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Non-genetic Factors that Affect Pre-weaning growth in River Buffalo

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ABSTRACT

The influence of non-genetic factors on pre-weaning growth of river buffalos was assessed at the Maraguán Genetic Enterprise in Camagüey, Cuba. Recorded data from 768 male and female calves born between 2006 and 2010 were used. The effects studied were calf sex, herd, number of deliveries, time and year of delivery. Basic statgraphics calculations were performed according to multiple variance models, package SPSS, version 15.0.1. The non-genetic factors had a significant influence ($P < 0.05$) on all the variables studied: birth weight (32.4 0.21 kg); weaning weight (107.9 1.3 kg); and age-related weight (413 0.07 g/day).

Key Words: *factors affecting pre-weaning growth, calves*

INTRODUCTION

The introduction of buffalo in Cuba was, certainly, a right decision; which has been corroborated by the years. The animals were distributed in all the national territory as an important source of food and draft animals (Delgado, 2006).

In 1986 Buffalo units were settled in the province of Camagüey, with just 30 animals on a dairy farm. The species quickly developed, even with using rudimentary techniques. Moreover, there are specialized enterprises that create income from buffalo milk and beef sales for development (Fundora, 2008 and Delgado, 2009).

Fraga *et al.* (2004) have reported several genetic and non-genetic factors that influence on pre-weaning growth features, like the breed, the studs, the sex of calves and herds, number of deliveries, year and time of birth.

In 2002 and 2003 the river buffalo project was started at the Maraguán Enterprise, in the province of Camagüey. So far, the influence of non-genetic factors that affect growth features is unknown, and it is an issue to be considered for assessment.

The aim was to estimate the growth features: birth weight (BW), weaning weight (WW), and age-related weight (ARW), along with the influence of non-genetic factors.

MATERIALS AND METHODS

The work was carried out on the Rancho Alegre Farm, with 768 male and female calves born between 2006 and 2010 in eight milking units of Maraguán Genetic Enterprise, municipality of Jimaguayú, east of the city of Camagüey, Cuba.

The area covered by the grazing farmland is 230 ha, with an average of two to four enclosures per milking unit; some areas are populated with undesirable plant species, like sickle bush (*Dichrostachys cinerea*), needle bush (*Acacia farnesiana*) and paspalums (*Paspalum virgatum*). Native pastures of Texan (*Paspalum notatum*) and Camagüeyan (*Bothriochloa pertusa)* are predominant, smut grass (*Sporobolus indicus)* and cultivated pasture like king grass (*Pennisetum* sp.), guinea grass (*Panicum maximun*), African Bermuda grass (*Cynodon nlemfuensis*) and sugar cane (*Sacharum officinarum*); also predominant are several different tree species of algarroba (*Samanea saman*), pinyon (*Glyricidia sepium*), guácima (*Guazuma ulmifolia*), leucaena (*Leucaena leucocephala*), ceyba (*Ceiba pentandra*), mango (*Manquifera indica*), chinks wood (*Cordia colococca*), cedar (*Cedrela odorata*), ficus (*Ficus* sp.) and royal palm (*Roistonea regia*).

Soils are fersialitic, according to the genetic classification of soils in Cuba (CITMA, 2003).

Water supply to animals is done through water pumping windmills, in circular tanks with a trough next to them, wells, dikes and micro-dams, which are varied in the herds studied. According to studies in the province of Camagüey, mainly in the farming area, mean humidity is 84 %; mean annual temperatures range between 24 and 29 ºC; and mean annual rainfall 1 120 mm .

Offspring handling

Buffalo dairies at the enterprise graze all year round; have direct mount of a stud per thirty cows; the calves are naturally raised; weaning takes place at 6-8 months of age. Hand milking is performed once a day, early in the morning in the presence of the calves, which are given a quarter of milk after milking, alternatively on a daily basis, twice a day in the morning and afternoon, for 30-40 min.

The growth features studied were BW and WW for every animal separately, by converting the thoracic perimeter to centimeters (TP), and live weight (LW) to kilograms. The conversion LW conversion chart in kilograms was used.

To calculate PPE the formula by Planas and García (2002) was used:

PPE=PVF / EF

Where:

PPE: weight per age

PVF: final live weight at weaning

EF: final age at weaning

To calculate the pre-weaning growth features (PN, PD and PPE) and the effect of the non-genetic factors that affect the features, SPSS (2006), version 15 was used for basic statgraphics calculations. The Kolmogorov-Smirnov test for variable normality; the Levene test, for variance equality; and the multiple variance analysis, were used.

The equation used to calculate the birth weight was,

$Y_{ijklmn} = \mu + S_i + R_j + N_k + T_l + A_m + E_{ijklmn}$

Where:

Y_{ijklmn}: general mean of the dependant variable for PN, corresponding to subclase i-differential.

μ: general constant

S_i: fix effect of calf´s sex (i=1,2)

R_j: fix effect of herd (R=1…..8)

N_k: fix effect of the number of deliveries by the mother (k=1…5)

T_l: fix effect of delivery date of reference (l= 1,2)

A_m: fix effect of delivery year (m= 1…..5)

E_{ijklmn}: experimental error

The difference between the models was that for PN, weaning age was not used as co-variable, contrary to PD and PPE. Thus, the equation may be,

$Y_{ijklmn} = \mu + S_i + R_j + N_k + T_l + A_m + \beta\,(ED_{ijklmn} - ED) + T_{ijklmn}$

where:

Y_{ijklmn}: general mean of dependent variable for PD and PPE, corresponding to the i-differential subclass

μ: general constant

S_i: fix effect of calf´s sex (i=1,2)

R_j: fix effect of herd (R=1…..8)

N_k: fix effect of the number of deliveries by the mother (k= 1…5)

T_l: fix effect of delivery date of reference (l = 1,2)

A_m: fix effect of delivery year (m = 1…5)

E_{ijklmn}: experimental error

$E_{Dijklmn}$: age at weaning

β: Regression coefficient at weaning age for PD y GPD as co-variants

RESULTS AND DISCUSSION

Table 1 shows the observations corresponding to the features assessed; there is a quite uniform behavior by effect, considered in the mathematical model used.

Weight at birth (Tabla 2) was 32.4 ± 0.21 kg, different from the results by Zava and Clebañer (2001) in Colombia, with 33.6 ± 4 kg, coinciding with the broad range observed by Borquese (2005), with 27-45 kg .

However, it is inferior to reports by Muñoz (2002) in Murrah (38 kg, Brazil). García and Planas (2003) were able to achieve 37,9-42,2 kg (Cuba) in Bufalipso for this feature, with feed based on pasture, molasses+urea and concentrates. Furthermore, Betancourt *et al.* (2005) in the same breed, with the same feed and conditions (eastern Cuba) observed a 34-38 kg range in the animals.

The authors criteria on the general mean for birth weight in this paper (Table 2) correspond to Latin-American, European and Asian researchers, with a range of 33-37 kg (Zava and Clebañer,2001; Muñoz, 2002 and Borquese, 2005).

Table 2 shows the results of weight at weaning and age-related weight, and they match the observations by Planas (2005) and Amorin (2010) who reported that maternity is a complex character on which milk production and maternal instinct has a great influence. Consequently, there is more viability and weight gain in the calf until weaning. In tropical areas, this character has a remarkable importance; the calves gain 40 % of total weight at weaning in the first 6-7 months of age.

The effect of calf´s sex on birth weight and age-related weight (Table 3) corroborates reports that the males were significantly higher in 2.2 kg; 3.2 kg and 12 g/day than females at pre-weaning, respectively.

In general terms, concerning calf´s sex, males are heavier than females during the natural breeding, until weaning, due to hormonal differences (Martins *et al*., 2000) and to the action of testosterone, which produces a higher metabolic rate in males. Széchy *et al*. (1995) confirmed that gestation of males takes 1-2 days longer than females; hence the male weight is higher at birth. ACB (2004) has pointed out that males can reach a higher weight and higher weight gains than females at different ages, until adulthood.

The behavior in the number of deliveries in terms of birth weight, weight at weaning and age-related weight (Table 3) was significant as well. It is considered an important factor as a source of variation for these features. Generally, in the first, second and third deliveries, the calves are less heavier because the young buffalo cows, and buffalo cows with seven or more deliveries, produce offspring with lower weight at birth, because they are in the growing and developing stages, until they reach six years of age (ACB, 2004 and Amorin, 2010).

The differences marked in the values achieved in the rainy and dry seasons (Table 4) are given by the care the buffalo cows receive in the last third of gestation. Moreover, in the rainy season, there is more availability of quality pasture, which causes nutritional variations that influence on the offspring growth and development (Méndez and Fraga, 2010).

Concerning year of delivery for the features studied, there is a difference between years (Table 4), which may be caused by —according to several authors— climate variability, staff, feed and animal handling in tropical and subtropical regions (Garcíay Planas, 2003; Padrón *et al.*, 2010).

The differences among herds may be caused by the fact that each dairy is under the influence of different weather conditions, feeding, animal burden, environmental conditions (including ponds used for refreshing and, drinking water), and natural shadows in the dairies to improve their comfort (Méndez and Fraga, 2010).

Concerning the environmental factors (date of reference, year and herd), that most affect buffalo breeding in the tropics, and especially at the Maraguán Enterprise in Camagüey, with a buffalo exploitation strategy, the results are inconsistent. There are no areas for sugar cane and kin grass forage production; protein stocks from legumes are not enough to face the dry periods every year; and the labor force is unstable, especially dairy managers.

CONCLUSIONS

The non-genetic factors (calf´s sex, herd, number of deliveries, date of reference, and year of delivery) must be considered when studying pre-weaning growth features in buffalos.

It was proven that in the years under the study, buffalos had no birth weight and weaning birth as has been reported in the literature, mainly influenced by environmental factors and general offspring handling.

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Table 1. Observations according to effects observed

Identification	Qualification	Total observations
Total		768
Calf´s sex	Male	395
	Female	373
Number of deliveries	1	228
	2	208
	3	174
	4	106
	5	52
Delivery season	1 (rainy)	600
	2 (dry)	168
Year of delivery	2006	117
	2007	174
	2008	165
	2009	177
	2010	135
Herds	1	43
	2	69
	3	99
	4	111
	5	122
	6	96
	7	81
	8	147

Table 2. Means and standard errors for the features studied. Variance analysis

Sources of variation	PN (kg)	PD (kg)	PPE (g/days)
Calf´s sex	**	**	**
Herds	**	**	**
Number of deliveries	**	**	**
Season of delivery	**	**	**
Year of delivery	**	**	**
β (age at weaning)	-	**	**
X ± ES	32.4 ± 0.21	107.2 ± 1.35	413 ± 0.1

Table 3. Behavior of sex and number of deliveries at pre-weaning

Calf´s sex	PN (kg)	PD (kg)	PPE (g/days)
Males	34.5 ± 0.25	108.7 ± 1.52	419 ± 0.09
Females	32.3 ± 0.24	105.5 ± 1.61	407 ± 0.07
Number of deliveries	PN (kg)	PD(kg)	PPE (g/days)
1	31.4 ± 0.29 a	95.5 ± 1.53 a	369 ± 0.11 a
2	31.9 ± 0.31 a	103.6 ± 1.95 b	394 ± 0.11 ab
3	31.5 ± 0.33 a	108.8 ± 2.17 c	414 ± 0.12 ab
4	34.7 ± 0.44 b	114.2 ± 2.82 d	445 ± 0.15 c
5	34.5 ± 0.53 b	113.4 ± 3.15 d	446 ± 0.22 c

Table 4. Behavior of season, year and herd for pre-weaning

Season of delivery	PN (kg)	PD (kg)	PD (kg)
Rainy	34.8 ± 0.18	109.4 ± 2.13	109.4 ± 2.13
Dry	32.05 ± 0.33	105.10 ± 1.21	105.10 ± 1.21
Year of delivery	PN (kg)	PD(kg)	PD(kg)
2006	32.2 ± 0.48 a	102.2± 1.25 a	102.2 ± 1.25 a
2007	32.3 ± 0.38 ab	108.2 ± 2.50 b	108.2 ± 2.50 b
2008	33.4 ± 0.37 b	105.8 ± 2.38 b	105.8 ± 2.38 b
2009	34.2 ± 0.32 c	104.8 ± 2.08 b	104.8 ± 2.08 b
2010	31.7 ± 0.34 ab	116.9 ± 3.13 b	116,9 ± 3,13 b
Herds	PN (kg)	PD (kg)	PD (kg)
1	34.1 ± 0.29 d	149.6 ± 3.83 d	149.6 ± 3.83 d
2	32.8 ± 0.49 b	93.6 ± 3.15 b	93.6 ± 3.15 b
3	31.9 ± 0.39 a	93.8 ± 2.51 b	93.8 ± 2.51 b
4	32.1 ± 0.37 c	116.5 ± 2.41 c	116.5 ± 2.41 c
5	34.3 ± 0.36 d	144.7 ± 2.31 d	144.7 ± 2.31 d
6	31.4 ± 0.41 a	74.4 ± 2.62 a	74.4 ± 2.62 a
7	33.1 ± 0.44 c	91.4 ± 2.86 b	91.4 ± 2.86 b
8	32.8 ± 0.34 b	93.1± 2.23 b	93.1± 2.23 b