Abstract M43

Heritabilities, genetic correlations and genetic trends for age at first calving and calving intervals in a Colombian Blanco Orejinegro-Angus-Zebu cattle population

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SUMMARY

Age at first calving and calving interval are traits that have substantial impact on production costs of beef cattle operations in Colombia. However, assessment of genetic variation and evaluation of animals in multibreed populations for these traits is scant. Thus, the objectives of this research were to estimate **genetic parameters and trends for age at first calving (AFC), interval between first and second calving (CI1), and interval between second and third calving (CI2) in a Colombian beef cattle population composed of Blanco Orejinegro, Angus, and Zebu straightbred and crossbred animals.** Data were analyzed using multiple trait mixed model procedures. Variance components and genetic parameters were estimated by Restricted Maximum Likelihood. The 3-trait model included the fixed effects of contemporary group (year-season of calving-sex of calf; sex of calf for CI1 and CI2 only), age of cow at calving (CI1 and CI2 only), breed direct genetic effects, and individual heterosis. Random effects were cow direct genetic and residual. Relationships among cows were accounted for. Program AIREML was used to perform computations. Heritabilities estimates for additive direct genetic effects were 0.15 ± 0.13 for AFC, 0.11 ± 0.06 for CI1, and 0.18 ± 0.11 for CI2. Low heritabilities for AFC, CI1, and CI2 suggest that nutrition and reproductive management should be improved to allow fuller expressions of these traits. Correlations between additive direct genetic effects for AFC and CI1 (0.33 ± 0.41) and for AFC and CI2 (0.40 ± 0.36) were medium and favorable, suggesting that selection of heifers for AFC would improve calving interval. Cow direct genetic AFC, CI1, and CI2 yearly means from 1989 to 2004 showed negative trends, suggesting that some selection for these traits existed in this population during these years.

INTRODUCTION

Beef production in Colombia is largely extensive (MADR, 2005) and primarily based on *Bos indicus* and *Bos taurus* x *Bos indicus* cattle, where *Bos indicus* is represented by Commercial Zebu and Brahman cattle, and *Bos taurus* breeds are Angus, Senepol, Simmental, and Criollo breeds (Blanco Orejinegro, Romosinuano, and Sanmartinero). Genetic evaluation of animals in Colombian multibreed populations for reproductive efficiency traits has not been conducted in spite of their large impact on production costs.

Two measurements of reproductive efficiency that are frequently taken in Colombian farms with extensive management systems are age at first calving and calving interval. Genetic improvement of these traits could have a major impact on beef productions costs. Shortening of age at first calving would decrease the cost of raising heifers for replacement and shortening of calving intervals would decrease production costs per calf produced per year.

The objectives of this research were the estimation of genetic parameters and genetic trends for age at first calving, calving interval between the first and second calving, and calving interval between the second and third calving in a large commercial enterprise in the department of Antioquia in Colombia.

MATERIALS AND METHODS

Animals and data. Data consisted of 1,630 ages at first calving (AFC), 1,221 of intervals between first and second calving (CI1), and 1,110 of intervals between second and third calving (CI2) collected at farm La Leyenda from 1989 to 2004. La Leyenda is located in the municipality of Caucasia, department of Antioquia, Colombia and it is owned by a large private cattle company (Custodiar S.A., Medellin, Colombia). Breeds represented in the dataset were Blanco Orejinegro (BON; a beef Criollo breed), Angus (A), and Commercial Zebu (Z). Table 1 presents numbers of cows by breed-group-of-sire x breed-group-of-dam combination .

Table 1. Number of cows by breed-group-of-sire x breed-group-of-dam combination for AFC, CI1, and CI2

		Breed group of sire			
Breed group of dam	Trait	A	BON	Z	AxZ
BON	AFC		10		
	CI1		5		
	CI2		8		
Z	AFC	788	53	638	
	CI1	634	22	493	
	CI2	555	22	498	
AxZ	AFC	3	18	108	9
	CI1	2	3	57	5
	CI2			27	
¾Zx¼A	AFC	3			

Management and feeding. Heifers and cows were maintained in a rotational grazing system. Pastures were composed mainly of *Brachiaria brizhanta* and *Brachiaria humidicola*. During the dry season (December to March), cattle were fed corn silage, and either sorghum or guinea grass. Cows and calves were maintained together up to weaning around 240 days of age.

Heifers and cows had their first mating by artificial insemination, and then placed in a paddock with a bull for 50 to 70 d. Mating occurred throughout the year. Pregnancy status was determined by rectal palpation. Estimated days of pregnancy at palpation is used to help determine whether a pregnancy was product of artificial insemination or natural mating.

Genetic predictions and genetic parameters. A 3-trait model involving AFC, CI1, and CI2 was used to obtain genetic predictions and estimates of variances and covariances. Variance components were estimated by Restricted Maximum Likelihood. The model included the fixed effects of contemporary group (year-season of calving-sex of calf; sex of calf for CI1 and CI2 only), age at calving (CI1 and CI2 only), breed direct genetic effects, and direct heterosis. Random effects for AFC, CI1 and CI2 were cow direct genetic and residual. Program AIREML (Misztal, 1997; Tsuruta, 1999) was used to perform computations. Genetic predictions were computed as a weighted sum of breed genetic effects and cow random effects (Elzo and Wakeman, 1998). Yearly means of EBV for cow AFC, CI1 and CI2 direct genetic effects were computed to study genetic trends between 1989 and 2004. Genetic trends were computed as a linear regression of yearly means on year using the procedure GLM of the Statistical Analysis System (SAS, 2007).

RESULTS AND DISCUSSION

Means and standard deviations were 1124 d and 145 d for AFC, 578 d and 101 d for CI1, and 523 d and 99 d for CI2.

Breed effects. Angus and BON had smaller AFC breed direct effects than Zebu under the tropical environmental conditions in Antioquia (Table 2). The CI2 breed direct effects for Angus were shorter than and those for BON similar to Zebu. These breed effects suggest that purebred Zebu and crossbred females with **high Zebu fractions took longer to calve for the first time and tended to have longer calving intervals** than crossbred cows with higher fractions of Angus and BON.

Table 2. Estimates of differences among direct breed effects

	Trait		
Breed	AFC (d)	CI1 (d)	CI2 (d
Angus-Zebu	-281 ± 42; P < 0.001	-7 ± 51; P = 0.56	-95 ± 50; P = 0.08
BON-Zebu	-162 ± 32; P < 0.001	-7 ± 39; P = 0.72	18 ± 32; P = 0.55
Angus-BON	-119 ± 30; P < 0.001	0 ± 38; P = 0.70	-113 ± 41; P = 0.001

Heterosis effects. Estimates of direct heterosis effects were -26 ± 21 d (P = 0.18) for AFC, -40 ± 26 d (P < 0.11) for CI1, and 16 ± 25 d (P < 0.49) for CI2. Although non-significant, estimates of direct heterosis for AFC and CI1 may be an indication that it **could help decrease AFC and CI1, thus be economically advantageous in this population.**

Genetic parameters. Table 3 shows estimates of genetic parameters for AFC, CI1, and CI2. Estimates of heritability for all traits were low suggesting genetic improvement for these traits would be slow in this population. If nutrition and reproductive management were improved, this may permit fuller expressions and potentially faster genetic progress for these traits in this population.

Genetic correlations between AFC and CI1, and AFC and CI2 direct genetic effects were positive (but with large standard errors), suggesting that selection of heifers for AFC might improve calving interval.

The positive genetic correlation between direct additive effects for CI1 and CI2 suggests that selection of cows for short first calving intervals could reduce second calving intervals.

Table 3. Heritabilities (on diagonal), genetic (above) and phenotypic (below) correlation

	Trait		
	AFC	CI1	CI2
AFC	0.15 ± 0.13	0.33 ± 0.41	0.40 ± 0.36
CI1	0.40 ± 0.04	0.11 ± 0.06	0.99 ± 0.54
CI2	0.09 ± 0.05	0.09 ± 0.05	0.18 ± 0.11

Weighted genetic means per year. Genetic trends for all traits were negative (Table 4). Figure 1 shows the trends for yearly EBV means of cows for AFC, CI1, and CI2 direct genetic effects. The steepest negative trend was for AFC (-6.26 d/yr). This decline was likely due primarily to the introduction of Angus sires into this multibreed population, and secondarily to phenotypic selection for these traits that also existed in this population during these years.

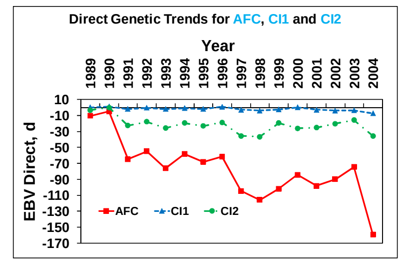

Table 4. Direct genetic trends for cows for AFC, C1, and C2

Trait		
AFC (d/yr)	CI1 (d/yr)	CI2 (d/yr)
-6.26 ± 1.19 (P =0.0002)	-0.32 ± 0.009 (P =0.002)	-1.16 ± 0.48 (P =0.029)

FINAL REMARKS

- **Low heritabilities** for age at first calving, calving interval between the first and second calving, and calving interval between the second and third calving, indicate that genetic progress for these traits in this population would be slow.
- **Positive genetic correlations** among age at first calving, calving interval between the first and second calving, and calving interval between the second and third calving would help improve all these traits in this population.
- **Age at first calving** decreased by 150 days from 1989 to 2004 due to a large extent to the use of Angus sires in this multibreed population.

LITERATURE CITED

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