

# Cattle breed-variation in infestation by the horn fly *Haematobia irritans*

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**Abstract.** A study was carried out to assess the resistance of pure and cross-bred groups of cattle to the horn fly *Haematobia irritans* (Linnaeus) (Diptera: Muscidae) in northern Argentina. Pure-bred cattle were Criolla, Iberian *Bos taurus* Linnaeus (Artiodactyla: Bovidae) and Nellore, *Bos indicus* Linnaeus (Artiodactyla: Bovidae). Cross-bred cattle were Hereford, British *B. taurus* (34%) × Nellore (66%) and Hereford (66%) × Nellore (34%). All were heifers and animals were maintained in two groups, each containing a mixture of pure and cross-breeds. The lowest fly numbers were found on Criolla heifers and the highest on Hereford × Nellore cross-breeds. However, it could not be determined from this study whether this was a consequence of breed and/or size, as Criolla heifers were lighter than the corresponding Hereford × Nellore heifers. Fly numbers on the heifers followed an approximately negative binomial distribution. However, the ranking of individual animals in their level of infestation within subgroups was not consistent. Hence, culling the most infested heifers on any given date would at best give only a small improvement in *H. irritans* control.

**Key words.** *Bos indicus*, *Bos taurus*, *B. taurus* × *B. indicus*, *Haematobia irritans*, infestation levels, Argentina.

## Introduction

The breeding of cattle resistant to parasites is a useful alternative to the reliance on chemicals for parasite control (Van Den Bosch & Stern, 1962). Several investigations have been carried out to attempt to detect cattle resistance to the horn fly, *Haematobia irritans* (Linnaeus), a haematophagous dipteran pest of cattle maintained on pasture (Bruce, 1964). Tugwell *et al.* (1969) stated that cattle carried a decreasing number of flies as the percent of Brahma, *Bos indicus* Linnaeus, genes increased. Doube (1984) and Brethour *et al.* (1987) found evidence to support this finding and Steelman *et al.* (1994) stated that Brahma cattle and their crosses were useful in the management of insecticide-resistant *H. irritans* populations. By contrast, Buseti *et al.* (1996) found that Beefmaster, a *Bos taurus* Linnaeus × *B. indicus* cross, was the most highly infested breed in a 2-year comparative study that also included four pure *B. taurus* breeds and three *B. taurus*

crosses. Ernst & Krasfur (1984) found no difference in horn fly numbers on *B. taurus* cows of Angus, Charolais, Hereford and Shorthorn breeds. However, Steelman *et al.* (1991) found that Chianina cows carried fewer flies than five other *B. taurus* breeds. Steelman *et al.* (1993) were also able to determine horn fly-resistant individuals within breed in heifers younger than 2 years old.

Resistance to the tick, *Boophilus microplus* (Canestrini) by *B. indicus* and *B. taurus* × *B. indicus* crosses has been demonstrated by the studies, amongst others, of Wharton *et al.* (1969), Utech *et al.* (1978) and Lemos *et al.* (1985). Studies carried out in Argentina have shown that Nellore (*B. indicus*) and their crosses with Hereford (British *B. taurus*) are resistant to *B. microplus* ticks, while Criolla (Iberian *B. taurus*), carried greater tick numbers than Nellore and Nellore × Hereford crossbreeds (Guglielmone *et al.*, 1990, 1992a). This latter observation raises the possibility that such tick-resistant cattle may also be less prone to *H. irritans* infestation. This paper presents the results of a study of the infestation of Criolla, Nellore and two Nellore × Hereford crosses by *H. irritans* under field conditions in northern Argentina.

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**Table 1.** Median, first and third quartile (in parentheses) numbers of *Haematobia irritans* on two groups of heifers of different breeds. Median numbers in a row not sharing letters are significantly different ( $P < 0.05$ , Kruskal–Wallis test).

Month and year	Criolla	Nellore	66% Nellore 34% Hereford	34% Nellore 66% Hereford
<b>Group 1</b>				
Dec 92	20 (6–40) ab *	6 (4–12) a	20 (6–30) ab	40 (20–50) b
Feb 93	12 (10–26) a	16 (4–24) a	20 (16–40) ab	36 (22–76) b
Mar 93	22 (12–36) a	16 (10–58) a	82 (34–144) b	66 (32–120) ab
Apr 93	10 (4–12) a	12 (6–22) ab	24 (18–100) b	44 (10–136) b
All counts	12 (6–28) a	12 (6–24) a	28 (14–68) b	42 (22–86) b
<b>Group 2</b>				
Sep 93	0 (0–0) a	0 (0–1) a	0 (0–1) a	0 (0–1) a
Oct 93	10 (3–28) a	18 (8–90) a	44 (14–110) a	16 (11–29) a
Nov 93	30 (28–52) a	40 (24–80) a	60 (32–100) a	70 (40–120) a
Dec 93	20 (7–42) a	28 (15–58) a	30 (9–50) a	60 (35–80) b
Jan 94	12 (6–27) a	16 (8–39) a	20 (11–49) a	28 (13–60) a
Feb 94	8 (3–31) a	8 (4–24) a	36 (20–60) b	24 (13–30) ab
Mar 94	24 (15–57) a	32 (13–60) a	60 (27–75) a	40 (30–65) a
Apr 94	8 (3–14) a	10 (4–17) ab	20 (9–45) b	20 (11–47) b
May 94	4 (2–11) a	32 (19–66) b	32 (21–65) b	24 (5–45) ab
All counts	10 (2–30) a	18 (7–43) b	30 (11–60) b	28 (11–60) b

## Materials and methods

The study was carried in the Campo Experimental of the Instituto Nacional de Tecnología Agropecuaria located in Leales (27°12'S 65°18'W), Tucumán, Argentina. Group 1 consisted of 60 heifers, born in 1991–92. Group 2 consisted of 56 heifers born in 1993. Each group contained equal numbers of Criolla, Nellore, Hereford (34%) × Nellore (66%) and Hereford (66%) × Nellore (34%), individuals. Hence, 15 and 14 heifers of each breed were in groups 1 and 2, respectively. Heifers of group 1 were 12–15 months old and those in group 2 were 7–9 months old at the onset of the evaluation.

Heifers of group two were exposed to natural *H. irritans* infestations from birth. Those of group 1 were naturally exposed to this fly species, from at least April 1992, when cattle infestation in the study area was noted after the first detection of this fly in the Argentinean continental territory in October 1991 (Luzuriaga *et al.*, 1991). The heifers of each group were run together from weaning at the age of 6 months to the end of the evaluation, on Gramma Rhodes (*Chloris gayana*) or natural pastures with predominance of *Cynodon dactylon*, *Digitaria insularis*, *Paspalum notatum* and *Desmodium canum*. No treatment against ectoparasites was carried out from 60 days before the first fly number estimation to the end of the evaluation period.

From the onset of the trial, *H. irritans* infestations were evaluated at 30-day intervals, with the exception of January 1993, when no counts were carried out for group 1. At each evaluation the number of horn flies that alighted on one side of the bodies of the heifers was counted (Hillerton & Bramley, 1986). The fly count for the first heifer started at 08.00 hours and continued heifer by heifer over a 2-h period until the infestation of all heifers had been recorded. Each total was doubled to provide an estimate of the total fly population on an

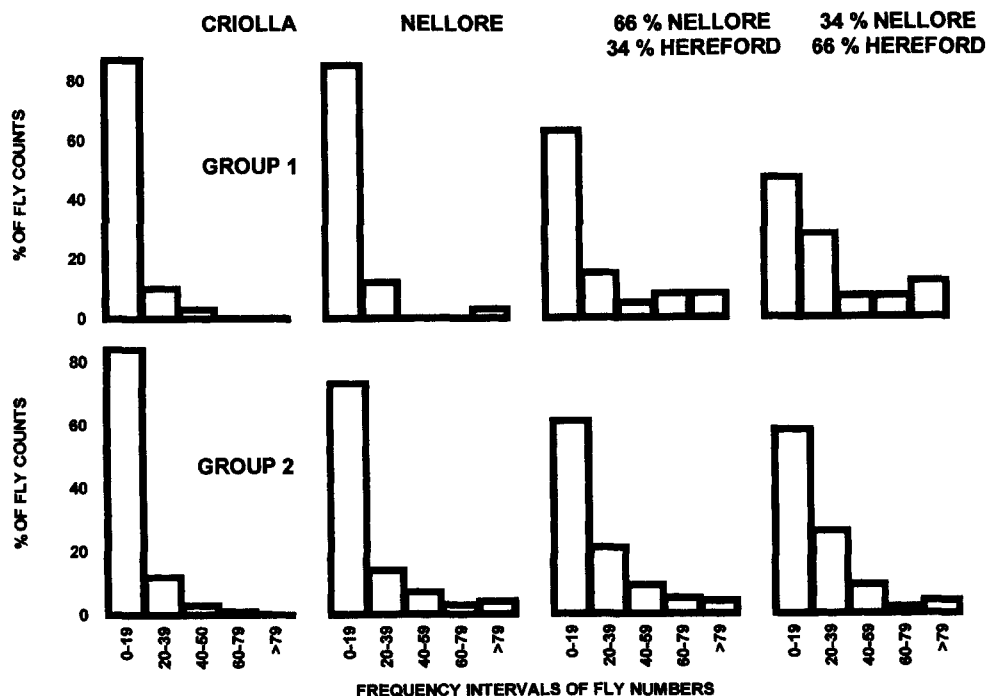
individual heifer (Bean *et al.*, 1987). Four fly counts were carried out for the heifers of group 1, the first on 16 December 1992 and the last one on 6 April 1993. The numbers of *H. irritans* were estimated nine times for the heifers of group 2, from 16 September 1993 to 23 May 1994. Heifer body weights were also recorded after the first and final fly counts for each group.

## Results

The median number and quartiles of *H. irritans* per breed in group 1 and 2, over time, are presented in Table 1. The frequency distribution of fly counts per breed are depicted in Fig. 1. Heifers were ranked according to infestation and the Kruskal–Wallis test applied to detect differences in *H. irritans* infestation within breeds at each count date. Criolla and Nellore heifers of group 1 carried fewer flies than the crossbreed heifers, resulting in significantly lower *H. irritans* numbers overall for this group. Criolla heifers of group 2 showed the lowest fly numbers, significantly lower than those recorded from Nellore and crossbreed heifers of this group.

Count data were not normally distributed. The number of most heavily infested heifers, which together carried 50% of the total number of *H. irritans* per breed at each count, was calculated. The number of heifers that carried 50% of the total *H. irritans* was similar in the different cattle breeds from both groups. However, the individuals forming this group were not consistent (Table 2). Most heifers were in this heavily infested group at some point during the study period.

The mean initial and final body weights were analysed by using ANOVA; Tukey's LSD test was used to detect differences amongst breed weights. Initial and final mean weights per breed and groups are presented in Table 3. The initial weights



**Fig. 1.** Frequency intervals of *Haematobia irritans* numbers in two group of heifers of different breed used to evaluate horn fly infestations. Group 1 ( $n = 60$  counts per breed), Group 2 ( $n = 117$  counts per breed).

**Table 2.** Mean number, standard deviations (SD) and percentage of most heavily infested heifers carrying 50% of the *Haematobia irritans* subpopulations, number and percentage of heifers that were at least once in this category, in two groups of different breeds used to evaluate horn fly infestations.

	Criolla	Nellore 34% Hereford	66% Nellore 66% Hereford	34% Nellore
<b>Group 1 (four counts) (<math>n = 15</math>)</b>				
Mean $\pm$ SD of heifers in the most infested group carrying 50% of total fly numbers	$3.8 \pm 0.50$	$3.0 \pm 0.82$	$3.3 \pm 0.96$	$4.0 \pm 0.82$
% of heifers in the most infested group	25	20	22	27
No. of heifers at least once in the most infested group	10	9	7	9
% of heifers at least once in the most infested group	67	60	47	60
<b>Group 2 (nine counts) (<math>n = 13</math>)</b>				
Mean $\pm$ SD of heifers in the most infested group carrying 50% of total fly numbers	$3.0 \pm 0.70$	$2.7 \pm 0.70$	$2.8 \pm 1.09$	$3.0 \pm 0.90$
% of heifers in the most infested group	23	21	22	23
No. of heifers at least once in the most infested group	11	10	8	10
% of heifers at least once in the most infested group	85	77	62	77

of Criolla and Nellore were lower than the weight of Hereford  $\times$  Nellore crosses, although differences were not always significant. Final weights of Criolla were lower than the corresponding weights of other cattle breeds but significant differences in final weights were found with both crosses.

## Discussion

Criolla heifers of group 1 carried lower numbers of horn flies than Hereford  $\times$  Nellore crosses, apparently showing that the crossbreeds were of relatively little value in limiting horn fly infestations. This was also the case in group 2.

The Criolla heifers were initially lighter than the crossbreeds and final weight differences were significant. Weight is related to size and Steelman *et al.* (1996) found that small Angus (British *B. taurus*) carried fewer flies. Busetti *et al.* (1996) showed that Beefmaster carried the highest *H. irritans* numbers, although this was the heaviest cattle breed in the study. Angus was lighter than the other breeds in the first year of their study and also carried the lowest fly numbers. A probable confounding effect amongst breed, size and cattle resistance is not exclusive to studies of *H. irritans*. Meltzer (1996) showed that alleged genetic breed resistance to *Amblyomma hebraeum* ticks was probably related more to size than breed; this author was concerned about farmers being

**Table 3.** Mean and standard deviation of initials and final body weights (kg) of two groups of heifers of different breeds used to evaluate *Haematobia irritans* infestations.

	Criolla	Nellore 34% Hereford	66% Nellore 66% Hereford	34% Nellore
<b>Group 1</b>				
Initial weight	193.0 ± 22.33 ab*	177.8 ± 33.91 a	217.0 ± 16.67 c	215.1 ± 20.69 bc
Final weight	218.6 ± 26.98 a	222.2 ± 38.66 a	255.2 ± 22.66 b	255.3 ± 23.05 b
<b>Group 2</b>				
Initial weight	165.2 ± 19.64 a	160.8 ± 31.57 a	185.4 ± 19.99 a	179.2 ± 21.86 a
Final weight	250.3 ± 18.52 a	267.7 ± 29.83 ab	297.0 ± 29.64 c	280.9 ± 24.28 bc

\*Numbers in a row not sharing letters are significantly different ( $P < 0.05$  ANOVA followed by mean comparisons using Tukey's test).

encouraged to change their breeding strategies without obtaining economic benefit. We share his concern.

It seems that evaluation of cattle resistance to *H. irritans* is complex. Cattle size may influence horn fly infestation (Busetti *et al.*, 1996; Steelman *et al.*, 1996). Cattle differential infestation related to coat colour was found to be important by some authors (Franks *et al.*, 1964; Morgan, 1964; Schreiber & Campbell, 1986) but not others (Tugwell *et al.*, 1969; Doube, 1984; Ernst & Krasfur, 1984). Controversial results have also been obtained for the relationship between the proportion of *B. indicus* genes and *H. irritans* infestations (Tugwell *et al.*, 1969; Doube, 1984; Brethour *et al.*, 1987; Steelman *et al.*, 1994; Busetti *et al.*, 1996; this study). In addition, Steelman *et al.* (1997) stated that hair density and quantity of sebum was inversely related to *H. irritans* density. Some studies have been carried out with cattle groups maintained in different paddocks, which may result in dissimilar conditions of paddock infestation or different levels of exposure to *H. irritans* immigration from external sources. Studies on horn fly immigration resulted in contradictory results (Chamberlain, 1982; Guillot *et al.*, 1988; Marley *et al.*, 1991). Fly counts may also be influenced by factors such as temperament of cattle, wind, time of day, temperature or the operators conducting the count. Therefore, the interpretation of studies of natural *H. irritans* infestations can be difficult. Experimental designs that consider all the factors mentioned above are difficult to achieve; this may partly explain the dissimilar results obtained from different studies.

In the present study, flies were not distributed evenly among the cattle and a relatively small proportion of heifers of any breed carried 50% of the total horn fly numbers at any particular count. This suggests that the distribution of *H. irritans* amongst cattle corresponds to a classical negative binomial distribution of parasites on their hosts (Poulin, 1993). This characteristic of parasitism has led to the suggestion that cattle most prone to *B. microplus* infestations in Australia should be culled to improve tick control (Sutherst & Utech, 1981). The same suggestion was put forward by Steelman *et al.* (1993) for *H. irritans* control. However, this characteristic was not useful in the control of *B. microplus* ticks under Argentinean field conditions because the heifer composition of the group most heavily infested with ticks was not consistent

(Guglielmone *et al.*, 1990, 1992a, b) and a similar problem was found Naves *et al.* (1998) dealing with *Amblyomma variegatum* ticks on cattle. The present study showed the same problem for horn fly infestation on heifers. We were unable to confirm the findings of Steelman *et al.* (1993) and this study appears to show that culling the most heavily infested heifers on any given date would at best render only a small improvement in *H. irritans* control.

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