Genetic by environment interaction for post weaning growth traits in tropical cattle

Michel Naves, Alberto Menendez Buxadera, Alain Farant, Nathalie Mandonnet

GENETIC BY ENVIRONMENT INTERACTION FOR POST WEANING GROWTH TRAITS IN TROPICAL CATTLE

M. Naves[1], A. Menendez Buxadera[1], A. Farant[2] and N. Mandonnet[1]

[1] INRA Unité de Recherches Zootechniques, 97170 Petit Bourg, Guadeloupe (FWI)
[2] INRA Domaine de Gardel, 97160 Le Moule, Guadeloupe (FWI)

INTRODUCTION

Although there is a high level of concern about the importance of the genotype by environment interactions in animal production (see Menendez Buxadera & Mandonnet, 2006), the references available on this subject for beef cattle in tropical conditions are scarce. Generally, the studies evaluate the interaction through the correlation of the same trait evaluated in different countries, considered as different environments (Meyer, 1995; de Matos et al., 2000; Quintanilla et al., 2002). However, also within tropical countries, there can be large differences in production environment. Accordingly our objective was to present a detailed study made in a tropical environment with a local and well adapted cattle breed named Creole. In particular, we analyzed some post weaning growth traits, measured on calves managed in intensive feeding systems or at pasture.

MATERIAL AND METHODS

Herd management. The animals belong to INRA Domaine de Gardel experimental farm, located in Guadeloupe, in the French West Indies (Lat. 16°N, Long 61°W). The experimental herds are composed exclusively of cattle belonging to the Creole breed. All the Creole calves born in the years 1998 to 2004 were included in the study. They were born in suckling herds managed entirely at pasture, on either natural savannahs or implanted pastures, with or without irrigation. The first two years, the calving occurred in two seasons. But later, calving was concentrated within three months at the end of the dry season. Parentage testing was performed, by DNA microsatellite analysis on calves. Weaning occurred at an average of 210 days, in half-herd at a time. The calves were later separated in 4 different management groups according to sex, balanced for sire origin and weaning weight and age at weaning. Half of both sexes were maintained in a feed lot and received an intensive feeding regime, consisting of cropped grass and concentrates (between 2.5 and 4.5 kg/d according to the live weight). The other calves were conducted at pasture, on artificial grasslands, with irrigation and fertilizers. The calves were dewormed at weaning, and acaricide treatments were applied in outside herds every 2 weeks to prevent ticks infestation. The growing period lasted until the age of 14 to 17 months in intensive fattening, and until the age of 17 to 21 months at pasture.

Data collected and analysed. The animals were weighted every month during the suckling period, and every 2 weeks, after weaning. From the observed weights, weights at standard age were calculated, at the age of 210 days (W210) from pre-weaning weightings, and at the ages of

365 days (W12), 455 days (W15) and 545 days (W18) from post weaning data. The observed weaning weight (WW) and age (WA) were also used in the analysis, and post weaning growth rates were calculated from weaning until 15 months (PWG15) or 18 months (PWG18). In the following analyses, post weaning growth traits estimation in both feeding systems were considered as separate traits, named W12i, W15i, PWG15i for the feed lot and W12p, W15p, W18p, PWG15p, PWG18p for the pastured calves. A total of 444 calves were included in the analysis, 129 and 88 steers and 114 and 113 heifers for feed lot and pasture regime respectively. They descended from 24 sires and 125 dams; the pedigree was extended as far as possible and a total of 689 animals were present in the pedigree.

Statistical analyses. (Co)variance components for all characters were analysed using restricted maximum likelihood (REML) methodology with ASREML software (Gilmour et al 2002). Different bi-variate animal models were studied, involving separate traits measured one in intensive fattening and the other at pasture. The only fixed effects were the contemporaneous group within sex. Different covariables were tested, P210 or WW and/or WA, for the analysis of live weights; no covariable were included in the model of analysis of the growth rates. To check the results, separate univariate analysis, with heteregenous variance across postweaning management groups were also performed on traits measured simultaneously in both management systems.

RESULTS AND DISCUSSION

A summary of the traits analysed is given in Table 1. For all animals included in the analysis, W210, WW and WA are known, and similar in both post weaning management system. The growth rate in intensive fattening was about twice the growth rate at pasture (614 g/d *vs* 348 g/d for PWG15i), leading to similar weights in intensive fattening and at pasture respectively at 12 months of age (W12i = 239.1 kg) and 15 months of age (W15p = 245.3 kg), or at 15 month (W15i = 302.7 kg) and 18 month (W18p = 288.6 kg).

Table 1: Growth traits studied on calves raised in intensive fattening or at pasture

	Intensive fattening			Pasture		
	N	M	SD	N	M	SD
W210 (kg)	243	153.5	31.2	201	159.5	25.1
WW (kg)	243	154.5	30.3	201	160.5	25.6
WA (d)	243	212.6	17.7	201	212.6	18.3
W12 (kg)	243	239.1	50.0	201	201.0	37.3
W15 (kg)	238	302.7	56.2	200	245.3	47.6
W18 (kg)				191	288.6	52.9
PWG15 (g/d)	238	614	151	200	348	167
PWG18 (g/d)				191	385	141

(N: sample size; M: mean; SD: standard deviation)

Only the results obtained with the models including WW and WA as covariables are presented, for these models lead to the lower residual variances for each trait analysed. Bi-variate analysis were conducted on the growth traits considered separately in both systems, at the same age (W12i and W12p; W15i and W15p, PWG15i and PWG15p), or at the same maturity stage (W12i and W15p; W15i and W18p; PWG15i and PWG18p).The (co)variance components and the estimates of genetic parameters are presented in Table 2 for each of these bi variate analysis.

Table 2: (Co)variance components and estimates of genetic parameters (mean ± SD) of post weaning growth traits measured in intensive fattening or at pasture

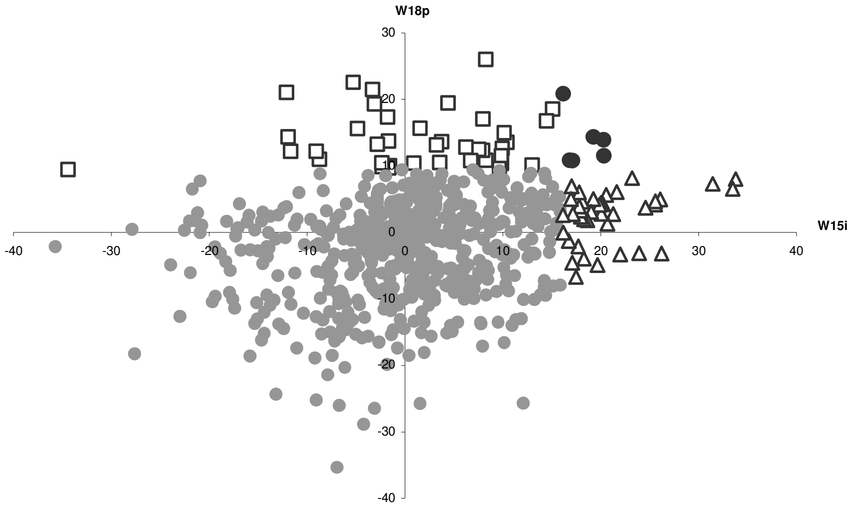
Traits analysed	Genetic variance		Cov	Heritability		r_g
(i: feed lot / p: pasture)	Feed lot	Pasture		Feed lot	Pasture	
W12i - W12p	208.0	41.57	34.93	0.33 ± 0.15	0.16 ± 0.14	0.38 ± 0.43
W12i - W15p	219.1	92.34	-23.51	0.44 ± 0.16	0.20 ± 0.16	-0.17 ± 0.42
W15i - W15p	342.6	87.96	- 4.02	0.44 ± 0.17	0.19 ± 0.16	-0.02 ± 0.47
W15i - W18p	332.5	303.9	29.03	0.43 ± 0.17	0.35 ± 0.19	0.09 ± 0.39
PWG15i – PWG15p	6712	1263	-391.3	0.46 ± 0.17	0.15 ± 0.16	-0.13 ± 0.48
PWG15i - PWG18p	6438	2702	174.4	0.45 ± 0.17	0.35 ± 0.19	0.04 ± 0.38

All the variance components of the traits measured at pasture are less than half the equivalent trait measured in intensive fattening at the same age or maturity stage, except for W15i and W18p, which represent the final weight. Very low genetic covariance is observed, either positive or negative, but not significative between each pair of traits.

The estimates of heritability obtained are consistent, between analysis, and with the literature on these parameters obtained in tropical cattle (Mercadante et al., 1995; Lobo et al., 2000). Very low genetic correlations between growth traits measured in intensive fattening system and at pasture are observed, however the precision is very poor. But these results are consistent with previous results we obtained from another set of data (Naves et Menendez Buxadera, 2005). The present data were better balanced between the management systems than the previous, giving more evidence to the genetic by environment interaction. Our results are also in accordance with findings from Schoemann and Jordaan (1998), with beef cattle successively managed in intensive fattening and at pasture.

Estimated breeding value obtained as solutions of the bi-variate analysis of W15i and W18p are presented in Figure 1. The best 45 animals (10 %) for each trait were selected.. When both subgroup of elite animals were merged, only 6 were present in the top ranking in both feeding system. This figure also illustrates the importance of genotype by environment interactions and its consequence on the different ranking of animal merit according to the management system.

Figure 1. Representation of estimated breeding value for W15i and W18p
(□: Top 10% animals for W18p; Δ: Top 10% animals for W15i; ●: animals present in both top ranking)



CONCLUSION

Our results indicate that there exists an important interaction between genetic merit and environment for growth traits of beef cattle during the post weaning growth period, in tropical climate. Such results are of importance for the selection of beef cattle for post weaning growth, as the efficacy of selection program may depend on the adequation between the management of the performance testing and the field conditions in commercial farms. This finding indicates that it maybe necessary to take into account the real management conditions in which the animals would be grown, in order to warrant the genetic progress in the population. More data is needed to confirm these results.

REFERENCES

De Mattos D., J.K. Bertrand, I. Misztal, 2000. *J. Anim. Sci.* **78**: 2121-2126.
Gilmour A.G., B.R. Cullis, S. J. Welham, R. Thompson, 2002. ASReml Reference Manual. 2nd edition. Orange, NSW 2800, Australia. 186 pp.
Lobo R.N.B., F.E. Madalena, A.R. Vieira, 2000. *Anim. Breed. Abst.* **68**:433-462.
Menendez Buxadera A., N. Mandonnet 2006. *Anim. Breed. Abst.* (submitted)
Mercadante, M.E.Z., R.B. Lobo, A. de los Reyes, 1995. *Arch. Latinoam. Prod. Anim.,* **3**: 45-89
Meyer K., 1995. *Australian J. Agric. Res.* **46**:1219-1229
Naves M., A. Menendez Buxadera 2005. *Arch. Zootec.* **54**: 377-384
Quintanilla R., D. Laloë, G. Renand, 2002. 7th *WCGALP*. **Ses. 18**, paper 10
Schoeman S.J., G.G. Jordan, 1998. *Australian J. Agric. Res.* **49**: 607-612.