Rev. prod. anim., 26 (1): 2014

Reproductive Performance of Chacuba Cattle Genotype

Ángel Ceró Rizo, Danilo Guerra Iglesias** y Manuel Rodríguez Castro***

*** Faculty of Agricultural Sciences, University of Camagüey, Cuba**

**** Research Center for Tropical Animal Breeding, Cuba**

angel.cero@reduc.edu.cu

ABSTRACT

Reproductive traits from Chacuba cattle genotype were characterized at the Livestock Center *Rescate de Sanguily* in Camagüey, Cuba. Traits assessed were calving to pregnancy interval, calving interval, and services per pregnancy. Data were collected from this enterprise, the Genetics National Center, and the Centers for Livestock Control from Camagüey and Havana. The data were statistically processed using SAS (1995) and ASREML (Gilmour *et al*., 2000) software packages. Services per pregnancy reached 1,66 inseminations, calving to pregnancy interval amounted 168,8 days, and calving interval ranged 456,7 days with inheritabilities of 0,05; 0,15, and 0,4. Estimated inheritabilities for the assessed reproductive traits showed low values.

Key Words: *reproductive trait, genetics, bovine, inheritability*

INTRODUCTION

Reproduction is the primary and decisive event to increase milk and beef production. The environmental factors, herd, number, season and calving year have a marked influence on genetic effects that are manifested through the genes inherited by the animal from its parents, which cause differences between animals that are kept under the same environmental conditions (Ossa *et al*., 2008 and Guerra *et al.,* 2009).

Rodríguez *et al.* (2005) reported that crossbreeding has been used in several countries to raise beef productivity. The superiority of this method has been corroborated when compared to purebreds in terms of reproduction, maternal skills and growth.

Silva *et al*. (2012) have emphasized that the reproductive features are vital for any livestock exploitation, but they are hard to measure or interpret, due to interactions among calves, cows and bulls. They have poor heredity, and also have different selection criteria, like age of first calving and calving intervals.

Rydhmer and Berglund (2006) have pointed out that the reproductive features are hard to deal with, both for variance estimation components and for genetic assessment, because they have poor heredity. Hence, to generate high accuracies they require plenty of information which is not commonly in the hands of researchers.

The purpose of this work was to determine reproductive features, such as service period (PS), calving intervals (IPP) and gestation services S/G); to estimate the genetic parameters for the above-mentioned features.

MATERIALS AND METODS

The data were collected from the department of technical control of the enterprise; the National Center for Livestock Control, in Havana and Camagüey; as well as the National Delegation of Bovine Genetics.

Artificial insemination was applied the year round, and calf natural raising, with weaning at 180 days of age, until 1992, and from 1993. When the economic crises struck the country in the nineties, weaning was practiced at 210 days of age.

The animals graze within nine herds on the San Diego Farm, at the *Rescate de Sanguily* Enterprise, all the year on native pasture, like texan (*Paspalum notatum*) and Camagüeyan (*Bothriochloa pertusa*); and cultivated pasture of guinea grass (*Panicum maximum*) and star (*Cynodon nlemfluensis*), and arborescent species, like algarroba (*Albizia saman*), pinyon (*Glyricidia sepium*) and *Leucaena leucocephala,* along with some species of native legumes, like *Desmodium, Centrosema* y *Calopogonium.*

Animal water supply was guaranteed, through water windmills connected to circular tanks and troughs around the area; as well as dikes and mini dams.

The reproductive features assessed were service period (PS) in days; calving intervals (IPP) in days; and gestation service (S/G) in inseminations performed. To estimate the non-genetic factors that affect PS, IPP and S/G, four mathematical models were used. The SAS GLM (1995) was also used. The female genotype, calving number and offspring sex were common in the models. Besides, same age groups (herd-year-calving season) were tested changing the season criterion from two-month to six month period. A single month was not analyzed, because more that 50 % of the groups were left with less than five contemporary calves. In general terms, the model can be stated as follows,

$$y_{ijklm} = \mu + GC_i + S_j + G_k + N_l + e_{ijklm}$$

Where:
Y: dependent variable of PS, IPP and S/G
G: fixed effect of female genotype (2)
S: fixed effect of calf sex (2)
N: fixed effect of calving number (8)
GC: same-age group in herd-year-season-calving season
e: random error

To estimate variance components, assessment was performed with ASREML (Gilmour et al., 2000), arranged as follows,

Each character was studied as an independent feature. The mathematical model in matrix notation was as follows,

$$y = Xb + Z1a + Z2m + e \quad (1)$$

Where:
y: observation vector for the feature studied
b: vector of fixed and co-variable effects
a: vector of random added effects on the animal (direct effects)
m: vector of random added maternal effects (maternal effects)
e: vector of random residual effects
X, Z1, Z2: design matrix that relates the data to fixed effects; added random effects in the animal and random added maternal effects, respectively
Where:
y: observation vector for PS, IPP and S/G
b: vector of fixed effects containing the RAT effect; female genotype; calving number and calf sex
a: vector of random effects in the animal
e: vector of random residual effects
X, Z: design matrices relating the data to fixed effect and animal, respectively

Multifactorial analysis of features

The model is represented as follows in matrix notation,

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} X_1 & 0 & 0 \\ 0 & X_2 & 0 \\ 0 & 0 & X_3 \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} + \begin{bmatrix} Z_1 & 0 & 0 \\ 0 & Z_2 & 0 \\ 0 & 0 & Z_3 \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} \quad (2)$$

Where:
yi: observation vector for i-differential feature
bi: vector of fixed and co-variable effects for i-differential feature
ai: vector of random effects in animals for i-differential feature
ei: vector of random residual effects for i-differential feature
Xi and Zi: design matrices relating the data with fixed and random effects, respectively

It is assumed that:

$$\text{var}\begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} g_{11}A & g_{12}A & g_{13}A & 0 & 0 & 0 \\ g_{21}A & g_{22}A & g_{23}A & 0 & 0 & 0 \\ g_{31}A & g_{32}A & g_{33}A & 0 & 0 & 0 \\ 0 & 0 & 0 & r_{11} & r_{12} & r_{13} \\ 0 & 0 & 0 & r_{21} & r_{22} & r_{23} \\ 0 & 0 & 0 & r_{31} & r_{32} & r_{33} \end{bmatrix}$$

Where:
gij: added genetic variance for i-differential feature i = j and genetic co-variance when i ≠ j
A: ratio matrix and rij is the residual variance when i = j and covariance when i ≠ j
Every feature was considered independent, but genetically and environmentally related to the others.
Where:
yi: observation vector for the *i*-differential feature (PS, IPP and S/G)

b*i*: vector of fixed effects containing the RAT effect, the female genotype, calving number and calf sex
a*i*: vector of random effects in the animal for the *i*-differential feature
e*i*: vector of random residual effects for the *i*-differential feature
X*i*, Z*i*: design matrices relating data and fixed and random effects, respectively

RESULTS AND DISCUSSION

The general means for PS, IPP and S/G are shown in Table 1. The PS and IPP means match studies by Alencar *et al.* (1993) in Brazilian Canchim breed; and Magaña *et al.* (2002), in several Cebu breeds, in Mexico; they are better than the results by Montaldo *et al.* (2006) for Simmental cattle, and not as good as results by Santana *et al.* (2004) in Cuban Cebu; where the means showed 218.9 and 509.1 days for PS and IPP, respectively. However, the values achieved in our study are over the 50-80 day range for PS; and 365-395 days for IPP, according to Brito (2010) for bovines. Though according to Veras (1999) there may be an extension of 85-110 days for PS and 365-400 days for IPP.

The lengthening of these characters may be caused, according to Calveras and Morales (2000), by poor nutrition, inappropriate hygiene and deficient handling after calving. There are other factors, like the sucking period and free access of calves to their mothers, which effect on post-calving by delaying follicular development and producing an increase in the service period and calving interval. These results corroborate reports by Lamb *et al.* (1997) regarding the inhibitory effect of sucking on ovarian activity producing ovary cycle restart delay.

The general mean for S/G was 1.66 inseminations (Table 1), with 1.6-2 considered acceptable for bovines (Brito, 2010). Similar values were presented by Planas and Ramos (2001) in Cebu, Charolaise and 5/8 Charolaise x 3/8 Cebú, in Cuban grazing conditions, with 1.8, 1.6, and 1.5 inseminations performed. Several researchers from the Center for Animal Breeding working on Cebu in Cuba, confirmed 1.76, 1.70 and 1.75 inseminations (Falcón *et al.,* 2005 and Guerra *et al.,* 2005).

The estimated heredity for PS, IPP and S/G through single and multi-factor analyses is shown in Table 2. PS had greater h^2 than reported by other researchers in Sahiwal (Santana *et al.* 2004) and Goyache *et al.* (2005) in Valley Asturian.

The heredity found for IPP (Table 2) was 0.15, very similar to reports by Johnson and Brunter (1996) in beef producing Aberdeen Angus, 0.06-0.19, and lower to findings by Cabral *et al.* (1999) for Charolaise and Nelore, respectively. For Cebu and Criollo it was found to be superior to findings by Núñez *et al.* (2006) and Ossa *et al.* (2008).

The estimation of heredity for S/G (Table 2) was 0.05, which matches the reports in Cuba for Charolaise and Cebú (Santana *et al.*, 2004 and Falcón *et al.,* 2005).

When the genetic parameters were assessed for reproductive features, heredity estimations both for single and multi-character analyses (Table 2) were very similar, due to little variation of variance components for the added genetic effect.

The genetic and environmental correlations (Table 2) between PS and IPP were 0.99, considered high positive. The opposite was found for S/G with the remaining features. It could then be inferred that if PS is improved, IPP is also improved.

When reproductive features are assessed, there are no differences in the female genotypes of 5/8 Charolaise x 3/8 Cebú and Chacuba, with acceptable PS considered at 114-200 and IPP, 401-487 days for the current conditions of herd raising and exploitation in Cuba (Rodríguez, 2007).

The environmental conditions where the herds are exploited are very similar and the differences for the non-genetic effects, like herd, number, month and calving year match the reports in the international bibliography (Véliz *et al.,* 2004).

A great volume of information on variance components of reproductive features has been generated, mainly on milk producing cattle, and most of it coincides in that h^2 is low for reproductive features (Wasike *et al.,* 2006). In that sense, the data for beef cattle are less abundant. However, Santana *et al.* (2004) and Véliz *et al.* (2004) published h^2 values for Cebu and Santa Gertrudis, respectively, between 0.01 and 0.08 for PS, IPP and S/G, being the lowest for S/G.

CONCLUSIONS

Heredity values for the reproductive features analyzed are similar to the ones reported by the international community.

The genetic and environmental correlations between PS and IPP were high and positive, indicating that if PS is improved, then IPP will be improved. Therefore, the results for the reproductive features may be considered acceptable for the handling conditions of the herds studied.

REFERENCES

ALENCAR, M.; OLIVEIRA, F.; TAMBASCO, A.; COSTA, J.; BARBOSA, R. y BUGNER, M. (1993). Desenvolvimento posdesmama e eficiencia reproductiva posparto em gado de corte: influencia da produção de leite. *Revista Brasileira de Zootecnia*, *22* (6), 1012-1018.

BRITO, R. (2010). *Fisiología de la Reproducción Animal con elementos de Biotecnología*. La Habana, Cuba: Ed. Ciencia y Técnica.

CABRAL, C.; MARTÍN, R. y BRAGA, R. (1999). Intervalos de partos e fertilidad real em vacas Nelore no

estado do Maranhao. *Revista Brasilera de Zootecnia*, *28* (3), 470-474.
CALVERAS, J. y MORALES, J. (2000). Lecciones prácticas de inseminación artificial y reproducción. *Revista ACPA*, (3), 31-38.
FALCÓN, R.; GUERRA, D.; VELIZ, D.; SANTANA, Y.; RODRÍGUEZ, M. y ORTIZ, J. (2005). *Estudio de los factores genéticos y ambientales que influyen sobre algunos índices reproductivos en novillas de la raza Cebú*. III Congreso Internacional sobre Mejoramiento Animal, 7-11 de noviembre, Ciudad de la Habana, Cuba.
GILMOUR, A; THOMPSON, R; CULLIS, B y WELHAM, S. (2000). ASREML. Reference Manual, Orange, 2800, Australia. *NSW Agricultura Biometric*, *3*, 210.
GOYACHE, F.; GUTIÉRREZ, J. P.; FERNÁNDEZ, I.; ROYO, L. J. y ÁLVAREZ, I. (2005). Genetic analyses of days open in beef cattle. *Livestock Production Science*, *93*, 283-288.
GUERRA, D.; GONZÁLEZ-PEÑA D.; RODRÍGUEZ, M.; PLANAS, T. y RAMOS, F. (2005). *Estimación de componentes de (co)varianzas de rasgos de crecimiento y reproductivos en el ganado Cebú Cubano*. III Congreso Internacional sobre Mejoramiento Animal, 7-11 de noviembre, Ciudad de la Habana, Cuba.
GUERRA, D.; ESPINOSA, J.; PALACIOS,A.; GONZÁLEZ, D.; RODRÍGUEZ, M. y GUILLÉN, A. (2009). Estimación de componentes de (co)varianzas de los días abiertos en bovinos Santa Gertrudis. *Revista Técnica Pecuaria de Méx*ico, *47* (2), 145-155.
JOHNSTON, D. y BUNTER, K. (1996). Days to calving in Angus cattle: genetic and environmental effects and covariance with other traits. *Livestock Production Sciences*, *45*, 13-22.
LAMB, C.; LYNCH, J.; GRIEGER, D.; MINTON, J. y STEVENSON, A. (1997). Adlibitum suckling by in unrelated calf in the presence or absence of a cows own calf prolongs postpartum an ovulation. *Journal Animal Science*, *75*, 2765-2769.
MAGAÑA, J.; DELGADO, R. y SEGURA, J. (2002). Factores ambientales y genéticos que influyen en el intervalo entre partos y el peso al nacer del ganado Cebú en el sureste de México. *Revista Cubana de Ciencias Agrícolas*, *3* (4), 317-322.
MONTALDO, H. H.; NÚÑEZ, S. G.; ROMÁN-PONCE, S.; RUIZ-LÓPEZ, F.; CASTILLO-JUÁREZ, H.; ROMÁN-PONCE H. y CASTAÑEDA, O. G. (2006). *Crossbreeding effects for milk production and reproduction traits in a Multibreed cattle population in Mexico*. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, Belo Horizonte, MG. Brasil.
NÚÑEZ, S. G.; MONTALDO, H. H.; ROMÁN-PONCE, S.; RUIZ-LÓPEZ, F.; CASTILLO-JUÁREZ, H.; ROMÁN-PONCE, H. y CASTAÑEDA, O. G. (2006). *(Co) variances for milk production and reproduction traits in a multibreed cattle population in the humid tropics of Mexico*. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, Belo Horizonte, MG. Brasil.
OSSA, G; SUÁREZ, M y PÉREZ, J. (2008). Valores genéticos de caracteres productivos y reproductivos de la raza colombiana Romosinuano. *Revista Corpoica*, *9* (1), 93-101.
PLANAS, T. y RAMOS, F. (2001). *La cría vacuna. La madre y su cría*. La Habana, Cuba: Sociedad de criadores de ganado de carne y doble propósito.
RODRÍGUEZ, M.; GUERRA, D.; CERÓ, A.; RAMOS, F. y PLANAS, T. (2005). Chacuba: un genotipo para las condiciones en el trópico. *Revista ACPA*, (2), 24-26.
RODRÍGUEZ, E. (2007). Elementos prácticos para medir la eficiencia en la ganadería vacuna. *Revista ACPA* (4), 47-50.
RYDHMER L. y BERGLUND, B. (2006). *Selection for reproduction: developments in several species*. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, Belo Horizonte, MG, Brasil.
SANTANA, Y.; GUERRA, D.; VÉLIZ, D.; FALCÓN, R.; RODRÍGUEZ, M.; GONZÁLEZ-PEÑA, D y ORTIZ, J (2004). Parámetros genéticos y no genéticos que afectan las características reproductivas de la hembra Cebú en Cuba. *Revista Cubana de Reproducción Animal*, *30* (1y 2), 39-46.
SAS (1995). *SAS/STATTM.SAT User´s Guide for Windows Enviroment* (608 ed.). SAS Institute Inc.
SILVA, M.; PEDROSA, V.; SILVAC, J.; HERRERA, L.; ELER, J. y ALBUQUERQUE, L. (2012). Parâmetros genéticos de lãs características andrológicas em la espécie bovina. *Archivos de Medicina Veterinária*, 44, 1-11.
VÉLIZ, D.; GUERRA, D.; SANTANA, Y.; RODRÍGUEZ, M.; ORTIZ, R. y FALCÓN, R. (2004). Características reproductivas de las razas Santa Gertrudis. *Revista Cubana de Reproducción Animal*, *29* (1 y 2), 315-318.
VERAS, B. (1999). Impacto de la reproducción en la rentabilidad ganadera. *Revista ACPA*, (4), 53-54.
WASIKE, C. B.; OJANGO, J. M. K. y KAHI, A. K. (2006). *Genetic Parameters for Growth and Reproductive Traits in the Kenya Boran Cattle*. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, Belo Horizonte, MG. Brasil.

.

Received: 20-10-2013 Accepted: 1-11-2013

Table 1. Unadjusted means (X); standard deviation (DS): variation coefficient (CV) and genetic correlations (on the diagonal line) and environmental (below the diagonal line) for calving intervals (IPP); service period (PS) and number of services per gestation (S/G)

Features	$\overline{X}$	DS	CV (%)	Correlations		
				IPP	PS	S/G
IPP (days)	456.76	83.45	18.26	1.00	0.99 ± 0.43	0.09 ± 0.11
PS(days)	168.88	83.30	49.32	0.99 ± 0.41	1.00	0.10 ± 0.14
S/G	1.66	0.95	57.22	0.41 ± 0.21	0.41 ±0.21	1.00

Table 2. Variance and heredity components for the reproductive features of females by single and multipurpose models

Features	σ^2_a	σ^2_e	σ^2_f	h^2
Single purpose				
IPP (days)	966.37	5 656.37	6 622.53	0.15 ± 0.02
PS (days)	949.37	5 636.77	6 586.14	0.14 ± 0.02
S/G	0.04	0.8456	0.89	0.05 ± 0.01
Multi purpose				
IPP (days)	1 055	5 642	6 647	0.15 ± 0.02
PS (days)	988.6	5 622	6 610.6	0.15 ± 0.02
S/G	0.04	0,85	0.89	0.04 ± 0.01