BREED EFFECTS AND INDIVIDUAL HETEROSIS FOR PREGNACY, CALVING AND WEANING RATES IN CRIOLLO, GUZERAT AND F1 COWS

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INTRODUCTION

In developing countries the relevance of including indigenous cattle in crossbreeding systems have been stated as an important factor to have successful breeding programs in beef cattle (Cartwright y Blackburn, 1989). In México there are several groups of Criollo cattle which are considered an indigenous population. In the mountain region of the state of Nayarit, México, a Criollo cattle population of around 16,000 heads is located (Martínez, 2005). In 1990, the National Institute for Forestry and Agricultural Research (INIFAP) started a diallel mating system with Criollo and Guzerat cattle to evaluate additive and nonadditive genetic effects for several traits. Up to date, results suggest that Guzerat x Criollo cows are an efficient option to produce calves for feedlot in Nayarit, México (Ruiz, 2005). The objectives of this study were to estimate direct and maternal genetic effects and individual heterosis influencing pregnancy, calving and weaning rates of Criollo, Guzerat, Criollo x Guzerat and Guzerat x Criollo cows.

MATERIAL AND METHODS

Reproductive data was recorded from Guzerat (G, n=202), Criollo (C, n=126), Criollo x Guzerat (CG, n=101), and Guzerat x Criollo (GC, n=35) cows since 2000 until 2003 at El Verdineño (INIFAP), located in Nayarit, México. El Verdineño is 60 m above sea level, with an average daily temperature of 24 ^{0}C, an average rainfall of 1200 mm and a dry season of seven to eight months (Secretaría de Programación y Presupuesto, 1981). Cows grazed mostly in llanero grass (*Andropogon gayanus*) and received a molasses-urea supplement from March to May of each year. Reproductive management included two breeding seasons beginning on March 15th and September 15th of each year. Cows were bred by AI using semen of Angus bulls during 45 days each breeding season. Calving seasons were from December to February and from June to August. Calves were weaned at seven months of age, on average.

Statistical analyses were carried out with the GENMOD procedure of SAS, considering a binomial distribution and repeated measurements (SAS, 2001). The GENMOD procedure can be applied to generalized linear models to estimate parameters of variables having the Normal, Binomial or Poisson distribution among others (Nelder and Wedderburn, 1972). Each variable was defined as total amount of cows in a breeding season dividing the total amount of cows in estrus (TE), pregnant (TG), calving (TP) or weaning (TD) from the same breeding season. Thus, TE, TG, TP or TD was codified as one if the female showed estrus, was pregnant, calved or weaned a calf and as zero, otherwise. Final models for TE and TG included the fixed effects of genotype of the cow (GE = G, C, CG and GC), productive status (E, with or without a calf), number of calving (NP), season of breeding and year of breeding. Fixed effects fitted to the model for TP and TD were GE, E, NP, season of calving and year of calving. Least squares means (MCM) from the analyses were converted as follows: $e^{(MCM)}$ / ((1+e)MCM). Contrasts were used to estimate individual heterosis and differences between direct and maternal genetic effects of Guzerat and Criollo based on models of Dickerson (1969; 1973). Differences between direct genetic effects of G and C were calculated as (G + GC - C - CG). Differences between maternal genetic effects were estimated as CG - GC.

RESULTS AND DISCUSSION

Least-squares means for TE, TG, TP and TD are presented in Table 1. Averages for TE and TG of G cows were different ($P<.10$) from all other genotypes. Percentages of estrus and pregnancies in the study indicate a better reproductive performance of C, CG and GC. Results published by Rios et al. (1996) showed pregnancy rates of 85±5, 82±4 and 79±5 % for crossbred cows which included as parental breeds Angus, Hereford and Brown Swiss while pregnancy rates for Indobrasil and Brahman cows were of 66±4 and 67±4 %. Other study carried out by Olson et al. (1993) with Angus, Brahman and Charolais reported pregnancy percentages of 92.9 and 93.0 in cows of two and three breed crosses while the average percentage of purebreds was 85.8. In contrast, no differences were found by Corva et al. (1995) between pregnancy rates of Angus (65.7 %), and F1 Criollo x Angus (65.1 %) cows, however, the same study showed a pregnancy rate of 80.0 % for F1 Angus x Criollo.

Table 1. Least squares means (%), individual heterosis and differences between direct and maternal genetic effects for estrus (TE), pregnancy (TG), calving (TP) and weaning (TD) rates of Guzerat (G), Criollo (C), Guzerat x Criollo (GC) and Criollo x Guzerat (CG) cows

	TE	TG	TP	TD
G	49 ± 13^{a}	46 ± 12^{a}	42 ± 14^{a}	38 ± 14^{a}
GC	82 ± 17^{b}	72 ± 16^{b}	71 ± 15^{b}	63 ± 21^{b}
CG	75 ± 10^{b}	64 ± 11^{b}	56 ± 12^{ac}	54 ± 13^{b}
C	69 ± 09^{b}	60 ± 09^{b}	59 ± 10^{bc}	52 ± 10^{b}
Individual heterosis	20*	15*	13*	13*
Guzerat – Criollo	TE	TG	TP	TD
Direct effects	-14^{ns}	-6^{ns}	-2^{ns}	-5^{ns}
Maternal effects	-6^{ns}	-7^{ns}	$-15^{¤}$	-9^{ns}

^{a,b,c} Means with no common superscript differ ($P<.10$).
* ($P<.10$) $^{¤}$ ($P\leq.10$) ^{ns} ($P>.10$)

No differences ($P>.10$) were detected between CG and G for TP (Table 1). This lack of differences could be attributable to additional embryonic or fetal losses occurring in CG cows which contributed to diminish the previous advantage showed for this genotype over G cows. Results for TP suggest that G cows or daughters of G cows had a less favorable maternal environment to support the survivability of the embryo or fetus, compared to C cows or daughters of C cows. Peacock and Koger (1980), analyzing data from cows managed under subtropical environment, reported calving rates of 92±2.4 and 90±2.6 % for Angus x Brahman and Charolais x Brahman cows while calving rates for purebred Angus, Brahman and Charolais were of 75±3.9, 90±3.8 and 80±3.5 %, respectively. Other experiment carried out by Rios et al. (1996) indicated better calving rates of Angus x Zebú (80±5 %), Hereford x Zebú (81±5 %) and Brown Swiss x Zebú (76±6 %) cows compared to Charolais x Zebú (67±6 %), Brahman (65±4 %) and Indobrasil (56±5 %) cows. Similarly, higher calving rates were reported by Williams et al. (1990) for reciprocal crosses of Angus x Brahman (75.4±8.5 and 75.9±5.8 %), Charolais x Brahman (78.3±6.2 and 71.1±8.3 %) and Hereford x Brahman (71.8±5.8 and 74.5±9.2 %) compared to Brahman (63.1±1.6 %) cows. In contrast, results with *bos taurus* crosses (Corva et al., 1995) showed similar calving rates for Angus x Criollo, Criollo x Angus, Angus and Criollo cows (86.5±7.6, 82.3±4.8, 83.1±2.9 and 82.0±4.3 %, respectively).

G cows had the lowest performance for TD (Table 1) being different ($P\leq.10$) in 14, 16 and 25 % to C, CG and GC genotypes. These results suggest less maternal ability of Zebu cows from calving to weaning and/or less survivability of their calves. Data published by Peacock and Koger (1980) showed weaning rates of 87±2.7 and 84±2.9 % for Angus x Brahman and Charolais x Brahman crosses while purebred Angus, Charolais and Brahman cows had averages of 67±4.4, 75±4.0 and 82±4.4 %, respectively. Similarly, Rios et al. (1996) reported higher weaning rates for Charolais x Zebú (61±6 %), Brown Swiss x Zebú (73±6 %), Hereford x Zebú (73±5 %) and Angus x Zebú (74±5 %) compared to Indobrasil (56±4 %) and Brahman (48±5 %) cows. Slighter differences were found by Corva et al. (1995) comparing weaning rates of Angus x Criollo and Criollo x Angus (83.3±8.2 and 79.5±5.2 %) to Angus and Criollo cows (74.7±3.2 y 77.9±4.6 %).

Results from this study suggest a better reproductive performance of GC, CG and C cows. Thus, GC, CG and C genotypes could be considered as part of a strategy to improve the reproductive efficiency of beef herds in the tropical region of Nayarit, México.

Heterosis estimates were positive (P<.10) for all traits (Table 1). Olson et al. (1993), analyzing data from a rotational crossbreeding system which included Angus, Brahman and Charolais breeds, reported heterosis estimates for calving rate of 7.1±4.0, 3.0±3.6, 6.3±3.2 and 7.2±3.6 % for F1, F2, backcrosses and three breed crosses, respectively. Peacock and Koger (1980) working with Angus x Brahman and Charolais x Brahman cows found heterosis estimates of 6.4 and 4.7 % for calving rate and 11.0 and 4.0 % for weaning rate. Similar and lower percentages for calving and weaning rates were published (Williams et al., 1990) for Angus x Brahman (5.8±6.6 and 4.8±7.3 %), Charolais x Brahman (3.9±6.7 and -1.0±7.4 %) and Hereford x Brahman (3.1±7.1 and 1.6±7.8 %) cows. Results from *Bos taurus* crosses (Corva et al., 1995) with Angus and Criollo breeds indicated heterosis estimates of 8.3±3.8, 9.3±4.1 and 10.1±4.1 % for pregnancy, calving and weaning rates.

Differences between direct genetic effects of Guzerat and Criollo were not important in this study (Table 1). In agreement with those results, Corva et al. (1995) did not find differences between direct genetics effects of Criollo and Angus breeds for calving rate (4.3±4.7 %) or weaning rate (4.9±4.7 %), however, differences were important (p<.05) for pregnancy rate (8.5±4.4 %) favoring Angus dams. A favorable effect for pregnancy rate was also found for direct genetic effects of Angus compared to Brahman and Charolais dams (Olson et al., 1993). On the other hand, an experiment conducted by Williams et al. (1990) indicated non significant (p>.05) direct genetic effects for calving or weaning rates of Hereford (7.1±3.6 and 7.0±4.0 %), Angus (3.6±3.7 and 5.9±4.0 %) or Charolais (-1.2±3.6 and -1.1±4.0 %) cows, although Brahman dams (-9.5±4.0 and -11.8±4.4 %) showed differences (p<.05) compared to those breeds. In contrast, Peacock and Koger (1980) reported no differences (p>.05) among direct genetic effects of Angus (-2.4±2.3 and -1.0±2.7 %), Brahman (3.5±2.3 and 3.2±2.0 %) and Charolais (-1.1±2.3 and -2.2±2.7 %) for calving and weaning rates, respectively.

Small or negligible differences between maternal genetic effects were detected in the study (Table 1). Estimates suggest a tendency of Criollo dams to be better than Guzerat dams, however, maternal genetic effects only were detected favorable (P≤.10) to Criollo cows in 15 % for TD. Similarly, Corva et al. (1995) did not find significant differences (P>.05) between maternal genetic effects of Criollo and Angus cows for pregnancy (9.6±6.2 %), calving (10.8±6.5 %) or weaning (10.8±6.6 %) rates. Non significant estimates (P>.05) were found for calving and weaning rates (Williams et al., 1990) for Brahman cows compared to average maternal genetic effects of Angus, Charolais and Hereford (1.7 and 1.9 %), for Charolais cows compared to average maternal genetic effects of Angus and Hereford (-8.2 and -8.4 %) and for Angus cows compared to Hereford (3.2 and 4.7 %). Another study published by Peacock and Koger (1980) reported negligible differences among maternal genetic effects for calving rate with percentages of 1.5±1.7, -0.1±1.7 and -1.4±1.7, and for weaning rate with percentages of -

0.6±1.8,-0.3±1.8 and 0.9±1.8 for Angus, Brahman and Charolais dams, respectively. Estimates from this study and literature results suggest that differences in direct and maternal genetic effects are not important for pregnancy, calving or weaning rate in beef cattle.

CONCLUSIONS

According to results GC and CG cows are good alternatives to produce beef calves in the tropical region of Nayarit, México. GC cows tended to show a better reproductive performance than CG cows. Individual heterosis was favorable for all traits. Differences between direct and maternal genetic effects were not relevant for Criollo and Guzerat.

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