Abstract W29

Combining ability of nine tropically adapted and temperate breeds for growth and ultrasound traits in Colombia

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ABSTRACT

The objective of this research was to compare the combining ability of sires from 2 tropically adapted *Bos Taurus* breeds (Blanco Orejinegro: BON; Romosinuano: RS), 3 tropically adapted *Bos indicus* breeds (Gray Brahman: GB; Guzerat: GZ; Red Brahman: RB), and 4 temperate *Bos taurus* breeds (Braunvieh: BV; Limousin: LIM; Normand: NM; Simmental: SIM) when mated to Gray Brahman cows for birth weight (BW), and adjusted weights (W), ultrasound rib eye area (REA) and backfat (BF) measured at 4 (W4, REA4, BF4), 7 (W7, REA7, BF7), 12 (W12, REA12, BF12), and 15 (W15, REA15, BF15) mo of age. Data were from 352 calves (22 to 100 per breed group) sired by 37 bulls (3 to 12 sires per breed). The GB cows were from 2 herds located in an area of Colombia classified as dry tropical forest. Cows and calves were kept under pasture conditions with a complete mineral supplement. The model included breed group of calf, contemporary group (herd-year-season-sex) and age of calf (ultrasound traits only) as fixed effects and sire and residual as random effects. Least squares means (LSM) for BW, W4 and W7 were similar across breed groups, whereas calves from SIM sires were heavier than calves from GB sires at 12 (P < 0.0009)and 15 mo of age(P < 0.0008). The LSM for REA were similar for calves from all breed groups, except for crossbred calves from LIM sires whose REA were larger than those from calves from GZ (P < 0.0078), NM (P < 0.0103), SIM (P < 0.0143), and RB sires (P < 0.0002)at 4 mo age, and from GB-sired calves at all ages (P < 0.0224 to P < 0.0002). The LSM for BF were similar across breed groups and calf ages. Thus, SIM sires had the best combining ability for growth and LIM sires had the best combining ability for REA under the pasture conditions of this dry tropical forest region of Colombia.

Keywords: crossbreeding, growth, ultrasound

INTRODUCTION

Colombian beef cattle productivity is below the world average. Thus, it is important to evaluate the available genetic resources in regions of the country where environmental conditions are favorable for beef production. Although approximately 72% of the Colombian cattle population is Zebu, Colombia has eight *Bos taurus* native breeds that like zebu are resistant to the tropical stress conditions, and a number of highly productive introduced temperate *Bos taurus* beef breeds. This variety of breeds suggests that crossbreeding system would be an efficient mating strategy to quickly increase the productivity level of beef cattle in the country. The large number of *Bos taurus* beef breeds in Colombia and available resources makes it necessary to test the combining ability of a few tropically adapted and temperate breeds at a time. Traits to be evaluated include growth, ultrasound, and carcass traits. Although growth traits are important, the migration of the industry to the concept of value based market has shifted the attention of producers to carcass quality and yield (Houghton and Turlington, 1992). Carcass price and quality are determined by its protein and fat contents (Hausman et al., 2008). Rib eye area and backfat have medium to high heritabilities and are highly correlated with total meat and fat yields (Wilson et al., 1992), thus they are useful traits for genetic improvement programs. No research on genetic evaluation for these traits exists in Colombia either in purebred or in crossbred cattle populations. Thus, the objective of this research was to compare the combining ability of sires from two tropically adapted *Bos taurus* breeds (Blanco Orejinegro: BON; Romosinuano: RS), three tropically adapted *Bos indicus* breeds (Gray Brahman: GB; Guzerat: GZ; Red Brahman: RB), and four temperate *Bos taurus* breeds (Braunvieh: BV; Limousin: LIM; Normand: NM; Simmental: SIM) when mated to Gray Brahman cows for birth weight and weights and ultrasound backfat and rib eye area measurements taken at a 4, 7, 12, and 15 months of age.

MATERIALS AND METHODS

Animals. Thirty-seven bulls of nine breeds were randomly mated to 1209 Gray Brahman cows and heifers. Bull breeds were: Blanco Orejinegro (BON), Braunvieh (BV), Gray Brahman (GB), Guzerat (GZ), Limousin (LIM), Normand (NM), Red Brahman (RB), Romosinuano (RS) and Simmental (SIM). Heifers were selected based on their weight (> 350 kg), whereas cows were selected based on their parity (> two) and a normal healthy reproductive system. Heifers and cows were randomly assigned to bulls and mated using a fixed time artificial insemination protocol. Calves were born in 2008 and 2009. The number of sires per breed was 12 for GB, 4 for RB, and 3 for BON, BV, GA, LIM, NM, RS, and SIM. Table 1 shows the number of bulls per breed and the number of calves per breed group by year of birth and total.

Table 1. Number of sires per breed and number of calves per breed group and birth year

Sire Breed	Number of sires	Breed group of calf	Number of calves		
			2008	2009	TOTAL
BON	3	BON × GB	21	12	33
BV	3	BV × GB	13	9	22
GB	12	GB × GB	64	36	100
GZ	3	GZ × GB	18	10	28
LIM	3	LIM × GB	21	15	36
NM	3	NM × GB	22	15	37
RB	4	RB × GB	27	8	35
RS	3	RS × GB	18	11	29
SIM	3	SIM × GB	22	10	32
TOTAL	37		226	126	352

Management. Animals were from two herds (Cabezas and Santa Helena) located in the municipality of Aguachica, department of Cesar, Colombia. The region is 50m above the sea level, has a mean temperature of 28^{0}C, a relative humidity of 80% and is classified as a very dry tropical forest. Animals were kept on pastures composed of Brachipará (*Brachiaria plantaginea*), Guinea (*Panicum maximum*) and Angleton (*Dichantium aristatum*) grasses. The only supplement offered to animals was a commercial mineral supplement with phosphorus content of 8% (Ganasal®, Colombia).

Traits. Five growth traits were considered: birth weight (BW, kg) and adjusted weights at 4 months (W4, kg), 7 months (weaning; W7, kg), 12 months (W12, kg) and 15 months of age (W15, kg). The eight ultrasound traits were area of the Longissimmus dorsi muscle or rib eye area (REA, mm^2), and backfat (BF, mm) between 12th and 13th rib measured at approximately 4 months (REA4 and BF4), 7 months (REA7 and BF7), 12 months (REA12 and BF12), and 15 months of age (REA15 and BF15). Actual calf ages at ultrasound measurements were reference age ± 2 months. Ultrasound measurements were taken by trained personnel (Colombian Zebu cattle Breeders Association, ASOCEBÚ, Bogotá D.C., Colombia) using an Aquila Esaote model device and Echo Image Viewer software of Pie Medical (Pie Medical Equipment B.V., Maastricht, Limburg, The Netherlands).

Genetic Analysis. A univariate mixed model was used for BW and adjusted weights. The mixed model included breed group of calf and contemporary group (herd*year*season*sex subclass) as fixed effects, and sire and residual as random effects. The univariate model for ultrasound traits contained all the effects for growth traits plus a covariate for age of calf because ultrasound records were not adjusted for age. Sires were nested within breeds, and relationships among sires were accounted for. Thus, sire random effects had mean equal to their respective breeds, and variance equal to A*σ_s^2, where A = additive relationship matrix, and $\sigma_s^2 = ¼\ \sigma_A^2 = ¼$ additive genetic variance, assumed to be the same for all breeds in this study. Residual effects were assumed to have mean zero, a common variance σ_e^2 and be uncorrelated. Because all calves were F1, sire breed effects were confounded with individual heterosis effects. Computations were carried out with the MIXED procedure of SAS (SAS, 2009). Least square means (LSM) for calf breed groups were compared with the Bonferroni multiple mean comparison test.

RESULTS AND DISCUSSION

Contemporary group effects were significant for all traits (P < 0.0001 to P < 0.0297), except for REA12. Age of calf was significant for ultrasound traits (P < 0.0001 to P < 0.0323), except for BF4 and BF12. Least squares means (LSM) for BW, W4 and W7 were similar across breed groups (Table 2), whereas calves from SIM sires were heavier than calves from GB sires (42.8 ± 9.9 kg; P < 0.0009) at 12 mo of age, and heavier than calves from RB sires (32.6±9.5; P < 0.0309) and GB sires (35.0 ± 7.9 kg; P < 0.0008) at 15 mo of age. At this age, calves from BON sires were heavier than those from GB sires (27.1 ±7.4; P < 0.0146). The LSM for REA were similar for calves from all breed groups (Table 3), except for crossbred calves from LIM sires whose REA were larger than those from calves from GZ (11.4 ± 3.0 mm^2; P < 0.0078), NM (11.0 ± 2.9 mm^2; P < 0.0103), SIM (10.3 ± 2.8 mm^2; P < 0.0143) and RB sires(11.0± 2.9 mm^2; P < 0.0079) at 4 mo age, and from calves from GB sires at 4 (11.3 ± 2.4 mm^2; P< 0.0002), 7 (6.8 ± 1.9 mm^2; P< 0.0174), 12 (9.7 ± 1.8 mm^2; P< 0.0224), and 15 mo age (11.3 ± 2.8 mm^2; P < 0.0051). Thus, SIM sires had the best combining ability for growth and LIM sires were the best for REA under pasture conditions in this dry tropical forest region.

Table 2. Calf breed group least square means (LSM[1]) and standard errors (SE) for growth traits

BREED GROUP	BW		W4		W7		W12		W15	
	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LS M	SE
BON × GB	32.72^{a}	1.54	122.96^{a}	5.62	182.86^{a}	5.45	251.82^{ab}	8.82	285.98^{ac}	6.34
BV × GB	34.22^{a}	1.57	113.5^{a}	6.34	178.09^{a}	5.90	249.99^{ab}	9.64	276.02^{abc}	9.08
GB × GB	33.64^{a}	1.01	114.49^{a}	4.18	173.40^{a}	3.66	232.61^{b}	5.27	258.90^{b}	4.48
GZ × GB	34.14^{a}	1.60	114.80^{a}	5.51	180.24^{a}	6.51	245.61^{ab}	9.94	263.97^{abc}	8.38
LIM × GB	33.73^{a}	1.55	128.92^{a}	5.29	181.17^{a}	5.69	252.01^{ab}	8.60	283.07^{abc}	8.32
NM × GB	32.55^{a}	1.58	120.25^{a}	5.61	179.54^{a}	5.68	256.33^{ab}	9.36	281.18^{abc}	6.41
RB × GB	33.60^{a}	1.48	113.24^{a}	5.49	174.43^{a}	5.77	253.06^{ab}	8.98	261.29^{ab}	6.80
RS × GB	28.36^{a}	1.59	124.08^{a}	6.05	176.02^{a}	5.81	243.29^{ab}	9.14	290.30^{abc}	9.24
SIM × GB	32.48^{a}	1.54	122.96^{a}	5.45	191.74^{a}	6.14	275.40^{a}	9.03	293.89^{c}	6.88

[1]Least square means with different superscripts show significant differences (P < 0.0002 to 0.0224)

Table 3. Calf breed group least square means (LSM[1]) and standard errors (SE) for ultrasound rib eye area

BREED GROUP	REA4		REA7		REA12		REA15	
	LSM	SE	LSM	SE	LSM	SE	LSM	SE
BON × GB	37.75^{ab}	2.17	42.45^{ab}	1.7	43.05^{ab}	2.61	44.52^{ab}	2.25
BV × GB	35.85^{ab}	2.34	41.27^{ab}	1.97	44.86^{ab}	2.86	41.92^{ab}	3.10
GB × GB	35.80^{a}	1.49	41.33^{b}	1.20	40.10^{b}	1.53	41.34^{b}	1.50
GZ × GB	35.19^{a}	2.38	45.58^{ab}	1.99	42.47^{ab}	3.14	43.14^{ab}	2.71
LIM × GB	45.71^{b}	2.22	48.15^{a}	1.80	49.76^{a}	2.50	52.66^{a}	2.62
NM × GB	36.27^{a}	2.27	42.17^{ab}	1.71	40.71^{ab}	2.74	45.10^{ab}	2.34
RB × GB	35.40^{a}	2.21	42.06^{ab}	1.78	44.77^{ab}	2.51	45.26^{ab}	2.24
RS × GB	38.01^{ab}	2.56	42.04^{ab}	1.87	43.98^{ab}	2.89	48.83^{ab}	2.61
SIM × GB	36.61^{a}	2.20	40.82^{ab}	2.03	49.19^{ab}	2.75	44.18^{ab}	2.26

[1]Least square means with different superscripts show significant differences (P <0.0008 to 0.0309)

The LSM for BF were similar across breed groups and calf ages suggesting that breed group of calf was not an important source of variation. The *Bos taurus* and *Bos indicus* sire breeds included in this study have low precocity, thus fat deposition under the pasture conditions of the dry tropical forest environment in the 2 herds likely prevented differences in their genetic potential for fat deposition to be expressed. Adipose tissue is highly influenced by nutrition, management, and maturity factors (Owens et al., 1995; Hausman et al., 2009). Thus, the young age of the animals, the low precocity of the breeds, and the pasture conditions in the 2 herds may all have contributed to lack of significance of BF among crossbred groups of calves here.

CONCLUSIONS

Simmental sires had the best combining ability for growth traits and Limousin sires had the best combining ability for REA under the pasture conditions of this dry tropical forest region of Colombia. This study provided objective information about crossbred progeny performance of tropically adapted and temperate sire breeds and heterosis effects useful for designing beef cattle crossbreeding programs in Colombia.

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