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Effect of selection for fleece weight on liveweight, reproductive performance and wool characteristics in mixed age Romney ewes

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ABSTRACT

This paper presents the analysis of 3525 annual production records of mixed age Romney ewes in a fleece weight selected (HF) or control (RC) flock over 11 years. HF ewes were significantly (P<0.001) heavier than RC ewes for autumn live weight (8%), winter live weight (9%), spring live weight (7%), greasy fleece weight (20%) and clean fleece weight (19%). Small but significant (P<0.01) flock differences were found for fibre diameter and yellowness. HF fleeces were coarser and more yellow than RC fleeces. HF ewes were significantly (P<0.01) higher than RC for ovulation rate (1.80 vs 1.73 SED 0.03), number of lambs born/ewes lambed (1.63 vs 1.56 SED 0.02), and number of multiple births/ewes lambed (60% vs 54% SED 2%), but lower (P<0.01) for number of lambs weaned/lambs born (0.84 vs 0.88 SED 0.01). The results indicate that single trait selection for fleece weight enhances greasy and clean fleece weights, live weight and ovulation rate, with an associated increase in FD and yellowness of their fleeces.

Keywords: Romney; fleece weight; selection; ovulation rate; fibre diameter.

INTRODUCTION

Crossbred sheep dominate wool production volume and value in New Zealand. Wool weight as a selection criterion in crossbred wool has been reviewed extensively (Wickham, 1966; Wickham and Bigham, 1976; Wickham and McPherson, 1985). Although earlier studies have emphasised selection for fleece weight, quality traits are becoming increasingly important. More recently, wool characteristics, as well as production traits, have been investigated for a flock screened from industry Romney flocks and subsequently selected for high fleece weight. Hawker and Littlejohn (1986) analysed two-tooth production and wool characteristics of the screened ewes. The hogget production performance and progress in this flock and its control flock have been reported (Hawker et al., 1988; Wuliji et al., 1991; Wuliji et al., 1998), showing that single trait selection for fleece weight increased hogget fleece weight by 24% and hogget live weight by 8%. However, there is little information on the retention of these genetic advantages in adults, and the associated effect on reproductive and wool traits. We present live weight, reproductive performance, fleece weight and wool characteristics responses in fleece weight selected mixed-age Romney ewes for 11 production years (between 1985 and 1995).

MATERIALS AND METHODS

Animal management

The source, management and selection criteria for the flocks under study have been described previously (Wuliji et al., 1991; Wuliji et al., 1992). Selected high fleece weight (HF) and random control (RC) mixed-age ewes were managed together except during mating and lambing. Ewes were grazed on AgResearch Woodlands Research Station at an average stocking rate of 17 ewes/ha on predominantly rye grass/white clover pastures. Each year ewes were joined with rams for two oestrus cycles (35 days) in single sire groups in April and lambed in these groups in September. Ewes were shorn in early December and culling and replacements were made in the following January, when 16 month old ewes were also shorn (two-tooth shear). Routine husbandry practices, such as drenching, dipping and vaccination were carried out simultaneously for all animals in both flocks.

Recording and measurements

The data presented in this report consist of 3525 records, of which 2380 were from HF and 1145 were from RC ewes, collected between 1985 and 1995. The live weights were recorded at pre-joining in April (autumn live weight - ALW), in July (winter live weight - WLW) and in December prior to shearing (spring live weight - SLW). Greasy fleece weight (GF), yield (%), clean fleece weight (CF), fibre diameter (FD), FD coefficient of variation (FDcv), wool brightness (Y) and yellowness (Y-Z) of ewes were measured. Fleece weights of two-year-olds were adjusted to a 12-month growing period. Reproductive performance was measured as ovulation rate (OR), number of lambs born/ewes joined (LBEJ), number of lambs born/ewes lambed (LBEL), number of ewes with multiple births/ewes lambed (NEMB), number of lambs weaned/lambs born (LWLW), number of lambs weaned/ewes lambed (LWEL), and number of lambs weaned/ewes joined (LWEJ). The OR was determined by laparoscopic counting of corpora lutea in each ewe after one cycle of mating (Davis et al., 1987).

Statistical analysis

The data were analysed by residual maximum likelihood with ewe as a random effect and fixed effects of year, flock and age of ewe, with older ewe classes (6 and above) combined. When checking first order interactions
RESULTS

Flock mean reproduction performances are shown in Table 1. The OR, LBEL and NEMB of ewes was significantly (P<0.01) higher for HF than for RC, but LWLB was significantly (P<0.01) lower. No difference was found for LBEJ, LWEJ or LWEJ.

TABLE 1: Least square means of reproductive performance in HF and RC ewes

<table>
<thead>
<tr>
<th>Age</th>
<th>ALW (kg)</th>
<th>WLW (kg)</th>
<th>SLW (kg)</th>
<th>GF (kg)</th>
<th>Yield (%)</th>
<th>FD (um)</th>
<th>FDev (%)</th>
<th>Y (m)</th>
<th>Z (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC</td>
<td>58.0</td>
<td>57.5</td>
<td>58.1</td>
<td>3.82</td>
<td>0.30</td>
<td>78.3</td>
<td>26.4</td>
<td>61.4</td>
<td>5.4</td>
</tr>
<tr>
<td>HF</td>
<td>61.9</td>
<td>62.8</td>
<td>62.3</td>
<td>3.59</td>
<td>0.35</td>
<td>78.6</td>
<td>25.9</td>
<td>61.4</td>
<td>5.4</td>
</tr>
<tr>
<td>SED</td>
<td>0.03*</td>
<td>0.03**</td>
<td>0.02**</td>
<td>0.02*</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
</tr>
</tbody>
</table>

** P<0.01; OR: ovulation rate; LBEJ: lambs born/ewe joined; LBEL: lambs born/ewe lamb; NEMB: number of ewes with multiple births/ewe lamb; LWEJ: lamb weaned/ewe lamb; LWEJ: lambs weaned/ewe joined.

Flock means of live weights, fleece weights and wool characteristics are shown in Table 2. HF was significantly (P<0.01) higher than RC for all live weights and fleece weights and for FD and yellowness.

TABLE 2: Least square means of live weights, fleece weights and wool characteristics in HF and RC ewes

<table>
<thead>
<tr>
<th>Age</th>
<th>ALW (kg)</th>
<th>WLW (kg)</th>
<th>SLW (kg)</th>
<th>GF (kg)</th>
<th>Yield (%)</th>
<th>FD (um)</th>
<th>FDev (%)</th>
<th>Y (m)</th>
<th>Z (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC</td>
<td>57.9</td>
<td>55.4</td>
<td>57.6</td>
<td>4.33</td>
<td>3.28</td>
<td>79.2</td>
<td>39.1</td>
<td>27.1</td>
<td>62.2</td>
</tr>
<tr>
<td>HF</td>
<td>60.9</td>
<td>62.0</td>
<td>61.9</td>
<td>4.55</td>
<td>3.64</td>
<td>79.2</td>
<td>40.0</td>
<td>25.7</td>
<td>61.1</td>
</tr>
<tr>
<td>SED</td>
<td>0.03*</td>
<td>0.03**</td>
<td>0.02**</td>
<td>0.02*</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
<td>0.03**</td>
</tr>
</tbody>
</table>

** P<0.01; ALW: autumn live weight; WLW: winter live weight; SLW: spring live weight; GF: greasy fleece weight; CF: clean fleece weight; Y: fibre diameter; FDev: FD coefficient of variation; Y: brightness; Z: yellowness; Rep%: repeatability.

The mean reproductive performances by ewe age groups and their repeatabilities are shown in Table 3. The OR, LBEJ, LBEL and NEMB significantly increased with age up to 4 years old while LWEJ, LWB and LWEJ were significantly higher for 3 and 4 than 2 year olds. Repeatability of OR was moderate while all other reproductive measurements gave low estimates (7 to 15%).

Mean live weight, fleece weight and wool characteristics of the age groups and their repeatabilities are shown in Table 4. Live weights and FD significantly increased with age up to 4 years old, but decreased from 5 to 6 year olds. GF and CF increased significantly from 2 to 3 years old, but decreased thereafter. Yield significantly decreased with age from 3 years old. FDev was significantly higher in 2 year olds than in other age groups. Two year olds had significantly higher Y and lower Y-Z than other age groups. Repeatability of live weight, fleece weight, FD and FDev were high (63 to 74%) while yield and colours were moderately repeatable (22 to 36%).

TABLE 4: Least square means and repeatability of live weights, fleece weights and wool characteristics measured by age groups

<table>
<thead>
<tr>
<th>Age</th>
<th>ALW (kg)</th>
<th>WLW (kg)</th>
<th>SLW (kg)</th>
<th>GF (kg)</th>
<th>Yield (%)</th>
<th>FD (um)</th>
<th>FDev (%)</th>
<th>Y (m)</th>
<th>Z (m)</th>
<th>Rep%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62.8</td>
<td>65.0</td>
<td>63.9</td>
<td>4.43</td>
<td>3.54</td>
<td>78.3</td>
<td>20.7</td>
<td>61.4</td>
<td>5.4</td>
<td>61.9</td>
</tr>
<tr>
<td>2</td>
<td>64.1</td>
<td>64.5</td>
<td>61.6</td>
<td>3.91</td>
<td>3.12</td>
<td>76.0</td>
<td>25.5</td>
<td>60.7</td>
<td>5.5</td>
<td>60.2</td>
</tr>
<tr>
<td>3</td>
<td>69.1</td>
<td>69.4</td>
<td>63.3</td>
<td>4.43</td>
<td>3.54</td>
<td>78.3</td>
<td>40.7</td>
<td>25.4</td>
<td>61.4</td>
<td>5.2</td>
</tr>
<tr>
<td>4</td>
<td>65.0</td>
<td>65.9</td>
<td>63.9</td>
<td>4.28</td>
<td>3.39</td>
<td>77.4</td>
<td>40.7</td>
<td>25.7</td>
<td>61.3</td>
<td>5.2</td>
</tr>
<tr>
<td>5</td>
<td>64.1</td>
<td>64.5</td>
<td>61.6</td>
<td>3.91</td>
<td>3.12</td>
<td>76.0</td>
<td>25.5</td>
<td>60.7</td>
<td>5.5</td>
<td>60.2</td>
</tr>
</tbody>
</table>

** P<0.01; ALW: autumn live weight; WLW: winter live weight; SLW: spring live weight; GF: greasy fleece weight; CF: clean fleece weight; Y: fibre diameter; FDev: FD coefficient of variation; Y: brightness; Z: yellowness; Rep%: repeatability.

Correlation coefficients among fleece weight and wool characteristics are shown in Table 5. Clean fleece weight was correlated significantly (P<0.001) with yield, FD, FDev (negatively) and yellowness; yield correlated significantly (P<0.01) with FDev, Y (both negatively) and Y-Z. Although the values were low; and Y and Y-Z were highly but negatively correlated.

TABLE 5: Pearson’s correlation coefficients in fleece weight and wool characteristics

<table>
<thead>
<tr>
<th>GF</th>
<th>Yield (%)</th>
<th>FD (um)</th>
<th>FDev (%)</th>
<th>Y (m)</th>
<th>Z (m)</th>
<th>Rep%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>0.93***</td>
<td>0.33***</td>
<td>0.36***</td>
<td>-0.18***</td>
<td>-0.02</td>
<td>0.21***</td>
</tr>
<tr>
<td>FD</td>
<td>0.05</td>
<td>-0.12***</td>
<td>-0.11***</td>
<td>0.09***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDev</td>
<td>0.05</td>
<td>-0.43***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** P<0.01; *** P<0.001; GF: greasy fleece weight; CF: clean fleece weight; Y: fibre diameter; FDev: FD coefficient of variation; Y: brightness; Z: yellowness.

discusSion

The reproduction and lambing performance differences between selected and control flocks and age groups in this study generally agree with previous investigations in Romneys (Kelly et al., 1978; Baker et al., 1979; Davis et al., 1987; Wuliji et al., 1992). The higher OR in HF compared with RC can be attributed to their higher live weight (Kelly and Johnston, 1982). This study has shown that the reproductive performances achieved in the HF breeding
flock at Woodlands are comparable to or exceed those of Romney strains selected for reproductive performances or in group breeding schemes summarised by Baker et al., (1987). The one reproductive trait (LWLB) where HF fared poorer than RC is not fully explained, there is a possible indication that HF ewes partition a higher proportion of their nutrition to fleece growth than milk production, compared with RC ewes. Lower survival for multiple-birth lambs would also contribute to this result.

Hight and Jury (1970) noted that age differences resulted in changes in the percentage of ewes lambing, lamb survival to weaning and particularly in the proportion of multiple births. Production traits increased from 2 to 3 years old. Thereafter fleece production dropped, despite some further increases in live weight and FD with age. Fleece production had dropped to 2 year old levels by the time the ewes were 5 year old. The fleece weight changes of age show an age gradient difference that is comparable, after adjustment for the 2 year olds’ wool growth periods, to a Romney flock studied earlier in Canterbury (Wright and Stevens, 1953) and on hill country farms in the North Island studying long wool breeds such as Coopworth, Perendale, Cheviot and Romney cross (Bigham et al., 1978).

Liveweights and fleece weights analysed in these flocks are similar to previous studies in crossbreds (Wright and Stevens, 1953; Bigham et al., 1978). Although the difference was small (1.0μm), FD was significantly coarser for HF than RC ewes, which is consistent with the analysis of hogget data from these flocks (Wuliji et al., 1998). The relative magnitudes of differences between HF and RC for GF, CF and FD are very similar to those reported for hoggets by Wuliji et al., (1998) indicating that the selection advantage in ewe hoggets is sustained through to adult performance. It has also been shown that the HF flock grew more wool in winter compared with RC resulting in a less seasonal wool growth pattern (Wuliji et al., 1995). The lower FDcv in HF indicates that fleeces possess more uniformity than RC, and consequently it would produce a better length and strength in fibre processing. Although there was no difference in brightness, HF fleeces showed yellower than RC, which also agreed with the tendency in Romney sheep for fleece weight selection (Hawker et al., 1988; Wuliji et al., 1998). Overall, these results suggest that selection for fleece weight in long wool sheep is generally positively associated with liveweight and reproductive performance traits.

CONCLUSIONS

The fleece weight selection trial at Woodlands has demonstrated that selection on fleece weight will increase fleece weight, ovulation and multiple birth rate, live weight, fibre diameter and Y-Z with little effect on other wool characteristics. As fleece weight is highly associated with other major productive traits, namely ovulation rate, lambs born/ewe lamb rate and live weight, there will be indirect gains in these traits with selection for fleece weight in long wool sheep. However further improvement in wool quality traits such as fibre diameter and colour would enhancecrossbred wool profitability in the future.

ACKNOWLEDGEMENTS

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REFERENCES