‘Parasitology and the targeted treatment of sheep in partnership with genetic selection’

Dave Bartley
Internal parasites of livestock

Protozoa

Tapeworms

Roundworms

Fluke
Worm control strategies

**IMMUNOLOGICAL**
- Vaccines
- Genetic selection
- Optimised nutrition

**MANAGEMENTAL**
- Grazing management
- Biological control
- Organic farming

**CHEMICAL**
- Anthelmintics
- Bioactive forages
Genetic selection

RESISTANCE – Develop immunity to control or influence pathogens

RESILIENCE – Tolerance to infection, minimising negative impact of infections
## Possible applicable measurements

<table>
<thead>
<tr>
<th>Resistance</th>
<th>Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Faecal egg count</strong></td>
<td><strong>Live weight gain</strong></td>
</tr>
<tr>
<td>Peri-parturient rise in FEC</td>
<td>Lamb growth proxy for milk production</td>
</tr>
<tr>
<td>Haematological parameters</td>
<td>Wool growth</td>
</tr>
<tr>
<td>Serological parameters</td>
<td>Anthelmintic treatments (overall requirement)</td>
</tr>
<tr>
<td>Dag score</td>
<td>Anthelmintic treatments (1\text{st} post weaning)</td>
</tr>
<tr>
<td></td>
<td>Reproductive performance</td>
</tr>
<tr>
<td></td>
<td>longevity</td>
</tr>
<tr>
<td></td>
<td>Haematological/ Serological parameters</td>
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</tbody>
</table>
What is required for sustainable control?

Reduce host/parasite contact to levels which do not affect performance or welfare but allow the acquisition of immunity.

Reduce the selection for anthelmintic resistance (AR) to ensure drugs work effectively for longer.

Cumulative weight gain (kg)

- Control
- 500
- 1500
- 3000
- 5000

Weeks
Targeted and targeted selective treatments
Targeted Treatments (TT)

Targeted treatments (TT) are those where the entire group (whole flock or mob) of animals is treated.

Challenge is to find times to treat when there are sufficient worms in refugia to minimise treatment impact regarding drug resistance.
TT – What you need to know

Over time monitoring can provide the necessary information e.g.

What parasites are present during the season

The extent of challenge and risk of disease

Which anthelmintics are working on your farm

This information should guide the development of farm specific worming programmes
## Targeted treatments using FEC

<table>
<thead>
<tr>
<th>Farm type</th>
<th>Number of ewes</th>
<th>Total annual saving (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hill</td>
<td>581</td>
<td>56.23</td>
</tr>
<tr>
<td>Hill</td>
<td>2150</td>
<td>1224.54</td>
</tr>
<tr>
<td>Lowland</td>
<td>905</td>
<td>251.58</td>
</tr>
<tr>
<td>Lowland</td>
<td>663</td>
<td>490.99</td>
</tr>
<tr>
<td>Lowland</td>
<td>1101</td>
<td>420.96</td>
</tr>
<tr>
<td>Upland</td>
<td>1193</td>
<td>434.48</td>
</tr>
<tr>
<td>Lowland/Upland</td>
<td>620</td>
<td>534.81</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>£663.86</strong></td>
</tr>
</tbody>
</table>

Amounts to an average of 35% reduction in anthelmintic usage
## Monitoring faecal egg counts

<table>
<thead>
<tr>
<th>Pro</th>
</tr>
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<tbody>
<tr>
<td>Can confirm presence of adult worms</td>
</tr>
<tr>
<td>Provide indicator of potential pasture contamination</td>
</tr>
<tr>
<td>Can be useful to improve productivity in flock, heritability value 0.3-0.48</td>
</tr>
<tr>
<td>Can be used to differentially diagnose from other causes of diarrhoea and ill-thrift</td>
</tr>
<tr>
<td>Only viable test for assessment of anthelmintic efficacy</td>
</tr>
<tr>
<td>Can be composited to give an over-view of situation in flock as whole</td>
</tr>
<tr>
<td>Provide a useful tool within the decision process toolbox for whether to treat</td>
</tr>
</tbody>
</table>
## Monitoring faecal egg counts

<table>
<thead>
<tr>
<th><strong>Con</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Not always consistent relationship with worm burden</td>
</tr>
<tr>
<td>Dose dependence</td>
</tr>
<tr>
<td>May no be present prior to onset of disease – acute <em>Nematodirus</em>, fluke</td>
</tr>
<tr>
<td>Better tools for improving productivity such as live weigh gain</td>
</tr>
<tr>
<td>Complicated by mixed infections – what cut-off do you use for treatment?</td>
</tr>
<tr>
<td>Can be influence by immune status of animal. Relaxation at parturition</td>
</tr>
<tr>
<td>Assumed high egg counts means lower productivity – not the case in resilient animals</td>
</tr>
<tr>
<td>Feed intake and composition and consequently faecal output can influence egg count</td>
</tr>
<tr>
<td>Need to be done regularly to be useful</td>
</tr>
</tbody>
</table>
Targeted Selective Treatments (TST)

Targeted selective treatments (TST) are those where individuals within the group are treated on the basis of need.

Ideal TST indicator would be:
- cost effective
- sheep side test
- simple to use

Challenge is to find ways of deciding who to treat and what parameters to measure!
Sensitivity of live weight gain

Weeks post infection

Peak egg count 6 weeks c300 epg

Effect on weight gain when egg counts are low

EPG

Wt gain Kgs

FEC

Control

Infected
Sustainable control

Group dosed at signs of infection – FEC, ill-thrift, diarrhoea

Production data  Body weight gain, body condition score
Parasitological data  Egg counts, FECRT
Summary results from 2006-2009

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean faecal egg count</th>
<th>Growth rate g/day</th>
<th>treatments per lamb</th>
<th>Mean efficacy overall</th>
<th>Change in efficacy (%) 2005-09*</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST</td>
<td>156</td>
<td>148</td>
<td>2.6</td>
<td>93</td>
<td>- 4</td>
</tr>
<tr>
<td>Monthly</td>
<td>50</td>
<td>149</td>
<td>5.25</td>
<td>76</td>
<td>- 21</td>
</tr>
<tr>
<td>Targeted</td>
<td>140</td>
<td>145</td>
<td>3.25</td>
<td>90</td>
<td>- 7</td>
</tr>
<tr>
<td>Clinical</td>
<td>215</td>
<td>134</td>
<td>2.5</td>
<td>95</td>
<td>- 2</td>
</tr>
</tbody>
</table>

*Pre-trial (2005) efficacy of ivermectin treatment was 97%

BUT can this be made to work on commercial farms?

System tested on 5 commercial farms to date with different management practices and sheep breeds:

✓ 20-30% reduction in drench use, no negative effect on weight gain

Kenyon et al., 2013
Control strategy conclusions

Given an understanding of the epidemiology TT whole flock strategies offer acceptable growth and maintain susceptibility but vigilance is required

TST approaches can provide the optimal use of anthelmintic with regard to the number of treatments, maintenance of production and anthelmintic efficacy but require increased input

Clinical signs treatment strategy carries a production penalty and monthly treatments a resistance penalty
So can we use these factors to inform selective breeding?
Weight of treated TST animals

Do only light animals require treatment?

Group average weight

Number of lambs

Deviation of treated lamb weight from average (kg)

Kenyon et al., unpublished data
The FEC of treated TST animals

Do only animals with high FEC need treatment?

Group average FEC

Number of lambs

Deviation of treated lamb FEC from average

Kenyon et al., unpublished data
Pros and cons

Points of consideration

• Resilience places less selective pressure on a worm to evolve than resistance?!
  • Change in worm pathogenicity / virulence?

• Resistance leads to decreased pasture contamination and therefore challenge

• Selection based on one trait may lead to unforeseen changes in other traits (positive OR negative)

• Caution is needed, as indicator traits may differ with time depending on the immune status of the animal <> 6 months of age or around parturition
Overall control strategies - conclusions

No “blue print”, the problems associated:
• vary from farm to farm
• occur at different times in the grazing season
• may vary between seasons
• vary in class of animal involved

The key to developing effective control is understanding the risk worms pose on your farm.

Monitoring can, over time, provide vets and producers with a clear picture of the relative risk each of these parasites poses.
Conclusion

• “It should not be forgotten, however, that all control technologies that leave survivors are subject to evolutionary erosion of their effectiveness.”

• “The important point, however, is not that any specific control method may be unsustainable when considered in isolation, but that the more choices there are and the more that different controls are used in combination rather than relying almost solely on anthelmintics, the longer can we eke out the continued effectiveness of all of them.” Barger 1997