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SHORT COMMUNICATION

COMPARATIVE PERFORMANCE OF SIX HOLSTEIN-FRIESIAN x GUZERA CROSSBRED GROUPS IN BRAZIL. HEALTH COSTS OF CALVES

R.L. Teodoro[1], A.M. Lemos[1], R.T. Barbosa[2] and F.E. Madalena[3]

ABSTRACT

Costs of drugs for pneumoenteritis and plasmosis treatment were evaluated in 614 bucket reared female calves of six Holstein-Friesian (HF) x Guzera crossbred groups (1/4 to ≥ 31/32 HF gene fraction). Important heterosis effects resulted in lowest health costs for F_1 (US$ 4.33 per calf) and highest costs for ≥ 31/32 HF calves (US$ 8.01).

INTRODUCTION

Crossbred *Bos taurus* x *B. indicus* calves have a higher rate of survival than purebreds in tropical conditions (Vaccaro, 1990). However, although heterosis is generally regarded as being more important for traits related to fitness, results quantifying its effects on the health of tropical cattle are not readily available. The purpose of this article is to investigate breed and heterosis effects on the cost of maintaining calves healthy, using data from a more general crossbreeding trial described elsewhere (Madalena, 1989).

MATERIAL AND METHODS

Animals and management

Data were originated from 614 female calves, of six red and white Holstein-Friesian (HF) x Guzera (Gu) crossbred groups, having expected proportions of 1/4, 1/2, 5/8, 3/4, 7/8 and ≥ 31/32 HF genes. The halfbreds were F_1 out of Gu dams, the 1/4 HF were first backcrosses to Gu sires. The 3/4, 7/8 and ≥ 31/32 HF were respectively first, second and fifth or higher backcrosses to HF sires. The 5/8 were obtained from inter se matings of 5/8 sires and dams. There were 19 HF, 15 Gu and eight 5/8 sires in the present data set. Further information on the genetic background of these animals was given by Lemos *et al.* (1984), who also presented climatic data.

Calves were born between April 1977 and September 1981 at Santa Monica Experimental Station, Municipality of Valencia, State of Rio de Janeiro, where they were reared. Males were disposed of early and could not be included in the study. The females were kept in an adapted pig nursery building up to two months of age and on pastures thereafter. They were bucket fed colostrum for the first 36 hours and four litres warm whole milk per day up to four months of age. On pastures they received supplementary minerals, concentrates and roughage in the dry season. The health program included navel disinfection at birth and vaccinations against anthrax, foot and mouth disease, pneumoenteritis and brucellosis. Gastrointestinal parasites and tick burdens were kept low by chemical control at frequent intervals. Other management details were given by Teodoro *et al.* (1984).

Records were available on the number of treatments each calf received for each particular disease (as

[1] EMBRAPA, Centro Nacional de Pesquisa-Gado de Leite, 36155-000 Coronel Pacheco, MG, Brasil. Send correspondence to R.L.T.

[2] Centro de Pesquisa da Região Sudeste, EMBRAPA, Caixa Postal 339, 13560-970 São Carlos, SP, Brasil.

[3] EPAMIG, Departamento de Zootecnia, Escola de Veterinária, Universidade Federal de Minas Gerais, Caixa Postal 567, 30161-970 Belo Horizonte, MG, Brasil.

diagnosed by the station veterinarian) up to one year of age. A fixed treatment was assumed for each calf, consisting of eight sulfadrug pills plus three antibacterial drug flasks, for pneumoenteritis (cost = US$ 6.58) and 7.5 ml of Terramycin plus 2.5 ml Ganaseg for plasmosis (cost = US$ 1.21). Health cost was obtained as the sum of the number of treatments for pneumoenteritis or plasmoses x cost per treatment. Other diseases were considered as zero cost. These were: cachexia, accident, bloat, intoxication, navel disorder, heart deficiency, septicemia, anaphylactic shock and arthritis.

Statistical analysis

Data were analyzed by least squares using SAS (1985), GLM procedure. The square root transformation of health cost was used to obtain homoscedasticity and independence of sub-class means and variances (Hoyle, 1973).

Records were classified by year of birth (four years, with 1980 and 1981 grouped together) and age of dam (three classes: ≤ 4 y-old; 5 to 7 y-old and ≥ 8 y-old).

A preliminary model including the effects of crossbred groups, years, ages of dam and all double interactions was initially run. Age of dam and the interactions were not significant (P > 0.22) and were disregarded thereafter. Two models were fitted: an additive-dominance model (1) and a crossbred group classification model (2). The additive-dominance model was:

$$Y_{ij} = \mu + g_1^I (q_i - \bar{q}) + h_1^I (z_i - \bar{z}) + h_1^M (w_i - \bar{w}) + YR_j, \quad (1)$$

where:

μ = overall mean;

g_1^I = individual breed additive difference (HF - Gu);

q_i = expected fraction of HF genes in individuals of the i-th crossbred group (i = 1, ..., 6; q = 1 was assumed for the ≥ 31/32 HF group);

h_1^I = individual heterosis effect;

z_i = expected proportion of loci with one gene from each breed in individuals of the i-th crossbred groups. The z-values were 1/2, 1, 30/64, 1/2, 1/4, and 0, respectively, for groups 1/4, 1/2, 5/8, 3/4, 7/8 and ≥ 31/32 HF;

h_1^M = maternal heterosis effect within F_i and backcrosses;

w_i = expected proportion of loci with one gene from each breed in dams of the i-th crossbred group. w - values were 1, 0, 1/2, 1, 1/2, and 0, respectively; for groups 1/4, 1/2, 5/8, 3/4, 7/8 and ≥ 31/32 HF;

YR_j = effect of the j-th year of birth (j = 1, ..., 4).

In the second model (2), the discrete crossbred group classification effects G_i substituted for the g^I, h^I and h^M regressions of model 1. Goodness of fit on both models was assessed by F tests of the mean squares due to fiting model 2 over and above model 1, which was tested against the model 2 residual mean square.

RESULTS AND DISCUSSION

The analysis of variance for model 2 is shown in Table I. Crossbred group and year of birth effects were highly significant (P < 0.01).

Table I - Analysis of variance of transformed calf health cost.

Source	d.f.	m.s.	Prob.
Crossbred groups	5	5.822	0.0062
Years	3	33.616	0.0001
Residual	605	1.775	-
Crossbred groups after fitting g^I and h^I regressions	3	0.205	> 0.1000

The h^M regression of model 1 was not significant (P > 0.16) and the analysis was re-run deleting this term. As shown in Table I, deviations from model 1 due to genetic effects other than g^I and h^I were not significant. The g^I parameter corresponds to Dickerson's (1969) average direct individual HF gene effects, measured as the difference from the Gu breed. The h^I and h^M parameters measure individual and maternal heterosis effects. They contain dominance and epistatic effects (Dickerson, 1969), which are confounded in the F_1 and backcrosses (Hill, 1982; Koch *et al.*, 1985). In addition, in these crosses the expected proportions of dam's HF genes equal $1-z_i$, so h^I is confounded with maternal additive effects (g^M). The heterosis regression of model 1 was highly significant (P = 0.0054), but the breed difference was not (P = 0.6758). The estimates obtained were $g^I = 0.116 \pm 0.277$ and $h^I = -0.669 \pm 0.240$ (in square root dollar units). We are not aware of other estimates of breed and heterosis effects on calf health costs.

Backcross transformed least squares means are shown in Table II. The F_1 calves had the lowest health costs, which increased for groups with reduced z-values (''heterozygosity''). The cost for the ≥ 31/32 HF group was nearly double the cost for the F_1.

Treatment of diarrhoea/pneumonia accounted for 98 percent of health costs. Ribeiro *et al.* (1983) reported these as the most frequent diseases in a dairy cattle region of Minas Gerais, followed by blood parasites and navel disorders. Differences between European breeds in terms of susceptibility to respiratory diseases was reported by

Table II - Least squares means of health cost (LSM) and standard errors (s.e.) estimated under group classification model 2.

	N	LSM (US$)	s.e.
Holstein-Friesian fraction			
1/4	122	5.64	0.015
1/2	99	4.33	0.018
5/8	109	6.46	0.017
3/4	91	5.96	0.020
7/8	100	6.66	0.018
≥ 31/32	93	8.01	0.019
Year of birth			
1977	157	3.60	0.012
1978	191	8.95	0.009
1979	104	5.96	0.017
1980/81	162	6.60	0.011
Mean	614	6.26	0.002

Roy (1970), who indicated differences in absorption of immunoglobulins as a possible mechanism of disease resistance. Singh *et al.* (1986) reported that Holstein/Jersey x zebu F_1 had a lower incidence of gastro-intestinal and pulmonary disorders, and blood parasitism than purebred zebus and 3/4 European crosses.

A lower incidence of babesiosis/anaplasmosis in *B. indicus* crosses than in *B. taurus* would be expected because of the higher resistance of the former species to ticks and to blood parasites (Guglielmone, 1992). Lemos *et al.* (1985) reported that tick resistance increase exponentially with the HF fraction, although tick burdens on 1/4 HF and F_1 were both of little practical importance. Incidence of plasmosis was lower for these two groups than for the other crosses in the present results, and this increased with HF fraction, but the numbers were too low for statistical analysis.

As discussed in a companion paper (Madalena *et al.*, unpublished results), published health/mortality results generally refer to bucket feeding experimental station conditions, while suckling rearing is commonest in tropical systems, which may prevent generalization of results because the high *B. indicus* grades are more difficult to train to bucket feeding, which was the case for 1/4 HF in our trials, and this may have affected their health. Ugarte (1992) reported that health costs with artificial rearing were 3.32 times higher than for suckling calves. Thus, the present genetic effects should not be generalized to other calf rearing situations, such as family labour and suckling.

Because z_i^I was confounded with q_i^M in the F_1 and backcrosses and also highly correlated (r = 0.94) with the additive x additive fractions the h^I effects may not be strictly attributed to dominance. However, irrespective of the nature of the genetic effects, the present results indicate that health costs are lower for intermediate genotypes between *B. indicus* and *B. taurus*. Thus, heterosis for this trait is a further advantage of crossbreeding systems, particularly for the F_1 heifer replacement system (Madalena, 1993).

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RESUMO

Foram avaliados os custos das drogas para pneumoenterite e plasmoses em 614 bezerras Holandês (H) x Guzerá (com fração H de 1/4 a ≥ 31/32, com aleitamento artificial. Efeitos de heterose importantes resultaram em baixo custo para F_1 (US$ 4.33 por animal) e alto custo para animais ≥ 31/32 HF (US$ 8.01).

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