offset the decreased reproductive performance in the small-sized cows.

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