Relative Economic Value for Merino Sheep in South Africa

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ABSTRACT: The selection for improved production and reproduction can be maintained with the establishing of a selection index that is a combination of the production and reproduction traits and their respective economic contribution. The estimated breeding value for profit (R/SSU; P<sub>ebv</sub>) or relative economic value for Merino sheep is a useful selection tool for wool farmers to identify future sires and dams that will have a positive effect on the profitability of their farming enterprise. Breeders have the option to use one of two P<sub>ebv</sub> values that include or exclude reproduction. The objective of this study was therefore firstly to determine the economic contribution of the production and reproduction traits under different selection scenarios. Secondly, to validate the relative economic value, that is the current selection index prescribed by Merino SA as a selection aid for stud breeders and commercial farmers in identifying the best animals for their stud or flock. Keywords: Relative Economic Value; Breeding Value for Profit; Merino

Introduction

The general goal in animal breeding is to attain a new generation of animals that will produce more efficiently than the present generation (Groen, 1990). The first steps in the development of a breeding program are the definition of the production system and the establishment of the selection goal. The goal of the individual animals should be to maximise the economic benefit (profit) of the production enterprise (Charfeddine, 2000). Harris (1970) and Ponzoni (1988) stated to acquire maximum economic gain from selection, an expression of the goal for individual animals is needed and most scientists begin by formulating a profit function

The profit function can be described as a procedure or rule that describes the change in net economic returns as a function of a series of physical, biological and economic parameters. Predominantly the role of the profit function in animal breeding is to define economic weights of traits contributing to economic improvement. Therefore, profit should be defined as a function of additive genetic values of aggregate genotype traits. Additional inputs such as management contributions and economic parameters should be considered as fixed. Consequently the profit function should consist of genotypic values for a given set of management and economic parameters (Charfeddine, 2000). The selection goal can be defined as an objective function of numerous traits, each with its own discounted economic value, called the aggregate genotype (Hazel, 1943) and used to characterize the genetic merit of an animal. According to Hazel (1943), the phenotypic standard deviations for each trait, the phenotypic and the relative economic value for each trait are required to construct a selection index.

The selection for improved production and reproduction can be reinforced with the formation of a selection index that is an amalgamation of the production and reproduction traits and their respective economic contribution. The objective of this study was therefore firstly to determine the economic contribution of the production and reproduction traits under different selection scenarios. Secondly, to validate the relative economic value, that is the current selection index prescribed by Merino SA as a selection aid for stud breeders and commercial farmers in identifying the best animals for their stud or flock.

Materials and Methods

A database consisting of body weight (BW), clean fleece weight (CFW), wool price (CWP), lambs born per 100 ewes mated (LB), meat price (MP) and profit were created. Three likely values for each of these variables were used to create 243 possible profit values with the SM2000 model of Herselman (2002). A multiple linear regression was fitted on the data (243 records) with profit as dependent variable and BW, CFW, CWP, LB and MP as independent variables. Different expansion and simplification steps were performed on this regression equation to finally end with an equation for the calculation of profit from estimated breeding values (P<sub>ebv</sub>) or the relative economic value. A total of seven equations were derived. Two relative economic values could be calculated from the final equation by including or excluding reproduction.

The relative economic value equation is recalculated annually in September from the previous five season’s wool and mutton prices. The prices are updated in September of each year. The average wool prices, as well as the average wool prices of good top maker wool at three length and nine micron categories of each wool season are included in the estimation of the equations. These prices are made available by Cape Wools. The weighted average mutton price for each season (August to July) that is included is calculated from the weekly purchase price of lamb carcasses and the total weight of the carcasses purchased for grades A0 to A6 which is obtained from the Red Meat
The wool and mutton prices from 1996 to 2013 were used to calculate the equation.

The MTINDEX Excel spreadsheet of Van der Werf (2008) was used for the quantification of the economical contribution of each trait under the different selection scenarios. The genetic information was combined with economic information to investigate the impact of a limited number of probable selection strategies, involving a combination of qualitative and quantitative production traits. The responses were predicted at a selection intensity of 1 when ~38% of the animals are selected. The traits that were normally included in selection programs for Merino sheep in South Africa were used in the analysis. The monetary value of each trait was derived from the 2012/2013 wool and mutton prices (Table 1). The genetic parameters were obtained from an analysis done by Olivier (2014) on a fine wool Merino stud.

Table 1. Output from MTINDEX summarising the genetic gain in monetary terms per year for each trait under the different scenarios.

<table>
<thead>
<tr>
<th>Trait</th>
<th>SD</th>
<th>Prices</th>
<th>Scenarios (ZAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>BW</td>
<td>11.69</td>
<td>19.80</td>
<td>16.03 15.13 14.93</td>
</tr>
<tr>
<td>CFW</td>
<td>1.35</td>
<td>417.10</td>
<td>58.91 64.66 62.28</td>
</tr>
<tr>
<td>FD</td>
<td>1.59</td>
<td>-35.00</td>
<td>-5.56 -5.87 -5.96</td>
</tr>
<tr>
<td>SL</td>
<td>17.16</td>
<td>0.50</td>
<td>0.65 0.42 0.44</td>
</tr>
<tr>
<td>SS</td>
<td>11.11</td>
<td>0.50</td>
<td>0.24 0.26 0.25</td>
</tr>
<tr>
<td>NLW</td>
<td>44.65</td>
<td>24.00</td>
<td>23.48 11.24 16.7</td>
</tr>
<tr>
<td>WQ</td>
<td>7.72</td>
<td>1.80</td>
<td>0.33 0.00 -0.01</td>
</tr>
<tr>
<td>BC</td>
<td>6.99</td>
<td>2.00</td>
<td>1.21 0.8 0.83</td>
</tr>
<tr>
<td>Total (R)</td>
<td></td>
<td></td>
<td>95.28 86.64 89.47</td>
</tr>
<tr>
<td>Total (%)</td>
<td></td>
<td></td>
<td>100.0 90.93 93.90</td>
</tr>
</tbody>
</table>

1 – all pedigree information and records of all the traits; 2 – all pedigree information and records of BW, CFW & FD; 3 – all pedigree information and records of BW, CFW, FD, NLW.24 - expressed as a percentage from scenario 1; BW – body weight at 15 months of age; FD – fibre diameter at 15 months of age; FW – clean fleece weight; SL – staple length; SS – staple strength; LW – number of lambs weaned over three lambing opportunities; WQ - Wool quality; BC - Overall body conformation; Total – total response

Results and Discussion

In figures 1 and 2 the effect of wool and mutton prices on the components that influence the relative economic value are depicted. It is evident from the results of this study that there was a marked increase in the average wool and mutton prices from 2010 (Figure 1 and 2). The contribution on the equation of clean fleece weight and fibre diameter follows the same trend as the wool price in both equations (Figure 1 and 2). The increase in the contribution of fleece weight to the profitability was the result of the increase in the wool price and the decrease in the price premium paid for fine wool.

The contribution of staple length is very low in the calculation of the relative economic value in both the equations. In the equation that excludes reproduction, body weight has a very small but positive contribution compared to a negative contribution in the equation that includes reproduction (Figure 1 and 2). This shift is due to indirect selection for reproduction incorporated in the relative economic value equation. The increase in mutton prices lead to a marked increase in the contribution of reproduction on the relative economic value. The following equation which includes reproduction is currently used by the Merino breed of South Africa to calculate the relative economic value:

$$REV (R/SSU) = -1040.92 + 0.36BW_{ebv} + 74.82CF_{Webv} + 0.35SL_{ebv} - 122.82FD_{ebv} + 2.6023(20+FD_{ebv})^2 + 9.27TW_{Webv}$$

The genetic gains expressed in ZAR obtained with the MTINDEX Excel spreadsheet per year for 2012/2013 are depicted in Table 1. The results from the calculations are expressed as responses per generation and were consequently divided by four years to obtain the response per year. It is evident from Table 1 that fleece weight had the
largest monetary contribution. Number of lambs weaned and body weight had the second largest contribution to the income of a sheep enterprise.

The antagonistic relationships between traits of economic importance (Olivier, 2014) can be detrimental if these relationships are ignored. Olivier et al. (2014) stated that replacement animal selection should not be done blindly. The implementation of a selection index based on current monetary values will aid breeders and producers in the selection of replacement animals. Furthermore, it is important to include all the traits of economic importance either as a selection objective or as a trait to be monitored for unwanted change (Olivier et al., 2014). Caution must therefore be taken in compiling the selection objective to ensure that sheep enterprises are profitable and not to put too much emphasis on wool when replacement animals are selected because this could be due to the fact that the exchange rate is favourable at this time.

**Conclusion**

It can be concluded from the results of this study that the estimated breeding value for profit (R/SSU) or relative economic value used by Merino SA will be a beneficial selection tool for wool farmers in South Africa to identify future breeding stock that will have a positive effect on the profitability of their farming enterprise. However, it is of utmost importance that selection objectives for individual traits are used as individual culling levels in combination with the relative economic value when breeding sires and dams are selected. This is due to the fact that different combinations of the estimated breeding values for the individual traits can lead to the same relative economic value.

**Literature Cited**