Investigations into Insecticide Resistance In Blowflies and Anthelmintic Resistance in Roundworms

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- Field and laboratory studies with the “Nimmitabel” strain of Australian Green Blowfly

- The prevalence of anthelmintic resistance on Australian sheep farms (2009-2012)
Larval implant study 2011/12

- Larval implant study
  - Both products performed as per label claim independent of strain used.
  - Conducted using sheep treated with either Vetrazin® SO or CLiK® SO using larvae from the Nimmitabel strain or a triazine susceptible reference strain.

<table>
<thead>
<tr>
<th>Implant week</th>
<th>Control</th>
<th>Cyromazine</th>
<th>Dicyclanil 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CYR-LS</td>
<td>DZR50</td>
<td>CYR-LS</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>-</td>
<td>54</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
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<td>-</td>
<td>55</td>
</tr>
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<td>10</td>
<td>0</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>11</td>
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<td>-</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>10</td>
<td>implant site</td>
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</tr>
</tbody>
</table>
Field study 2011/12

- Conducted on original Nimmitabel property.
  - Continually monitored by producer and once every 4 weeks by Novartis for any strike.
  - Fly trap, dag and climate data recorded.
Field study 2011/12

[Graph showing the number of flies over weeks, with categories for L. cuprina and other flies.]
Field study 2011/12

- Results:
  - 1 dag strike at 4 weeks in Vetrazin treated group (no skin damage).
  - No strike in either group up to 14 weeks.
  - At 18 weeks, 5 lambs with breech strike in Vetrazin treated group.
  - No strikes in CLiK® treated group.

<table>
<thead>
<tr>
<th>Week post-treatment</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyromazine treated sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated sheep remaining in study</td>
<td>386</td>
<td>385</td>
<td>385</td>
<td>354</td>
<td>353</td>
<td>353</td>
</tr>
<tr>
<td>No. strikes</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Cumulative strike rate (%)</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
<td>0.28</td>
<td>0.28</td>
<td>1.70</td>
</tr>
<tr>
<td>Dicyclanil 5% treated sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated sheep remaining in study</td>
<td>198</td>
<td>198</td>
<td>198</td>
<td>198</td>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td>No. strikes</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cumulative strike rate (5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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</table>
These studies demonstrated that, against this field isolate, under both field and controlled laboratory conditions, Vetrazin® spray–on and CLiK® each maintained the registered protective period after treatment.

- Use Integrated Pest Management (IPM)
  - chemical and non chemical means of making sheep less attractive to fly.

- Use a different chemical to treat fly struck sheep to the one you used to prevent fly strike (different mode of action).

- Use different chemicals for treatment of fly and lice.

- Product application:- use products that suit your management in a sustainable manner that maximises productivity and animal welfare
  - “Do it once and do it right”.

 protects the future of your flock
Aim: Conduct a survey of submissions to veterinary diagnostic laboratories

WECRT’s conducted between 1 January 2009 and 30th March 2012

Criteria for inclusion:
- 10 or more animals per group
- Concurrent untreated control group
- Larval differentiation conducted
- >100 epg/genus

- 394 submissions received (4 discarded) – 2.5% of farmers?
- Resistance is always defined as <95% efficacy.
### Table 1: National summary of proportion of WECRTs with <95% WECR in sheep

<table>
<thead>
<tr>
<th>Active Ingredient(s)</th>
<th>Teladorsagia (Small Brown Stomach Worm)</th>
<th>Trichostrongylus (Black Scour Worm)</th>
<th>Haemonchus (Barbers Pole Worm)</th>
<th>Any Parasite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Properties</td>
<td>% Properties</td>
<td>% Properties</td>
<td>% Properties</td>
</tr>
<tr>
<td>BZ</td>
<td>88</td>
<td>87</td>
<td>75</td>
<td>96</td>
</tr>
<tr>
<td>LEV</td>
<td>82</td>
<td>86</td>
<td>30</td>
<td>96</td>
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<tr>
<td>NAP</td>
<td>72</td>
<td>79</td>
<td>15</td>
<td>86</td>
</tr>
<tr>
<td>IVM</td>
<td>76</td>
<td>31</td>
<td>74</td>
<td>87</td>
</tr>
<tr>
<td>ABA</td>
<td>49</td>
<td>25</td>
<td>83</td>
<td>77</td>
</tr>
<tr>
<td>MOX</td>
<td>38</td>
<td>14</td>
<td>52</td>
<td>54</td>
</tr>
<tr>
<td>CLOS</td>
<td>N/A</td>
<td>N/A</td>
<td>43</td>
<td>N/A</td>
</tr>
<tr>
<td>MPT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Summary - Single actives across any species

% of farms tested where efficacy is less than 95%

- **BZ**: 96
- **LEV**: 96
- **NAP**: 86
- **IVM**: 87
- **ABA**: 77
- **MOX**: 54
- **MPT**: 0

Anthelmintic active

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Protecting the future of your flock
Summary - Scour worms (*Trichostrongylus* and *Teladorsagia*)

% of farms tested where efficacy is less than 95%

- **Trichostrongylus**
  - BZ: 88%
  - LEV: 82%
  - NAP: 72%
  - IVM: 31%
  - ABA: 25%
  - MOX: 14%

- **Teladorsagia**
  - BZ: 87%
  - LEV: 86%
  - NAP: 79%
  - IVM: 76%
  - ABA: 49%
  - MOX: 38%
  - MPT: 0%
Summary – Barbers Pole Worm (Haemonchus)

% of farms tested where efficacy is less than 95%

Anthelmintic active

- BZ: 75%
- LEV: 30%
- NAP: 15%
- IVM: 74%
- ABA: 83%
- MOX: 52%
- MPT: 0%
- CLOS: 43%
Range of efficacy by anthelmintic

Naphthalophos

Benzimidazole

Levamisole
Range of efficacy by anthelmintic

Ivermectin
- Teladorsagia: ave=61%
- Trichostrongylus: ave=91%
- Haemonchus: ave=38%

Abamectin
- Teladorsagia: ave=76%
- Trichostrongylus: ave=88%
- Haemonchus: ave=46%

Moxidectin
- Teladorsagia: ave=81%
- Trichostrongylus: ave=95%
- Haemonchus: ave=83%
## Results: Combination products

<table>
<thead>
<tr>
<th>Active Ingredient(s)</th>
<th><em>Teladorsagia</em> % Properties</th>
<th><em>Trichostrongylus</em> % Properties</th>
<th><em>Haemonchus</em> % Properties</th>
<th>Any Parasite % Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZ/LEV</td>
<td>79</td>
<td>48</td>
<td>19</td>
<td>81</td>
</tr>
<tr>
<td>LEV/NAP</td>
<td>67</td>
<td>67</td>
<td>13</td>
<td>69</td>
</tr>
<tr>
<td>BZ/NAP</td>
<td>57</td>
<td>73</td>
<td>20</td>
<td>74</td>
</tr>
<tr>
<td>BZ/PYR</td>
<td>47</td>
<td>33</td>
<td>14</td>
<td>53</td>
</tr>
<tr>
<td>BZ/LEV/NAP</td>
<td>59</td>
<td>55</td>
<td>11</td>
<td>74</td>
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<tr>
<td>BZ/LEV/ABA</td>
<td>22</td>
<td>6</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>BZ/LEV/IVM</td>
<td>27</td>
<td>20</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>BZ/LEV/CLOS/ABA</td>
<td>0</td>
<td>0</td>
<td>44</td>
<td>44</td>
</tr>
</tbody>
</table>
Drench to maximise productivity and minimise resistance.

If you rely on the older drench classes (including the ML’s) aim to preserve them while maintaining productivity...

How?

- WECRTs every 2-3 years to know the status of your farm
- Effective quarantine drenching (don’t buy someone else’s problem!)
- Within season rotation of drenches – have a drench plan!
- Use of older actives in combination – this delays/slows resistance
- Incorporation of new actives in rotation now (they can’t help you on the shelf)
- Drench check 10-14 days after short acting drenches