The Genetics Of Fleece Weight And Fibre Diameter: Within-flock variation

Produced for the CRC for Premium Quality Wool undergraduate program by;
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Distributions of progeny values of purchased sires of each strain

**Fine wool sires**

**Broad wool sires**

**Medium wool sires**

Source: Taylor and Atkins (1997)
Which selection criteria are best?

- Historically Merino breeders have relied on indirect criteria to improve wool cut and quality.
- Indirect criteria can only be more effective than direct if they are:
  - more strongly inherited (higher $h^2$)
  - strongly genetically correlated with the traits to be improved
  - less expensive to measure
As direct selection criteria CFW and MFD are highly heritable and relatively inexpensive at around $3 per head.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Heritability ($h^2$)</th>
<th>sheep (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFW</td>
<td>0.38 (0.23 - 0.62)</td>
<td>12</td>
</tr>
<tr>
<td>MFD</td>
<td>0.48 (0.25 - 0.75)</td>
<td>6</td>
</tr>
</tbody>
</table>

The genetic correlation between these two traits (0.15, range 0.05 - 0.31) indicates some genetic antagonism but is sufficiently weak to enable simultaneous improvement in both traits.

Source: Davis and McGuirk (1987)
Index selection

- A selection index is more efficient than independent culling on each trait.

- A selection index applies economic weights for each trait (determined by breeding direction) for each sheep. Sheep are then ranked on overall merit for both traits.

- This allows outstanding sheep for one trait to rank well even if slightly outside desirable limits for the other.

- These sheep make a valuable contribution to the gene pool of the next generation.
Making the best use of CFW and MFD to predict breeding values

- Records need to be adjusted for non-genetic factors that affect performance

- In young Merinos these are:
  - birth and rearing status (singles or multiples)
  - age relative to cohorts when measured
  - age of dam (maiden or adult)

- Ideally full pedigree is also recorded so that breeding values of relatives can also be considered.
## Design of Trangie QPLUS selection experiment

<table>
<thead>
<tr>
<th>Strain</th>
<th>Line (MP)</th>
<th>No. Ewes</th>
<th>No. Sires</th>
<th>Description of Selection Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fine</strong></td>
<td>8.0 %</td>
<td>200</td>
<td>8</td>
<td>Equal emphasis on fleece weight and diameter</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>200</td>
<td>8</td>
<td>Random</td>
</tr>
<tr>
<td><strong>Medium - Peppin</strong></td>
<td>Industry (~4.5%)</td>
<td>200</td>
<td>8</td>
<td>Emphasis on fleece quality, conformation, fleece weight and diameter</td>
</tr>
<tr>
<td></td>
<td>3.0 %</td>
<td>200</td>
<td>8</td>
<td>Emphasis on fleece weight, maintain diameter</td>
</tr>
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<td>8</td>
<td>Random</td>
</tr>
<tr>
<td><strong>Broad</strong></td>
<td>8.0 %</td>
<td>200</td>
<td>8</td>
<td>Equal emphasis on fleece weight and diameter</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>200</td>
<td>8</td>
<td>Random</td>
</tr>
</tbody>
</table>

Source: Taylor and Atkins (1997)
Selected sires of each strain

1995 Fine Wool Sires

1995 Broad Wool Sires

1995 Medium Wool Sires

Pat Taylor
Source: Taylor and Atkins (1997)
Response to selection in each of the Medium - Peppin lines

- **3% MP**
  
  (+17.1%, -0.24µm)

- **8% MP**
  
  (+8.3%, -2.2µm)

- **15% MP**
  
  (+1.3%, -3.05µm)

- **Ind. Line**

- **3% Line**

- **8% Line**

Source: Taylor and Atkins (1997)
Response to selection in 8% lines in each strain

8% MP
(+8.3%, -2.2µm)

Source: Taylor and Atkins (1997)
Genetic improvement in perspective

Estimated Progeny Values of QPLUS and Central Test Medium Wool Sires

CFW deviation (%) vs. FD deviation (µm)

Source: Taylor and Atkins (1997)