Rev. prod. anim., 27 (1): 2015

Non-genetic Factors in Four Buffalo (*Bubalus bubalis*) Herds II. Reproduction Features

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ABSTRACT

Non genetic factors of reproduction features from four buffalo herds at the *Ruta Invasora* Cattle Raising Company, in the Province of Ciego de Avila, Cuba, were assessed. The data from 925 observations of 120 buffalo cows were collected, from 1994 to 2012. SPSS, version 15, was used to process all statistics. The results for the reproductive features were as follows: age at first calving (38.6 ± 0.79 months), and calving interval (409.4 ± 4.1 days). The effects of herd and year of birth were observed to have significantly influenced ($P < 0.01$)on age at first calving; and the effect of herd, number of calvings, season and year of calving are the non-genetic significant effects ($P < 0.01$) on the calving interval.

Key Words: *buffalo, reproductive features*

INTRODUCTION

The buffalo population has grown very fast, ranking second in terms of milk production. Additionally, its meat is equally appreciated for its high quality. Other buffalo productions include skins, horns, bones and manure as organic fertilizer, according to FAO reports (2002). Rusticity is one of the most important species´ features, as it has the ability to adapt to different climatic regions, and have high fertility rates, even higher than bovines (Lourez, 2001).

Méndez and Fraga (2007) consider that buffalo raising is an alternative for milk and meat productions, because the animal growth, environmental tolerance, health, and production increase vertically. Besides, mortality is very rare in the species, due to high disease resistance and high reproduction. Both factors make the buffalo business very profitable in every environmental setup, with a minimum of investment for exploitation.

Herd growth depends on complex interactions between the environment and the animal genotype, especially in tropical ecosystems. Milk production, growth and reproduction in tropical ecosystems may be affected by the environmental conditions and their interactive influence on the animal genetic potential, quality and quantity of feedstuffs. Therefore, the growth and reproductive features of animals are mainly affected by herd, number of calvings, season, year of birth and calving, according to criteria by Crespo *et al*. (2010), and Fraga and Ramos (2011).

The purpose of this study was to assess the non-genetic factors of reproductive features in buffalo herds in Ciego de Avila, Cuba.

MATERIALS AND METHODS

This research was developed from 925 observations of 120 River Buffalo cows in four units of *Ruta Invasora* Cattle Raising Company, in the province of Ciego de Avila, in 1994 – 2012 period.

Herd management, milking and water supply were performed according to Ceró *et al*. (2015).

The data (date of birth, date of first calving and date of each calving) were taken from individual reproduction control cards from the four units included in the study. Age at first calving (EPP) and calving interval (IPP) were calculated.

EPP is one of the most important zootechnical parameters used to assess herd productivity, which is calculated as follows:

$$EPP = \frac{(FPP - FN)}{30}$$

EPP: age at first calving,

FPP: date of first calving

FN: date of birth.

To calculate the reproductive and growth features, and the non-genetic effects that affect them, SPSS (2006), version 15, was used for basic statigraphs.

The varying causes used in the math model for the reproductive features of EPP were, herds (4), season of birth (2) and year of calving (14). Season one comprises November – April (dry); and season two comprises May – October (rainy).

The following model was used,

$Y_{ijkl} = \mu + R_i + E_j + A_k + e_{ijkl}$

Where:

Y_{ijkl}: dependent variable of age at first calving, corresponding to the *i th* individual from the *ijkl th* subclass.

μ: general mean.

R_i: herd effect (i = 1…4)

E_j: birth season effect (j = 1; 2)

A_k: calving year effect (k = 1…14)

e_{ijkl}: residual effect or experimental error.

The varying causes used in the math model for the reproductive feature (IPP) were, sex of the calf (2), number of calvings (12), herds (4), calving season (2) and calving year (14). Besides, season 1 comprises November – April (dry); and season 2 comprises May – October (rainy). The following math model was used,

$Y_{ijklmn} = \mu + S_i + N_j + R_k + E_l + A_m + e_{ijklmn}$

Where:

Y_{ijklm}: dependent variable of calving interval, corresponding to the *i th* individual of the *ijklmn th* subclass.

μ: general mean.

S_i: calf sex effect (i = 1; 2)

N_j: number of calving effect (j = 1…12)

R_k: herd effect (k = 1…4)

E_l: calving season effect (l = 1; 2)

A_m: calving year effect (m = 1…14)

e_{ijklm}: residual effect or experimental error.

RESULTS AND DISCUSSION

In table 1, the age at first calving (EPP) is significantly affected ($P < 0.01$) by herd and year of birth, not by season of birth. It corroborates reports by Baruselli *et al.* (1993) noting that this parameter may be affected by the above-mentioned studied factors.

Average age at first calving was 38.6 ± 0.79 months, which coincides with values reported by Tonhati *et al.* (2004) and Sampaio *et al.* (2001)of 39.0 ± 6.5,and 37.8 ± 2.3 months, respectively; as well as Bedoya *et al.* (2002),with 37.7 ± 1.96 months in Colombia. Cassiano *et al.* (2003) reported 36.27 ± 2.53 months of EPP in Brazil. Méndez and Fraga (2010) noted that the first calvings were most frequent at 36and48months in the eastern province of Granma, Cuba, corresponding to a desired reproductive response stage.

Mitat (2011) and Méndez *et al.* (2011) explained the results of 36 months of study in the country, so measures for handling and feeding must be implemented in order to reduce or eliminate the negative factors that interfere with calf growth and development. The objective should be to increase the productive life of buffalo cows, allowing them to have a larger number of calves, thus increasing productivity of the system.

Regarding season of birth, no significant differences were observed for EPP, which may be given by the fact that buffalo cows have a remarkable calving seasonability, with possible effects on this result, since 70 % calving occurred between July and November (Mitat, 2002).

Concerning herd behavior to EPP (Table 2), significant differences ($P < 0.05$), were observed, because the fourth herd had the best results of all. It showed 36-month values, similar to Mitat (2011), with average values of 36.6 months in the country.

Nevertheless, this parameter is directly associated with live weight and age of integration. Accordingly, to minimize these results, calf integration must be achieved, according to the literature, by watching the climatic conditions, management and nutrition to which animals are exposed (Planas and Ramos, 2007). This allows researchers to conclude that young buffalo cows are most affected by the environmental factors, nutrition being one of the most significant (Gutiérrez, 2010).

Table 3 shows a significant difference ($P < 0.05$) for the reproductive feature of age at first calving for the birth years studied (1994 - 2007). The results of the birth year for age at first calving were the poorest, with significant differences observed in the 1994 – 2004period. The best results were achieved between 2005 and 2007, with the values of33 - 36 months, also below the 36.6 months reported for the country, according to Mitat (2011). Guzmán *et al.* (2011), noted that the birth year effect is directly linked to climatic conditions and nutrition; therefore, high temperatures and relative humidity, together with poor availability and quality of pastures, might produce EPP increases. Accordingly, to improve the reproductive behavior of buffalo cows, it is advisable to improve pasture quality, and minimize negative environmental effects, including human impacts (Silveira *et al*., 2004).

Table 4 shows the results of variance analysis for IPP, which was highly significant ($P < 0.01$) for the herd, number of calvings, season and year of calving; except for calf´s sex. The average IPP was 409.4 days, very similar to reports for the country, with 401.9 days (Mitat, 2011).

The mean achieved corroborates observations by Garcia (2002) and Brito (2005), on the physiological possibility of 365-day IPP, conditioned by good reproductive practices and adequate nutrition of buffalo cows with similar reproductive potential, in order to achieve increased milk yields and more calves.

Moreover, Table 4 shows that the calf´s sex had no significant differences; i.e., it has no impact on IPP duration. These observations are similar to reports by Méndez and Fraga (2010) about the lack of significant influence of calf´s sex on IPP. The results also corroborate observations by Soysal and Kok (2004),and Scannone (2006), who stated that the fetus´s sex does not affect that indicator.

Herd IPP (Table 5) had significant differences ($P < 0.05$), with the best results observed in herd 1 (393.3 ± 6.3 days), lower than the rest. These results have been possible also thanks to the presence of the unit manager in the facility. In addition, each region´s climatic condition may be exerting a favorable effect. In consequence, there is coincidence with Betancourt *et al*. (2005), and Fraga and Ramos (2011), on variations in nutrition, husbandry, and climate conditions leading to significant differences of herd effect.

Furthermore, research done by Ramos *et al.* (2007), Mitat (2011) and Guzmán *et al.* (2011) noted that range fluctuation within this indicator is determined by the influence of herd husbandry and conditions of nutrition.

Table 5 shows a significant difference ($P < 0.05$) for the calving interval (IPP), regarding the number of calvings, which remained stable between deliveries 2 – 7. However, it tends to decrease in the number of days from delivery 8 on, which may be caused by age, growth, and sexual maturity (Padrón, 2010).

These results have been endorsed by Crudelli (2002), when he asserted that IPP is reduced progressively in relation to the number of calvings. He also added that younger buffalo cows have longer IPP, which has to do with stress produced during the first calving. However, under favorable nutrition, stress is higher in native-pasture-only fed animals. In this research these features may be influenced by the possibility that buffalo cows reached their maturity and productive peak from the fourth delivery on.

The number of buffalo calvings is assumed to be proportional to IPP, in terms of productive efficiency; i.e., the more calvings a buffalo cow has, the better the values for IPP. That rate reverts when the animals reach their production peak, with over 12 calvings; an issue to be considered for reproductive assessment in buffalo herds.

IPP behavior regarding season (Table 7), had significant differences ($P < 0.05$) between the dry and rainy season, with values of 414 to 404 days, respectively. Camargo (2007)notes that in Brazil the calving season influence on herd calving intervals had a significant influence on the reproductive indicators, like calving intervals, with differences observed for the buffalo cows that gave birth in July, in contrast to the ones that did it in December.

Accordingly, García(2010), considered that buffalo cows that calve in the dry season, have higher IPP due to unfavorable nutritional and climatic factors in relation with the rainy season.

According to Lacerda *et al*. (2008) female buffalos that calved in the rainy months experienced the lowest IPP average, in comparison to the dry months, because these animals recovered very easily, a factor strongly influenced by nutrition. Moreover, these differences owed to availability, quality and access to pastures, thus improving the nutritional aspect. García (2010) considered that buffalo cows that calve in the dry season have a higher IPP due to unfavorable nutritional and climatic factors related to the rainy season. As a result of precipitation, increased grass quality and availability per hectare is produced, directly effecting animal nutrition and reproductive efficiency indicators, like IPP (Méndez and Fraga, 2010).

Compared to IPP, the calving year (Table 8) had significant differences ($P < 0.05$). The highest IPP values were registered in 1999, with 460 days; and the lowest ranges were observed between 2000 and 2006(387 and 408 days), though in general terms, it remained stable, with values between 387and426 days.

These results have been endorsed by García *et al.* (2007),Fraga and Ramos (2011), and Suárez *et al.* (2011), by noting that all years did not behave in the same way, in terms of climate and staff in charge of activities in the dairies; along with feedstuff availability and animal husbandry in tropical and subtropical regions. In this research the year with respect to IPP duration was determined.

CONCLUSIONS

The non-genetic factors, like herd and year of birth demonstrated a significant influence on EPP; whereas herd, number of calving, season and calving year, except calf´s sex, all affected IPP.

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Received: 25-9-2014
Accepted: 10-10-2014

Table 1. Results of the variance analysis for Age at First Calving (months)

Variation sources	Age at First Calving (months)
Herds	**
Season of birth	NS
Year of birth	**
$\overline{X} \pm ES$	38.6 ± 0.79
R^2 (%)	48.1

** (P < 0.01)

Table 2. Age at first calving (months) for the herds studied

Herds	Age at First Calving (months) $\overline{X} \pm ES$
1	$39.8^b \pm 0.79$
2	$40.4^b \pm 0.79$
3	$38.6^b \pm 0.79$
4	$36.0^a \pm 0.81$

Means with letters on the same column differ significantly (P < 0.05). Tuckey Test

Table 3. Age at first birth for the year of birth

Years of birth	Age at first calving (months) $\overline{X} \pm ES$
1994	43.2 c ± 1.79
1995	41.6 bc ± 2.29
1996	43.0 c ± 1.08
1997	38.4 abc± 1.88
1998	41.3 abc ± 1.84
1999	38.6 abc± 1.01
2000	38.3 abc ± 0.84
2001	38.0 ab ± 1.19
2002	39.3 abc ± 0.82
2003	41.9 bc ± 1.78
2004	37.6 abc ± 0.98
2005	35.7 a ± 0.83
2006	33.9 a ± 2.29
2007	33.3 a ± 1.59

Means with letters on the same column differ significantly ($P < 0.05$). Tuckey Test

Table 4. Results of variance analysis for the calving interval (IPP)

Variation sources	Calving interval (days)
Sex of calf	NS
Herds	**
Number of calvings	**
Season of calving	**
Year of calving	**
$\overline{X} \pm ES$	409.4 ± 4.1
R^2 (%)	10.2

** ($P < 0.01$)

Table 5. Calving interval for the herds studied

Herds	Calving interval (IPP) $\overline{X} \pm ES$
1	$393.3^{a} \pm 6.3$
2	$423.2^{b} \pm 3.2$
3	$428.5^{b} \pm 2.6$
4	$430.8^{b} \pm 3.1$
Sig.	P < 0,05

Means with letters on the same column differ significantly ($P < 0.05$). Tuckey Test

Table 6. Calving interval (IPP) for the number of calvings

Number of cal-ving	Calving interval (IPP) $\overline{X} \pm ES$
2	417.6 ^{ab} ± 5.61
3	411.0 ^{ab} ± 5.69
4	428.4 ^{b} ± 5.89
5	430.8 ^{b} ± 6.20
6	420.1 ^{b} ± 6.82
7	421.3 ^{b} ± 13.73
8	401.5 ^{ab} ± 7.36
9	395.5 ^{ab} ± 8.37
10	403.2 ^{ab} ± 9.46
11	379.4 ^{a} ± 12.11
≥12	387.6 ^{a} ± 12.68

Means with letters on the same column differ significantly (P < 0.05). Tuckey Test

Table 7. Calving interval (IPP) for the calving season

Calving season	Calving interval (IPP) $\overline{X} \pm ES$
Dry	414.8 ^{b} ± 3.48
Rainy	404.0 ^{a} ± 4.67

Means with letters on the same column differ significantly (P < 0.05). Tuckey Test

Table 8. Calving interval (IPP) for the year of calving

Year of calving	Calving interval (IPP) $\overline{X} \pm ES$
1999	460.2 ^{b} ± 16.48
2000	388.8 ^{a} ± 14.65
2001	387.2 ^{a} ± 13.54
2002	396.1 ^{a} ± 11.35
2003	396.4 ^{a} ± 9.60
2004	399.1 ^{a} ± 8.57
2005	402.2 ^{a} ± 8.27
2006	408.1 ^{ab} ± 6.81
2007	397.2 ^{a} ± 6.90
2008	414.7 ^{ab} ± 6.48
2009	421.7 ^{ab} ± 6.06
2010	416.7 ^{ab} ± 6.16
2011	417.2 ^{ab} ± 5.68
2012	426.1 ^{ab} ± 5.72

Means with letters on the same column differ significantly (P < 0.05). Tuckey Test