COW WEIGHT IN A CLOSED BRAHMAN HERD

J. Arango and D. Plasse

Facultad de Ciencias Veterinarias, UCV. Apartado 4563, Maracay, Aragua, Venezuela

INTRODUCTION

Body weight is associated with size, and is the most practical measurement of animal growth in beef cattle. Weights and weight gains at different ages in young animals are commonly used as main selection traits to improve meat production. The positive genetic correlation between weights taken at different ages has caused concern that selecting for early growth might increase mature size of beef cows to an extend which could compromise efficiency. This is especially important in poor environments, typical of tropical production systems, characterized by food shortage and seasonal forage availability. Under such conditions it seems that smaller animals tend to be more efficient (Taylor *et al*., 1972 ; Fitzhugh, 1978). Beef cattle are characterized as having a low rate of reproduction and high maternal cost per animal marketed. The two most important components that determine efficiency of beef cows are milk production and mature body weight (Dickerson, 1970). The importance of body size for efficiency has led to define traits associated with size, mass and dimension to be included in selection programmes. This paper reports variance component and genetic parameter estimates for cow weights in an experimental Brahman herd in Venezuela, managed on pastures without supplementation.

MATERIALS AND METHODS

Herd history and management. *La Cumaca* is a university-owned 450 ha experiment station located in the central part of Venezuela, characterized by a typical tropical climate with bimodal precipitation pattern. Precipitation, which averaged 1 705 mm during the years of the study, is concentrated between May and November. Soils are poor in phosphate and nitrogen and are slightly acid. The herd was established between 1960 and 1961 with purebred Brahman cows (n = 150) and bulls (n = 10) imported from different herds in the Gulf Coast region of USA. Importation of 7 sires followed until 1967 when the herd was genetically closed. Management was centered in a breeding season (BS), which was progressively shortened until 1968 when it lasted three months. Cows were maintained on pastures with predominance of *Panicum maximum* and had no access to supplement except for minerals (*ad libitum*), and molasses during the dry season. Heifers were weighed at the beginning of the BS, and served with a minimum weight of 270 to 300 kg (depending on the year), and at 3 years of age until 1968 and 2 years afterwards. They were culled (13 to 30 %) if they failed to conceive in their first breeding season. Cows were weighed twice a year : at the beginning of the BS (W1) and at weaning of the calf (W2). They were selected on reproductive efficiency and mothering ability, but culling was limited by the need to increase herd size to 215 cows. Bull selection was based on breeding value for weight at weaning and 18 months of age, estimated initially within the herd and later through a cooperative progeny-testing program. Bulls were randomly assigned to single sire pastures with 18 to 25 cows, trying to avoid inbreeding. Detailed description of the herd, its history and genetic programmes is available (Plasse *et al*., 1994).

Data and statistical analyses. Repeated records of W1 (n = 2 087) and W2 (n = 1 030) were available from 606 cows of 2 to 13 years old (average 5.4), which had 1 to 11 (average 3.5) weight records. Weight gain (W2-W1) during the BS was calculated for cows having both records. Data were also available on pregnancy diagnosis. Lactation codes were assigned (1 to 6) according to date of calving with respect to beginning of the BS. Generation code was assigned starting with foundation cows (0) up to great-grand daughters (3). The original database included 2 092 records, five (0.2 %) of which were omitted as of doubtful validity.
Mixed model analyses assuming cows' sires as a random effect, were carried out with SAS (Littell *et al*., 1996) to explore fixed effects affecting cow weights. Estimates of variance components and genetic parameters, and prediction of breeding values were performed using restricted maximum likelihood (REML) methodology. Repeatability univariate and bivariate animal models were applied using the set of programs MTDFREML (Boldman *et al*., 1995). Final models had cow age (years), lactation status, year of BS and their interaction, and generation as fixed effects for W1. For W2 lactation status was removed and substituted by pregnancy diagnosis. Calf's birth and 205-day weights were used as covariates for W1 and W2, respectively. Animal additive genetic and cow permanent environmental effects were random. Additional analyses were done to explore the effect of weight or weight gain on cow conception rate that included those variables as covariates and cow age, lactation status, their interaction, and year as fixed effects, besides the same random effects. To describe late growth curve, a set of polynomial models were used including the same fixed effects as above but with cow age as covariate.

RESULTS AND DISCUSSION

Cow weights. The unadjusted weight means were 397 ± 1.28 kg (260 to 590 kg) for W1 and 411 ± 1.55 kg (280 to 564 kg) for W2. Cows continued growing up to 12 and 11 yr of age for W1 and W2 but at a decreased rate at later ages. Age affected ($P < 0.01$) both cow weights. The adjusted means according to cow age for W1 and W2 are presented in figure 1. Cows had gained 94 % of their final weight by 5 yr of age ; while this figure was of 95 to 99 % by 6 to 9 yr of age. Certain weight fluctuation at older ages would be due to sampling given the small amount of records after 12 yr of age. The growth curves for W1 and W2 fitted a third polynomial degree (the highest being significant), whose coefficients were 59.848, -5.613 and 0.174 for W1, and 77.183, -8.312 and 0.295 kg for W2. Studies reporting weight of Brahman females in tropical environments include Plasse *et al.* (1989) in which heifers averaged 324 kg at the beginning of the first BS (747 d of age), and Plasse *et al.* (1992) who found a weight of 309 kg at first BS at 2 yr of age. In the subtropics, Sacco *et al.* (1990) reported that first calving Brahman cows weighed 489 and 403 kg in two generations. Olson (1993) found that 2, 3 and 5 yr or older Brahman cows of different frame sizes (small, medium and large) averaged 353, 413 and 442 ; 429, 467 and 474, and 467, 503 and 517 kg, respectively.

Parameter estimates. Phenotypic and genetic parameters for W1 and W2 estimated with repeatability models are shown in table 1. Heritability and repeatability estimates for cow weight agree with previous results reported for beef cows that were moderate to high. Koots *et al.* (1994) found an overall pooled estimate of heritability of 0.50 for mature cow weight from 25 studies in an extensive review. Rosa (1999) summarized a mean heritability of 0.44 from 22 studies, in which estimates from *Bos indicus* cows averaged 0.36. In Australia, Meyer (1995) reported a heritability of 0.54 for the average of adult weights in Wokalup (a composite breed including Brahman genes) cows.

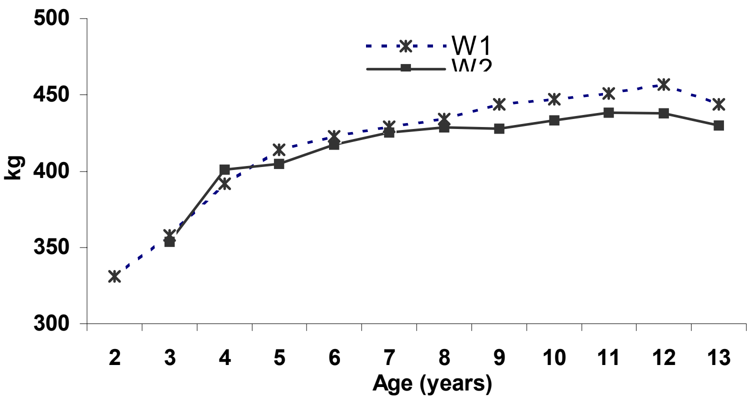

Figure 1. Adjusted means for weight of cows at the beginning of the breeding season (W1) and at calf weaning (W2) according to age

Table 1. Estimates of genetic and phenotypic parameters for cow weight

Trait	Parameter [A]				
	h^2	r_i	r_g	r_p	r_e
Weight 1 (W1)	0.68 ± 0.07	0.77			
Weight 2 (W2)	0.49 ± 0.10	0.70			
Bivariate (W1)	0.66	0.77	1.00	0.81	0.93
(W2)	0.57	0.69			

[A] h^2= heritability ; r_i= repeatability ; r_g= genetic correlation ; r_p= phenotypic correlation ; r_e= environmental correlation.

Genetic trend. Breeding values for cow weight ranged from –71 to 78 and from –74 to 81 kg for W1 and W2. The genetic trend, regressing the average breeding values on year of birth, was not significant for either cow weight when all animals were considered. The regression, however, was significant (P < 0.01) when only the 13 years in which cows with records were born were included. The corresponding regression coefficients were of 0.688 and 0.722 kg/year for W1 and W2. That difference in genetic trends seems to be due to exclusion of foundation cows, many of which were culled early due to poor reproductive performance. Rosa (1999) reported breeding values ranging form –42 to 60 kg and a genetic trend of 0.4 kg/year in Nellore cows from 34 herds.

Relationship between cow weight and reproduction. The effects of W1 and weight gain on cow's pregnancy were significant (P<0.01), with regression coefficients of 0.07 and 0.25 %/kg, respectively. In Brazil, Oliveira *et al.* (1994) found that heavier Guzerat cows were more efficient than lighter ones because they had shorter calving intervals and had more calves. Rosa (1999) reported a correlation of 0.18 between weight of Nellore cows and their productivity (kg of calf weaned/year). In USA, young large sized Brahman cows were, on average, heavier and less fertile than small and medium ones. Large adult cows, however, were more efficient due to larger weight of their calves (Olson, 1993 ; Vargas *et al.,* 1999).

CONCLUSION

In this population of Brahman cows, managed on tropical pastures without supplementation, weights taken after 5 yr of age could be considered as mature weights ; reproductive rate was positively related with weight gain during the BS. Selection would be effective in changing weight of adult cows, which should be taken cautiously given the environmental restrictions to supply the extra nutritional requirements needed by large size cows.

REFERENCES

Boldman, K.G., Kriese, L.A., Van Vleck, L.D., Van Tassell, C.P. and Kachman, S.D. (1995) «A manual for USE of MTDFREML. [DRAFT]», USDA, Agricultural Research Service, USA.

Dickerson, G.E. (1970) *J. Anim. Sci.* **30** : 849-859.

Fitzhugh, H.A. (1978) *Anim. Prod*. **27** : 393-401.

Koots, K.R., Gibson, J.P., Smith, C. and Wilton, J.W. (1994) *Anim. Breed. Abstr*. **62** : 309-338.

Littell, R.C., Milliken, G.A., Stroup, W.W. and Wolfinger, R.D. (1996) «SAS System for Mixed Models». SAS Institute Inc. Cary, NC, USA.

Oliveira, H.N., Lôbo, R.B. and Pereira, C.S. (1994) *Proc. 5th WCGALP* **19** : 189-192.

Olson, T. (1993) *Proc. 42nd Annual Florida Beff Cattle Short Course* 39 - 44.

Plasse, D. (1994) In «X Cursillo sobre Bovinos de Carne», p 1-51, Editors D. Plasse, N. de Borsotti and J. Arango, Universidad Central de Venezuela, Maracay, Venezuela.

Plasse, D., Fossi, H. and Verde, O. (1989) In «V Cursillo sobre Bovinos de Carne», p 317-331, Editors D. Plasse, N. de Borsotti, Universidad Central de Venezuela, Maracay, Venezuela.

Plasse, D., Fossi, H., Verde, O., Rodríguez, C. and Silva, V. (1992) *Proc. VII Congreso Venezolano de Zootecnia* **GR** : 27.

Rosa, A. do N. (1999) PhD Thesis, Universidade de São Paulo, São Paulo, Brasil.

Sacco, R.E., Baker, J.F., Cartwright, T.C., Long, C.R. and Sanders, J.O. (1990) *J. Anim. Sci.* **68** : 3103-3108.

Taylor, C.R., Caldwell, S.L. and Rowntree, V.J. (1972) *Science* **178** : 1096-1097.

Vargas, C.A., Olson, T.A.,Chase, C.C., Hammond, A.C. and Elzo, M. (1999) *J. Anim. Sci.* **77** : 3140-3149.