Genetics and Reproduction

Original

Ten-Year Trends of Buffalo Performance Indicator Tests in a Cuban Company

Luis Mateo Fraga Benítez *, Delia María Cino Nodarse **, Orestes López Morera ***

* Animal Sciences Institute Carret. Central km 47 ½. San José de las Lajas. Mayabeque, Cuba.
** Pasture and Forage Research Institute. Ave. Independencia. Calle 184 No. 20520. Rpto Río Cristal. Boyeros. Havana, Cuba.
*** EPG Los Naranjos. Carr. Caimito-Vereda km 4 ½. Artemisa, Cuba.

Correspondence: lmfb48@gmail.com

Received: June 2022 Accepted: August 2022 Published: September 2022.

ABSTRACT

Aim. To conduct a study of the evolution of weaning weight, live weight (20 months), weight gain (8-20 months), and age-related weight (20 months) observed in the buffalo performance tests at Los Naranjos Livestock Company between 2011 and 2021, based on the quadratic minimum constants (QMC) representing the adjusted means of the input year, genetic values, and error effects. **Materials and Methods:** The performance test data were collected from 435 individuals in a Cuban company between the input years (IY) 2011 and 2020. The mix model was based on 9 (IY) as the fix effect, covariance to adjust the weaning weight (WW) at 8 months, initial age (IA), final weight (FW) at 8 months, by final age (FA), Gain (Gain) at 8-20 months, by duration (Dur) and weight by age (WA). The random effect was the IY-nested individual (IDT). **Results:** The QMC from the IY indicators included plotting and docimation, and remained significant (P<0.0001), whereas the covariances were relevant, except for the FW. The WW was stable through the IY, though there were differences between them of up to 20 kg, whereas the FW, Gain, and WA dropped from 2017 on. **Conclusions:** The environmental conditions for handling and feeding deteriorated during the last period, though the genetic evaluations should be more rigorous.

Keywords: buffaloes, indicators, trend, genetic value (*Source MeSH*)

INTRODUCTION

Today, the buffalo genetic breeding program in Cuba is run according to the genetic evaluations of the mothers for milk production and performance tests of grazing males from the highest milk

Citation (APA)
Fraga Benítez, L., Cino Nodarse, D., & López Morera, O. (2022). Ten-Year Trends of Buffalo Performance Indicator Tests in a Cuban Company. *Journal of Animal Production*, *34*(3). https://revistas.reduc.edu.cu/index.php/rpa/article/view/e4248

production mothers. The performance tests consist of male growth evaluations for approximately one year, under grazing conditions, from a single company, starting at weaning (8 months of age), but from different herds. At the end of the test, the best animals are identified for future reproductive functions, as studs, depending on their growth and their mothers' milk production during lactation, in percentages, both weighted (70:30), according to Mitat. *et al*, 2010.

No statistical study has been conducted about the evolution of the indicators of the tests that began in 2011, to determine their evolution and take proper measures through fit data as a result of the most significant environmental effects. This paper aims to conduct a research study of the evolution of weight at weaning, live weight at 20 months of age, weight gain at 8-20 months, and weight by age at 20 months during the buffalo performance tests, run at Los Naranjos Livestock-Genetic Company between 2011 and 2021, depending on the QMC the represent the means fit to the effects of input year, genetic values, and error. In the tropics, the studies do not include growth selection programs, though they are economically important (Martínez-Reina *et al*., 2020), and estimations of genetic parameters, so research on growth trends are inexistent. However, there are reports on reproductive indicators in Egypt (Amin *et al*., 2021).

MATERIALS AND METHODS

The information was collected at Los Naranjos Livestock-Genetic Company, in Artemisa, Cuba, where performance tests (PT) were run in buffaloes fed on enhanced fodder (*Cynodon nlemfuensis*) in a 0.6-1.0 animal/ha rate, for 12.72 months on average. The animals selected had adequate weaning weights for three consecutive calving seasons, from mothers regarded as high milk producers, between 2011 and 2019, totaling 435 individuals. The database was corroborated through the data collected from the performance tests, including the weaning weight at 8 months (WW), final fit weight (FW) 20 months following the performance test, live weight gain to the end of the PT (Gain), weight by age (WA) at the end of the PT, age at the beginning of the test (IA), age at the end (FA) of the PT, and PT duration (Dur.).

The mix SAS (2013) method was used, together with Proc GLIMMIX (Wolfinger and O'Connell 1993; Schabenberger 2006) to process the WW, FW, Gain, and WA, following identification of the fittest data distribution, using Proc Severity. The fix effect of IY to the PT was studied, with 9 levels, in 2011/2012 (perhaps joined due to insufficient information about the first year), to 2020, and the randomized effect on the animal nested to the PT's IY. The fix effects, WW covariance fits at the input age for the PT, final weight and WA at the final age for the PT, whereas Gain fit the Dur. The QMCs were plotted with the IA to determine their changes through the IY. The mix model used is below.

$$\mathbf{Y_{ijklm} = \mu + \alpha_i + a_j(\alpha_i) + B_k\,(X_l - \mu_l) + e_{ijklm}}$$

μ = General mean or common constant to all the observations

α_i = Fix effect of the i^{th} input year of the PT (i=2011/2012…, 2020).

B_k (X_l –μl)= Linear fit effect by k covariance of the initial age for the PT regarding the WW, FA for the FW and WA or Dur for Gain (l=1,2,3,4 and k=1,2,3,4).

$a_j(\alpha_i)$ = The randomized effect of the j^{th} animal or individual identification IDT (j=1,2…, 435) nested in the i^{th} IY of the PT.

e_{ijklm}= Randomized effect associated with the observations $\rightsquigarrow$ N (o, δ^2_e)

The results were used to produce line graphics, considering X as the years (2011/2012-2020; that is nine years), and Y as the performance means WW, FW in Kg, and Gain or WA in g/day from the 435 observations.

RESULTS AND DISCUSSION

The IY affected all the indicators evaluated, while covariance was not significant just with the FW, which may have been caused by the individual fit for this age (Table 1). It means that when the FW by final age does not fit the FA, covariance is required, which in the case of Gain and WA depends on the two measurements, if necessary, its consideration for modulation. Normality fit was not necessary for the WW, contrary to the expected, since the PT only included the individuals with good WW from mothers with the best milk productions in their lactation periods. The other measurements did require the Gamma transformation with link log

According to graphic 1, there is some variability of weaning weight through the IY, probably because despite the fit by input age, they differed one another with the lowest values near 130 kg and the highest around 150 kg. In other words, there are 20 kg of difference, though it is stable considering that through the years a sustained drop or loss was observed. However, the factors that generated the low values observed from individuals that undergo the PT must be observed for several years.

Table 1. ANOVA result for the indicators studied (N=435).

Indicators	Effects				Link normality/function fit
	Input year	Covariance	IDT (year)	Error	
Weaning weight	***	IA (***)	-	-	Gauss/Identity
Final weight	***	FA (NS)	-	-	Gauss/Log
Gain	***	Dur(***)	-	-	Gauss/Log
Weight by age	***	FA (***)	-	-	Gauss/Log
Freedom degrees Numerator/denominator	8/398	1/27	407	398	-

*****: (P<0.0001) NS: not significant (P<0.3277)**

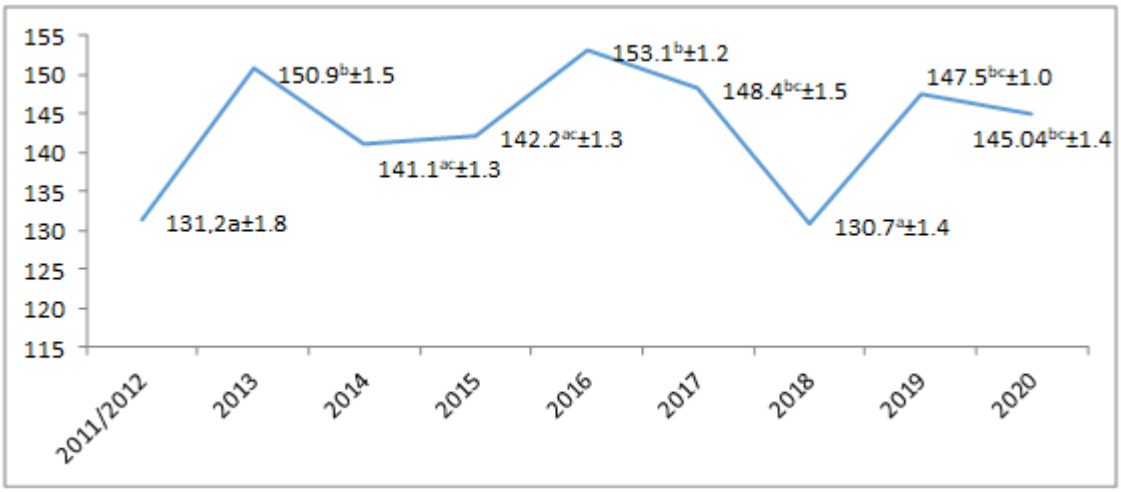

Figure 1. CMC ± WW's IA (kg) according to the PT's IY

The same occurred for the other indicators evaluated, where the PT's IY effect was always important, though in these cases there was a drop in the IY from 2016-2017. It means that since then, there have been several effects of environmental character, such as genetic, which hinder the proper expression of the genetic potential. Among them are,

Genetic:

1. Increase of consanguinity in the population studied.
2. Flaws in the growth selection of individuals in the population, particularly from the parents.

Environmental:

1. Inappropriate nutrition expressed in the quality and quantity of pastures and forages administered and other nutritional supplements.
2. Inappropriate management expressed through the stocking rate or night enclosure with food shortage.

Studies done using the ENDOG program on the same population (Fraga, 2022), suggest the absence of elements that may be attributed to the fact that consanguinity is a likely cause of the decline by means of an unbalanced contribution, mean consanguinity estimated, the average parenthood coefficient, and the number of ancestors, which explain 50% of the genes with values that showed the nonexistence of consanguinity hazards.

The above means that there is a need to opt for more accurate genetic breeding methods, not due to the consanguinity-related effects.

The results of weaning weight may be considered acceptable, contrary to the live weight values at 20 months (Figure 2), which are low compared to the 400 kg or more reported by Borghese *et al*. (2010), in Italy, with buffaloes at 15 months, or from Brazil, with 300--351 kg, by Malhado *et al*. (2008) and Jorge *et al*. (2005), and the 336 kg at 18 months by Crudeli *et al*. (2007) with

Mediterranean buffaloes, though similar to the reports from Colombia, with 277 kg reported by Agudelo *et al*. (2009), cited by Bolivar *et al*. (2012). A similar effect is observed with the gain and weight by age (Figures 3 and 4).

As to the environmental effects withstood by the company or other companies in Cuba, there should be better expression of the genetic potential of the animals in these moments where there is a general reduction of the indicators, and the buffaloes need enormous efforts to achieve higher performance. Collateral data evidenced that in recent input years (2018, 2019, and 2020), the QMC from PLM of these individuals also saw a decline, with values of 905, 877, and 851 kg above the reported value (742 kg), by Mitat (2022) in the same period, same company's all animals.

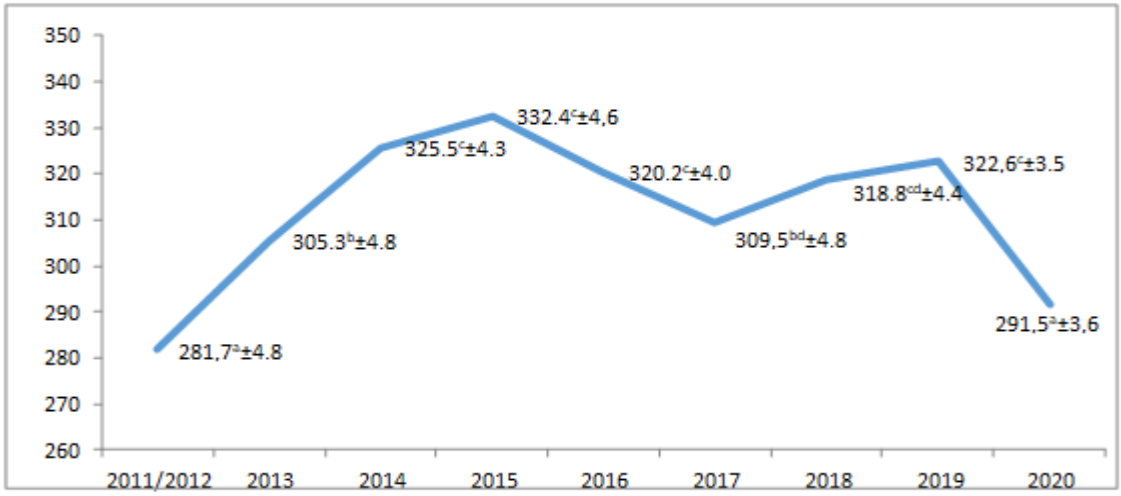

Figure 2. CMC ± IA for the effect of FW (kg) according to the PT's IY

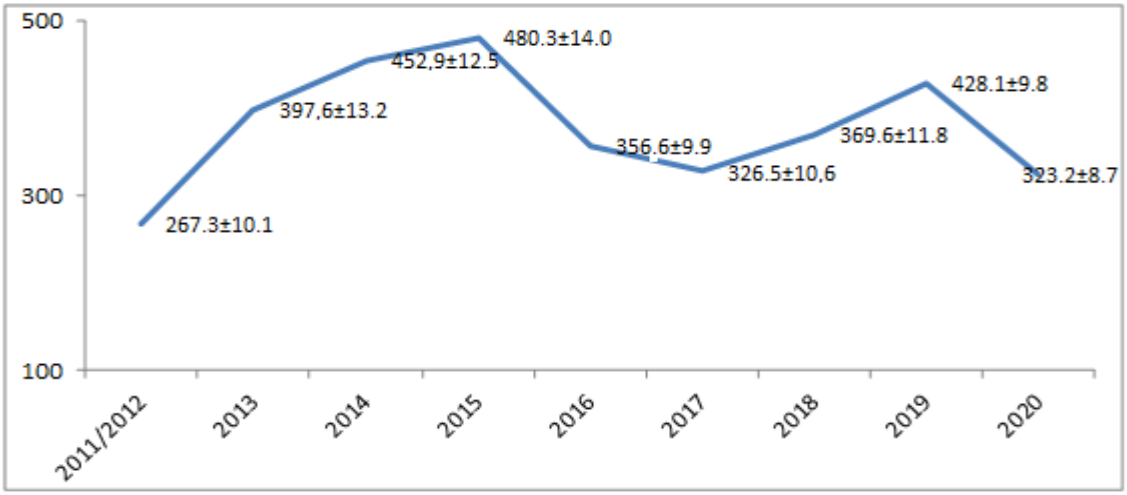

Figure 3. CMC ± IA for the effect of Gain (g/day) according to the PT's IY

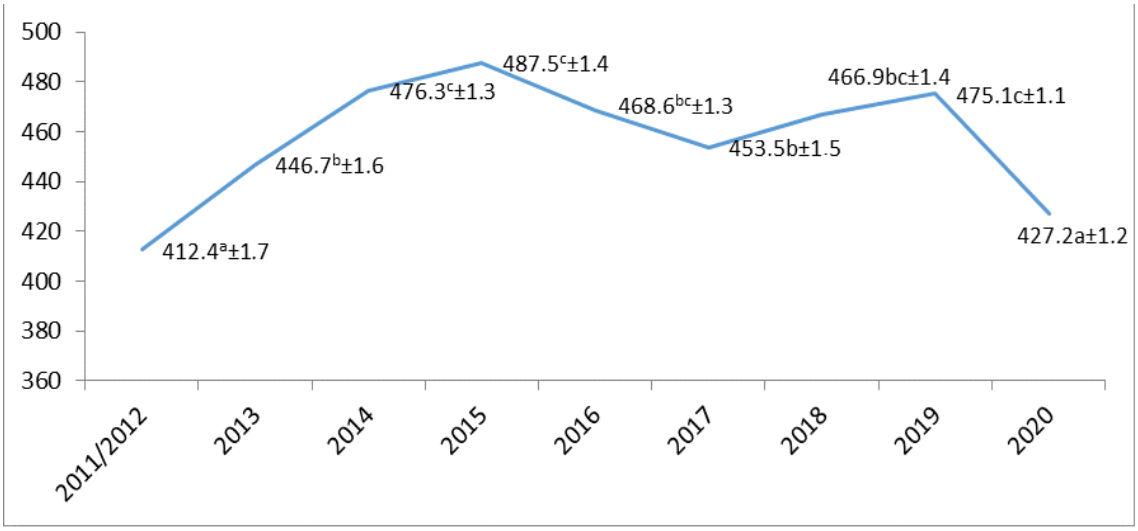

Figure 4. CMC ± IA for the effect of WA (g/day) according to the PT's IY

CONCLUSIONS

The individual final fit weight at 20 months did not require covariance fit at the final age, which is necessary for the WW, WA or Gain regarding the input age, final age or duration of the PT. These elements must be considered for the selection made to ensure the uniformity of measurements.

The drop of the final live weight observed from 2016 on, particularly in the last IY, reached similar values to the 2011-2012 period. However, there were variations through the IY of weight at weaning, which indicated that management issues must be addressed, as they are affecting the PT period, thought there is still a possibility to run a more efficient and accurate selection.

REFERENCES

Amin, A. M., Abo-Ismail, M. K., & Salem, M. M. (2021). Genetic parameters and genetic trends for reproductive traits in Egyptian buffalo. *Animal Reproduction Science*, *231*, 106800. https://doi.org/10.1016/j.anireprosci.2021.106800

Bolivar, D.M., Cerón-Muñoz, F.M., Ramírez, E.J., Agudelo, D.A., & Cifuentes, T. **(**2012). Genetic parameters for growth traits of buffaloes (*Bubalus bubalis Artiodactyla, Bovidae*) in Colombia. Rev. *Colomb. Cienc. Pecu.*, *25*, 202-209. http://www.redalyc.org/articulo.oa?id=295023555005

Borghese, A., Terzano, G.M., Mazzi, M., Razzano, M., Sabia, E., & Pacelli, C. (2010). Fattening of Buffalo Young Bulls with Different Diets. Meat production. 9no Congreso Mundial de Bufalos. Buenos Aires. Argentina. http://www.wbc2010.org

Crudeli, G., Pochon, D., Olazarri, M., Monzón, N., Chaparro, L., Flores, S., Patiño, E., & Cedrés, J. (2007). Morphometric evaluation of male Mediterranean buffaloes in Northern Corrientes, Argentina. *J Anim Sci.*, *6*(2), 1281-1283. DOI:10.4081/ijas.2007.s2.1281

Fraga, L.M. (2022). Informe final proyecto: Evaluación genética del ganado bubalino para leche, crecimiento y reproducción. MES. Instituto de Ciencia Animal. Mayabeque. Cuba.

Jorge, A.M., Andrighetto, C., & Castro, V.S. (2005). Desenvolvimento ponderal de bubalinos da raça Murrah criados em pastagem de Brachiaria brizantha no Centro-Oeste do Estado de São Paulo, Brasil. *Cienc Rural*, *35*, 417-421. DOI:10.1590/S0103-84782005000200027

Malhado, M.C., Ramos, A.A., Carneiro, S.P., Azevedo, R.M., Filho, M.R., & Souza, J.C. (2008). Melhoramento e estrutura populacional em bubalinos da raça Mediterrânea no Brasil. *Pesquiça Agropecuria Brasil*, *43*, 215-220. DOI:10.1590/S0100-204X2008000200009

Martínez-Reina, A. M., Doria-Ramos, M., García-Jiménez, J., Salcedo-Carrascal, E., Herrera-Pérez, N., & Carrascal-Triana, E. L. (2020). Caracterización técnica y económica del sistema de producción de búfalos *Bubalus bubalis* en el departamento de Córdoba de Colombia. *Archivos de zootecnia*, *69*(268), 444-452. https://www.uco.es/servicios/ucopress/az/index.php/az/article/view/5392

Mitat Valdés, A. (2022). Búfalos de agua. I. Comportamiento del rebaño Buffalypso puro en Cuba. *Revista de Producción Animal*, *34*(1). https://revistas.reduc.edu.cu/index.php/rpa/article/view/e4092

Mitat, A., Lezcano, J., Pérez, M., García, A., García, J., Ramos, F., Valero, C., Fraga, L.M., Uffo, O., Domínguez, A., & Arias, Y. (2010). Bases para la elaboración del Programa de Mejoramiento Genético de los búfalos en Cuba. Ministerio de Agric. La Habana. Cuba.

AUTHOR CONTRIBUTION STATEMENT

Research conception and design: LMFB, DMCN, OLM; analysis and interpretation of data LMFB, DMCN, OLM; redaction of the manuscript: LMFB, DMCN, OLM.

CONFLICT OF INTEREST STATEMENT

The authors declare the are no conflicts of interest.