Strategic Management of Worms
Take advantage of worm weaknesses and livestock strengths.

Doug Alcock
What are your enterprise goals
Healthy productive animals

- Good lamb growth

- Good Reproduction
Round worms are one of the major health issues for sheep and goats

- $260 Million (industry wide)
- More than $11 per breeding ewe in high summer rainfall zones.
- 80% of this is lost production.
A BIT ABOUT THE WORMS
The most important worms are..

- **Barbers Pole**
  - *(Haemonchus contortus)*

- **Brown Stomach**
  - *(Teladorsagia curcumcinta)*

- **Black Scour**
  - *(Tricholstrongylus spp.)*
Barbers Pole

(*Haemonchus contortus*)

- 20 – 30mm
- 10,000 eggs per day
- 4\(^{th}\) stomach (abomasum)
- Burrow into the wall and suck blood
- Animals anaemic and can exhibit bottle jaw.

Source: Wormboss
Brown Stomach  
(*Teladorsagia curcumcinta*)

- 10mm, 50-100 eggs per day.
- 4th stomach (abomasum)
- Damage to the gut causing inflammation and scouring
- Reduced appetite and protein loss
  - 35% less weight gain
  - 20% less wool growth
  - 20% less milk before there are clinical signs.
Black Scour
*(Tricholstrongylus spp.)*

- <1mm
- 100 – 200 eggs per day
- Small Intestine (first 3m)
- Lethargy, weight loss, scouring, death.
- Losses before signs are apparent.
General Effects of Worms

- Wormy sheep eat less
- Damage to intestine reduces nutrient absorption.
- Greater endogenous loss of protein.
- Diversion away from productive uses of nutrients toward immune responses.
When are sheep most susceptible to worms?

- Immature
  - Undeveloped immune system
  - Nutritional set backs.
- Lambing (loss of acquired immunity)
Weaners are more susceptible. Also less high quality pasture available.

Pre-partum slump in immunity in ewes. In adequate winter pasture.
Options to manage worms

- Use management to break the worm lifecycle.
- Increase host (sheep) resistance/resilience.
- Treat the infection with anthelmintics
Grazing Management to break the worm lifecycle.
Creating low worm pastures

- Understand and manipulating the lifecycle
- Critical times for low worm pastures
  - Lambing
  - Weaning

Worm Life-cycle

Pre-patent Period

Host stage 16-21 days* to complete

- Adults lay eggs

Larvae mature and develop into adult worms (L4) inside the sheep

Free-living stages 2 - 12 weeks to complete

- 3rd stage L3 larvae are infective. They migrate to the herbage and wait to be eaten by a sheep

Eggs in dung

1st stage larvae in dung

2nd stage larvae in dung

SCOPS 2012
<table>
<thead>
<tr>
<th>Time to die?</th>
<th>Adults in the sheep</th>
<th>Eggs on pasture</th>
<th>L3 larvae on pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barbers Pole</strong></td>
<td>Months once established (depends on host immunity)</td>
<td>5 days but… $10^4$ eggs/day</td>
<td>3 months if daily max $&gt;22^\circ C$ 6 Months if daily max $&lt;15^\circ C$</td>
</tr>
<tr>
<td><strong>Black Scour T. colubriformis</strong></td>
<td>Or when you drench</td>
<td>16 days</td>
<td>Vitrinus need cool/moist Can survive frost B.Scour inside pellet</td>
</tr>
<tr>
<td><strong>Black Scour T. vitrinus</strong></td>
<td></td>
<td>16 days</td>
<td></td>
</tr>
<tr>
<td><strong>Small Brown Stomach</strong></td>
<td>Can overwinter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Liver Fluke</strong></td>
<td>Years!</td>
<td>Complex dual host life cycle</td>
<td></td>
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</table>
Worm larvae will take around 5 months to die.

Lambing paddock prep starts at joining.

Time to die = 3m

Time to die = 6m
## Conditions for eggs to hatch

<table>
<thead>
<tr>
<th></th>
<th>Life span</th>
<th>Daily Min &amp; Max Temp°C</th>
<th>Ideal Temps</th>
<th>Moisture mm/week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barbers Pole</strong></td>
<td>5 days</td>
<td>&gt;10 min</td>
<td>25-30</td>
<td>10-15+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;18 max</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Black Scour</strong></td>
<td>16 days</td>
<td>&gt;5 min</td>
<td>25-28</td>
<td>10+</td>
</tr>
<tr>
<td><em>T.colubriformis</em></td>
<td></td>
<td>&gt;15 max</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Black Scour</strong></td>
<td>16 ?</td>
<td>&gt; 2 min</td>
<td>8-18</td>
<td>10+</td>
</tr>
<tr>
<td><em>T.vitrinus</em></td>
<td></td>
<td></td>
<td></td>
<td>Loves wet winters</td>
</tr>
<tr>
<td><strong>Small Brown Stomach</strong></td>
<td>Can over winter</td>
<td>&gt;4 min</td>
<td>13-21</td>
<td>Not much</td>
</tr>
</tbody>
</table>
Middle tercile rainfall and temperature for Bombala 1968 - 2007

When will Black Scour worm eggs produce larvae?

- Rest or graze with Cattle
- Can graze with sheep here without autoinfection of pasture
- Lambing
- Joining

Can graze with sheep here without autoinfection of pasture

Degrees C

mm/week
Cross Species Grazing

- Sheep and Goats share their problems.
- Cattle have different worms
- Grazing with cattle gives rest from reinfection with sheep/goat worms.
- Not really much active cleaning.
- Most effective with scour worms.
“Grazing Systems”

- "Techno grazing"
- "Cell Grazing"
- "HRM"

All are based on intensive rotations

- Short graze (< 10 days) & long rest (> 40-80 days)
- Avoids autoinfection.
- Particularly good for Barbers Pole.
Smart Grazing

- Originally for winter rainfall areas (Vic)
- Adapted for summer rainfall areas.
- Uses the pre-patent period to advantage
- Sheep grazing events that manage pasture mass but don’t re-contaminate.
Smart Grazing steps to prepare lambing paddocks

- Recently drenched sheep
- Any Sheep

Steps:
- 21 days before lambing

Diagram:
- Radar chart showing time frames for different steps.
Smart Grazing Barbers Pole Example

Projected herbage mass and digestibility

- Ewes @ 40/ha
- Hoggets @ 15/ha
Smart Grazing Scour Worm Example

- Ewes @ 40/ha
- Weaner Heifers @ 4/ha
Words of warning.

- Any strategy that effectively cleans pasture exacerbates selection for drench resistance.
  because
- Drenches are applied to the majority of the worm population.
Drenching animals on wormy pastures

- Worms on pasture (refugia)
- Worms in animals subject to treatment
- Worms surviving the treatment
Drenching animals on wormy pastures

Resistant worms are massively diluted with unselected worms

Worms on pasture (refugia)
Drenching animals on wormy pastures

Worms on pasture (refugia)

Worms surviving the treatment

Worms in animals subject to treatment
Drenching animals on wormy pastures

Resistant worms make up a large proportion of a small total worm population

Worms in animals successfully treated
If using Long Acting product in lambing ewes:

- Use a priming dose with unrelated drench
- Make sure this drench is EFFECTIVE
- Use long acting drench at lambing
  - Selects for resistance
- Use an exit drench
  - Different family and EFFECTIVE
- Next graze with wormy sheep
- Follow with cattle
Special Comment on Goats

- Happy to graze the top of tall pasture.
- This is helpful as most worm are lower than 100mm in the pasture sward.

But

- Metabolise drenches quicker.
- Many drench options are off label.
- Frequently win the drench resistance race.
Increasing the resilience / resistance of sheep to worms
Nutrition Impacts

- Host *Resistance*
- Host *Resilience*
Minerals and trace elements

- Phosphorous (<0.2% DM)
  - Reduced immunity to scour worms
- Cobalt (< 0.1mg/kg)
  - Impaired immune function
- Copper supplements
  - Reduce establishment of BP and BS
- Molybdenum
  - Pen trials increased rejection of BP & BS
BUT….

Dietary *protein* and *energy* are still the most important. Mineral supplements will not compensate inadequate energy and/or protein.
Protein nutrition affects ewes' worm resistance

Source: Donaldson et al 1997

Highest wt. gain
Sheep more resilient

Source: Donaldson et al 1997
And also improves lambs resistance to infection…

Source: Datta et al 1998
Nutrition also affects resilience in lambs

Source: van Houtert et al. (1996)

XX = Grams of protein consumed
XX.X = extra energy intake
Good pasture also gives resilience in lambs.

Pasture
- 70% DMD
- 40% Clover
- WEC
  - Zero
  - 800 epg

Kahn et al. (2001)
Grazing Management Compromise?

- Management to influence pasture quality
- Management to reduce infective larvae

Can do both but usually in sequence.
Breeding sheep to resist worms

- WEC traits are heritable (0.2 – 0.3)
- Correlated traits
  - Staple strength  (-0.16)
  - EMD       (-0.17)
  - Fat        (-0.26)

These correlations are desirable
Rate of gain in WEC

- Around 2% per year without losing production.
- Trials in WA
  - Resistant vs Unselected lines
    - 10 fold difference in WEC
    - Ewes up to 18% heavier at time of peak challenge
    - Lambs weaned up to 22% heavier.
- Resistance is across worm species.
Do low WEC high production sheep exist?
## Top 10 sires on the FP+ Merinoselect index

<table>
<thead>
<tr>
<th>Rank</th>
<th>YWT</th>
<th>YEMD</th>
<th>YCFW</th>
<th>YFD</th>
<th>YSS</th>
<th>YWEC</th>
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<tbody>
<tr>
<td>1</td>
<td>-0.2</td>
<td>-1.4</td>
<td>26.7</td>
<td>-2.8</td>
<td>3.2</td>
<td>-44</td>
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<tr>
<td>2</td>
<td>1.9</td>
<td>0.2</td>
<td>19.8</td>
<td>-2.6</td>
<td>8.6</td>
<td>-</td>
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<tr>
<td>3</td>
<td>1.4</td>
<td>-1.8</td>
<td>34.1</td>
<td>-2.2</td>
<td>0.8</td>
<td>-37</td>
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<tr>
<td>4</td>
<td>4.4</td>
<td>-1.5</td>
<td>30.3</td>
<td>-2</td>
<td>1.1</td>
<td>-16</td>
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<tr>
<td>5</td>
<td>0.8</td>
<td>1.1</td>
<td>13.2</td>
<td>-2.9</td>
<td>2.2</td>
<td>-72</td>
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<tr>
<td>6</td>
<td>-1.2</td>
<td>-0.2</td>
<td>24</td>
<td>-1.9</td>
<td>4.4</td>
<td>-39</td>
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<tr>
<td>7</td>
<td>11.7</td>
<td>-0.5</td>
<td>25.8</td>
<td>-2.8</td>
<td>4.3</td>
<td>21</td>
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<tr>
<td>8</td>
<td>-1.3</td>
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<td>-4</td>
<td>-4.6</td>
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<td>-56</td>
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<tr>
<td>9</td>
<td>1.9</td>
<td>0</td>
<td>19.8</td>
<td>-1.9</td>
<td>7.8</td>
<td>27</td>
</tr>
<tr>
<td>10</td>
<td>2.9</td>
<td>-0.6</td>
<td>23.8</td>
<td>-1.8</td>
<td>5.7</td>
<td>-</td>
</tr>
</tbody>
</table>
Drenching / Drenches
Drenches

- BZ (Benzimidazole)
- LEV (Levamisole)
- ML (‘mectins, abamectin, moxidectin)
- AAD (Monepantel)
- Sal-P (Closantel)
- OP (Napthalaphos)
Drench Resistance

2013 Survey results

Survey results found:

<table>
<thead>
<tr>
<th>Drench Active(s)</th>
<th>Brown stomach</th>
<th>Black scour</th>
<th>Barbers pole</th>
<th>Any Parasite*</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZ</td>
<td>88</td>
<td>87</td>
<td>75</td>
<td>96</td>
</tr>
<tr>
<td>LEV</td>
<td>82</td>
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<td>96</td>
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<tr>
<td>NAP</td>
<td>72</td>
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<td>ABA</td>
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<td>77</td>
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<td>MOX</td>
<td>38</td>
<td>14</td>
<td>52</td>
<td>54</td>
</tr>
<tr>
<td>MPL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BZ/LEV</td>
<td>79</td>
<td>48</td>
<td>19</td>
<td>81</td>
</tr>
<tr>
<td>BZ/LEV/ABA</td>
<td>22</td>
<td>6</td>
<td>14</td>
<td>28</td>
</tr>
</tbody>
</table>

*Any parasite refers to Teladorsagia, Trichostrongylus or Haemonchus spp.

Severity: The severity of resistance was found by calculating the average efficacy (%) of each active against black scour worm, brown stomach worm and barber’s pole worm across all of the farms on which it was used. Results revealed average efficacies of levamisole 61%; naphthalophos 72%; abamectin 73% and moxidectin 86%.

Source: Wormboss
Do you know your drench resistance status?

- Do a Drench Test every 2-3 years
- Do DrenchCheck-Day10 in between times.

Don’t import resistance!

(quarantine drench with 4 actives including Monepantel.)
Slowing down resistance

- Use effective drenches.
- Use combinations
- Rotate at each treatment.
- Use short acting treatments.
Strategic Drenching

- Under the NSW non-seasonal umbrella
  BUT

- Monaro is a bit unusual
  - Warm season dominant rainfall
  - Rainfall varies across the district (450 – 800mm)
NSW non-seasonal
Monaro rainfall actually Summer dominant
Strategic Drenching Program

- Mix of WEC monitoring and drenching
- Mix of Non Seasonal and Summer rainfall tablelands
Worm Monitoring
New Directions for Treatments

- Prevention rather than cure.
- Development of vaccines for parasites.
  - Stimulate the animals immune system to do the job for us.
Vaccines

- Barbervax
  - Joint venture
    - Moredun Inst. and DAFWA
  - Currently going through registration with APVMA.
  - 70 - 80% efficacy
  - Requires repeated doses for ongoing protection
    - around 4 times over the season.
New Anthelmintics

■ Startect
  – Combination of derquantel + abamectin
  – Registration in Aust. still under negotiation.
    • More data needed.

■ Others always in the pipeline but..
  – Very few make it past the toxicology screening.
  – Anything currently showing promise is still 7 – 10 years away.
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Protect the drench families you have.
Go to Wormboss for more information