GM 4 Estimation of correlations between resilience traits in Texel breed lambs

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Estimación de las correlaciones entre rasgos de resiliencia en corderos Texel

Introduction

Resilient animals are minimally affected by environmental disturbances. When affected, they can return quickly to the state that was previous to the disturbance (Colditz & Hine, 2016). To test this hypothesis, we attempted here to measure the relationship between resilience traits in lambs from the Uruguayan Texel breed.

Materials and Methods

Data was collected at INIA Tacuarembó, La Magnolia Experimental Unit. Animals were housed in the Intensive Sheep Phenotyping Platform for measuring their feed efficiency and methane emissions. Data were from 76 Texel castrated males (n = 41) and females (n = 35) measured during a 56-day test for feed efficiency. Actual starting date was January 2, and the final day February 27, 2023. The period of acclimatation lasted 14 days. The animals were fed *ad libitum* with lucerne haylage (crude protein 26.6%, neutral detergent fiber 31.0%, and acid detergent fiber 25.4%). All protocols applied were approved by the INIA Animal Ethics Committee (INIA 2018.2). Data on daily body weight were collected automatically and sent to the cloud using the Ponta software (Ponta, MG, Brazil). The criterion for editing the information was reported by Amarilho-Silveira *et al.* (2022).

To estimate the average daily gain (ADG, in kg) of each animal, we fitted individuals' regressions of daily body weight. The coefficient of determination (R^2ADG) and following statistics were calculated with PROC REG of SAS (2023, Cary, NC, USA). The residuals from these regressions were calculated considering actual individual growth trajectory, as suggested by Berghof *et al.* (2019). Other statistics calculated were the variance (VARe), its natural logarithm (LnVARe), and skewness (SKEWe) of the residuals. For the negative residuals we also calculated mean of absolute value (MEAN-e), variance (VAR-e), and skewness (SKEW-e), because negative variations indicate that the animal was affected in a negative way by a disturbance. Additionally, the autocorrelation (ACF) and residual autocovariance (ACOV, lag=1) were estimated by PROC TIMESERIES (SAS). Subsequently, the Pearson correlations between all the pairs of these variables were obtained with PROC CORR (SAS).

Results and Discussion

The ADG of lambs was 0.201±0.035 kg with a minimum of 0.097 kg and a maximum of 0.307 kg. Several traits were highly correlated with each other, such as VARe (LnVARe), ACOV, VAR-e, and MEAN-e (Table 1). Except R^2ADG, all traits showed non-significant correlation with ADG. While R^2ADG was correlated with ADG and showed a moderate and negative correlation with VARe (LnVARe), ACOV, VAR-e, and MEAN-e. This can be interpreted that growth curves that better fit the estimated line (higher R^2ADG values) displayed lower variances. These indicators (R^2ADG, VARe, LnVARe, ACOV, VAR-e, MEAN-e) can be useful when the purpose is to identify animals that have a higher ability to bounce back after challenges or to be less affected by them. Explained on, most of them capture the degree and duration of the variations in the animals' growth curve, for example larger VARe shows more pronounced variations.

Also, the following correlations support this statement: VAR-e and VARe; VAR-e and ACOV and LnVARe; ACF and ACOV; ACOV and LnVARe; and VAR-e and MEAN-e.

On the other hand, if the purpose is to identify animals with different response (direction and severity of the deviations) to the disturbances, the skewness of residuals (SWEWe) and negative residual (SKEW-e), which were moderate correlated between them, are recommended (Berghof *et al.*, 2019).

Table 1. Results of the estimated Pearson correlations. NS: the correlation is not significant.

	R^2ADG	VARe	LnVARe	SKEWe	ACF	ACOV	VAR-e
ADG	0.57	NS	NS	NS	NS	NS	NS
VARe	-0.72						
LnVARe	-0.71	0.96					
SKEWe	NS	-0.35	-0.33				
ACF	-0.27	0.34	0.29	NS			
ACOV	-0.63	0.88	0.79	-0.24	0.69		
VAR-e	-0.59	0.85	0.80	-0.72	NS	0.72	
MEAN-e	-0.65	0.91	0.88	-0.40	0.32	0.80	0.77
SKEW-e	NS	NS	NS	0.50	NS	NS	-0.34

Conclusions

The estimated indicators of the degree and duration of the response after a disturbance were moderately to highly correlated among them. Therefore, they could serve to identify animals with the ability to recover after a challenge. Moreover, they may also be less affected by the disturbance, which cannot be visualized when considering only the ADG trait. The association of the indicators estimated here with long term animal performance requires further investigation, as well as the study of their genetic parameters, with the objective to determine the most promising traits for being included in breeding programs.

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