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Economic indexes including tick resistance for Hereford and Braford breeds raised in Southern Brazil. [1]

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Summary

The aims of this study were to estimate economic values for breeding goal (BG) traits and develop a selection index that combines tick resistance, birth rate and growth traits (direct and maternal weaning weight, mature cow weight, and carcass weight) for a typical beef cattle production system (FCS) in Southern Brazil using Hereford (HH) or Braford (BR) breeds. A bio-economic model was developed for this full cycle production system, which specializes in selling fattened steers, harvest heifers, and cull cows. The EV for tick resistance was developed by a stochastic method that considered the costs of chemicals, loss of weight and the probability of an animal's death. EVs were -19.96 for TICK, (3.62, 3.64) for birth rate (BR), (0.92, 0.88) for carcass weight, (0.71, 0.67) for weaning weight (WW) direct, (0.47, 0.43) for WW maternal, and (0.22, 0.24) for mature cow weight in HH and BR, respectively. The overall genetic gain per year, was US$ 5.33 and US$ 5.19 for HH and BR, where growth traits contributed with 90% of this value in both breeds, and TICK and BR contributed only 10%. The minor progress using the proposed index would be expected for TICK and BR, and new strategies should be studied for their genetic improvement, particularly BR which has large relative economic importance compared to the other traits.

Keywords: economic values, genomic estimating breeding values, tick resistance

Introduction

To increase the profitability across the Southern Brazilian beef chain, a genetic improvement program that uses an economic index across the full production cycle. - calf cropping, stocking, and finishing – needs to be considered (Costa *et al*, 2017). Traits to be considered in the breeding objective include survival and adaptation in young animals, fertility, longevity, feed intake and growth. To include them in a breeding program, economic values for these traits need to be derived, such that selection can be implemented by using an economic selection index.

An important trait in this production system that may have a high impact is tick resistance. Tick count (TICK) is an expensive and laborious phenotypic measurement. An option for its genetic improvement might be genomic selection as it allows selection without phenotypic measurement on all selection candidates. However, to be able to justify investment in genotyping and phenotyping, the economic impact of such investment on selection response needs to be established. The aim of this study was to develop economic selection indexes for a typical full cycle beef cattle production system in Southern Brazil using Hereford (HH) or Braford (BR) breeds. We derived economic values for breeding goal traits including survival/adaptation (tick resistance), reproduction (birth rate) and growth and weight traits (direct and maternal weaning weight, mature cow weight, and carcass weight).

Material and methods

A deterministic bio-economic model was developed for HH and for BR to simulate a herd, which specializes in selling fat steers, harvest heifers, and cull cows. The herd contained 10.000 females (5,500 dams), and considered the age at first calving of heifers at three years, pregnancy rate for each age class of dams (varying from 64 to 100% for 3 -8 years of age), mortality (varying from 1 to 5% between age classes), average daily gain, feed requirements and costs of each animal category (Costa *et al.* 2017).

Revenues from the sale of the 24 month old steers, 30 month old harvest heifers, and cull cows were calculated based on stochastic simulation with each animals assigned a value from a normal distribution for hot carcass weight (HCW in kilograms -kg) and fat thickness (FAT, in millimeters -mm). Animals with a minimum fat score of 3 (3-6 mm), received a bonus at base carcass price according to the HCW and age, as measured by teeth score. For a fat score less than 3, animals needed to be fattened until they reached 3mm which incurred extra costs.

To estimate the economic value for TICK we used a stochastic simulation that considered the number and costs of chemical treatments, labor, weight losses due to the level of tick infestation and losses from animal deaths due to diseases transmitted by ticks, such as tick fever caused by infections of *Babesia sp*. and *Anaplasma sp*. (Jonsson, 2006). The weight loss of animals due to tick infestation was distributed after the effective period of the chemical controls. A loss of 1.18 grams per tick per day (Jonsson, 2006) was used during the period of 181 days per year.

To estimates the economic values (EVs) each breeding goal trait was increased by one unit without changing the mean value of other traits. The difference in profit was divided by the number of dams in the herd, giving the economic value of the respective trait per matting dam (MacNeil *et al.*, 1994).

Phenotypic and genetic parameters to develop the economic index were obtained from Meyer *et al.* (2004), Reis *et al.* (2017), Teixeira (2013) and Urioste *et al.* (1998). The following selection criteria traits were used: weaning weight direct (WWd), maternal weaning weight (WWm), post weaning gain (PWG), scrotal circumference (SC), muscle score (MS), height score (HS), TICK count, and mature cow weight (MCW). The six breeding goal traits included WWd, WWm, TICK, birth rate (BR), MCW, and hot carcass weight (CW). We assumed selection on estimated breeding values (EBV) for all traits using phenotypic information and pedigrees.

An exception to this was TICK resistance as selection for this trait was based on a genomically estimated breeding values (GEBV) using the Embrapa/Conexão Delta G reference population (Cardoso *et al.*, 2015). A selection index procedure to combine EBV and GEBV was used according to Dekkers (2007). The response per year in the breeding goals (R_y) was calculated considering different age classes, selection intensity, generation interval, and accuracy of EBV and GEBV for males and females, where 66% of sires are between two to five years old and 70% of females are between three to five years old.

Results and Discussion

Economic values for the various breeding objective traits are in Table 1. There was a high negative economic value for TICK, because ticks affect chemical costs, average daily gain by parasitism but, mainly in younger animal age categories, reducing the value of animals, and can result in animal deaths (Jonsson, 2006).

Table 1. Economic values (EV), in US$, Relative importance (RI), in percentage, and Response per year (R_y) for Hereford and Braford breeding goals.

			Hereford			Braford		
	h^2	σ_g	*EV*	*RI*	*Ry*	*EV*	*RI*	*Ry*
WWd	0.13	10.03	0.71	9.95	1.828	0.67	9.50	1.824
WWm	0.09	8.52	0.47	5.59	-0.682	0.43	5.18	-0.679
TICK	0.19	0.14	-19.96	3.84	-0.006	-19.96	3.89	-0.006
BR	0.05	9.68	3.62	48.96	0.117	3.64	49.82	0.117
MCW	0.18	23.10	0.22	7.10	2.212	0.24	7.84	2.223
CW	0.60	19.10	0.92	24.55	3.615	0.88	23.77	3.612

WWd = direct weaning weight (Kg); WWm = maternal weaning weight (Kg); TICK = tick count (Log_{10} (count)); BR = birth rate (%); MCW = mature cow weight (Kg); CW = hot carcass weight (Kg); σ_g = genetic standard deviation; $R_i = (EV_i \times \sigma_{gi})/\sum(EV_{ij} \times \sigma_{gij})$.

The most important trait (RI) in this production system was the birth rate, followed by carcass weight, other growth traits and TICK. This result was expected because reproductive traits have a direct impact on the number of animals born per year, and consequently increase the number of animals available for sale (Laske *et al.*, 2012). The RI of TICK was relatively low compared to BR and CW.

The response per year (Ry) was higher for growth traits compared to survival/adaptation and reproductive traits; 18.9, 18.2, 9.6, -8.0, -4.5 and 1.20% of a genetic standard deviation (σg), for CW, WWd, MCW, WWm, TICK and BR, respectively, showing that selection using the economic indexes in Table 1, does not allow high genetic gains in TICK and BR.

The overall genetic gain, in dollars per year, was US$ 5.33 and US$ 5.19 for HH and BR, respectively. For these gains, growth traits contributed almost 90% in both breeds, and TICK, and BR traits just about 10%.

Conclusions

The developed indexes allow to maximizing the profit in full cycle herds based in Hereford and Braford breeds, and growth traits provide most economic benefits in full cycle systems in Southern Brazil that use HH and BR breeds.

The selection through economic indexes does not provide a high response in new uncorrelated traits like TICK, and other selection strategies should be studied for its genetic improvement.

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