Developments in the Genetic Improvement of a Large Commercial Population in the New Zealand Sheep Industry

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Landcorp Farming Ltd

- State Owned Enterprise.
- Animal production business – profit from commercial livestock products.
- 107 farms (368,000 ha).
  - 612,000 sheep.
  - 106,000 beef cattle.
  - 124,000 deer.
  - 19,000 dairy cattle.
Landcorp Farming Ltd . . .

- Sheep meat = 28% of Landcorp’s operating revenue of NZ$104.3m.
- 385,000 slaughter lambs per year (1.5% of NZ lamb production).
- 412,000 breeding ewes.
- 1,300 new replacement sires per year.
- Landcorp breeds its own sires.
Corporate Sire Breeding Programmes . . .

• Financially-based breeding objective:
  – Company objective of on-farm profitability is complementary to breeding objective.

• Single ownership of all livestock:
  – Breeding programmes designed from perspective of the total commercial population.
  – Value of breeding programmes to Landcorp = the value of revenue-earning progeny.
Corporate Sire Breeding Programmes . . .

• Large base female population:
  – Develop new (enhance existing) breeding programmes to suit new market requirements.
  – Use specialist resources – low per head costs.

• Optimise animal breeding structure:
  – Selection intensity, selection accuracy, generation interval, dissemination of genetic improvement.
Landcorp Sheep Breeding Programmes . . .

Developments:

• Structure of programmes.

• Terminal sire programmes.
  - Large base population.
  - Rates of genetic improvement.
  - Use of specialist technology.
  - R & D.
Structure of Landcorp’s Sheep Breeding Programmes
<table>
<thead>
<tr>
<th></th>
<th>Maternal</th>
<th>Terminal</th>
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</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>Romney</td>
<td>Lamb Supreme*</td>
</tr>
<tr>
<td></td>
<td>Landmark*</td>
<td>Texel</td>
</tr>
<tr>
<td></td>
<td>Carwell*</td>
<td></td>
</tr>
<tr>
<td>Beef cattle</td>
<td>Angus</td>
<td>Simmental</td>
</tr>
<tr>
<td>Deer</td>
<td>Red*</td>
<td>Wapiti*</td>
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</tbody>
</table>

* Interbred composites
Landcorp Terminal Sire Programmes
Landcorp Terminal Sire Programmes

- Full birth details
- Weaning weight [Dam NLW, MAB]
- Liveweight (at ~6-7 months)
- U/sound muscle depth, width, fat depth
- CT weights of meat and fat in carcass
- CT eye muscle area

→ BLUP-estimated BV’s
→ Lean Growth Index
Use of large base population . . .
Use of large base population . . .

Landcorp Lamb Supreme

- Composite terminal sire line.
- Screened 501,000 ewe hoggets over 2 years.
- Selected top 0.8% on liveweight.
- Used wide range of sire breeds (3 years).
- Crossbred progeny = Landcorp Lamb Supreme.
- Continues to be non breed-specific.
Rates of genetic improvement . . .

Landcorp Lamb Supreme

Landcorp Texel
Rates of genetic improvement . . .

Accumulated genetic gain in Landcorp terminal sire programmes (last 10 years)

<table>
<thead>
<tr>
<th></th>
<th>Landcorp Lamb Supreme</th>
<th>Landcorp Texel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of lean</td>
<td>+ 2.1 kg</td>
<td>+ 2.3 kg</td>
</tr>
<tr>
<td>Weight of fat</td>
<td>+ 0.01 kg</td>
<td>+ 0.06 kg</td>
</tr>
<tr>
<td>L. dorsi area</td>
<td>+ 1.7 cm²</td>
<td>+ 1.7 cm²</td>
</tr>
<tr>
<td>Liveweight at 8 months</td>
<td>+ 4.7 kg</td>
<td>+ 5.3 kg</td>
</tr>
</tbody>
</table>
Genetic Trend - Landcorp Lamb Supreme -/04
Lean and Fat Weights

Lean = +0.21 kg/yr
Fat = +0.001 kg/yr
Landcorp Texel - Genetic trend -/04
Lean and Fat Weights

Lean = +0.23 kg/yr
Fat = +0.006 kg/yr
Use of specialist technology . . .
(eg, INNERVISION™)

- Spread costs over large base population
- Measurement accuracy
- Appropriate carcass trait BVs
- Increased rate of genetic improvement
Estimated benefit from including CT measurements

Landcorp Lamb Supreme . . .

(Nicoll et al., 2002)
Specialist technology - further developments . . .

\textit{INNERVALUE}^{TM}

Kvame \textit{et al.} (2004):

- 6 CT images to predict weight and composition of primal lamb cuts.
- Selection index of merit for primal cuts.
- Higher net benefits compared with standard 4 CT images.
Specialist technology - further developments . . .

CT scanning vs progeny testing

Discounted net benefits from two-stage selection (CT and progeny testing with 10 or 20 progeny) (Jopson et al., 2004)
Specialist technology - further developments . . .
CT scanning young Wapiti bulls
Specialist technology - further developments...

Landcorp Carwell

- Inseminated >300 ewes from Carwell stud, NSW, Australia.
- In 4 years …
  - Identified the “REM” locus.
  - Developed a marker test for the Carwell gene.
  - Evaluated phenotypic effects of the gene.
  - Determined its mode of inheritance.
Landcorp Carwell

- Effects of the Carwell gene . . .
  - +10-11% L. dorsi area.
  - +7% L. dorsi weight.
  - Dominant inheritance.
  - No adverse effects on L. dorsi tenderness.

- Frequency of Carwell allele has increased from 25% to 85% in 10 years.

- Parallel introgression of putative Myostatin gene variant into the Landcorp Carwell flock.
  (= a unique resource?)
Participation in industry initiatives . . .

Landcorp routinely contributes data for a range of industry investigations:

- Sire effects on lamb survival.
- Sire effects on ewe litter size.
- Validation of markers for disease resistance (FE).
- Search for/fine mapping of muscling QTL.
- Across-flock sire evaluation (NZ Texel Society, ACE).
- Industry-based central progeny tests.
• Landcorp Farming Ltd is a unique, large-scale commercial livestock production business.

• Sire breeding programmes are designed to relate directly to the company’s commercial profitability.

• Scale advantages cost-effectively exploit application of animal breeding principles and specialist technologies.
Summary . . .

• High rates of genetic improvement in Landcorp’s ram breeding programmes is only a means to an end.

• Profitable *commercial sheep production* is the measure of the value of the breeding programmes to the company.