A survey of drench resistance in sheep worms

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Recommended Citation
Available at: https://researchlibrary.agric.wa.gov.au/journal_agriculture4/vol26/iss2/5
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Sheep worms which are resistant to chemical drenches have been detected with increasing frequency in Western Australia’s south-western farming areas between 1977 and 1980. These worms have anthelmintic resistance and such genetic resistance puts essential internal parasite control practices at risk.

This prompted veterinarians in the Esperance, Albany, Bunbury, Geraldton and Northam areas to survey farms to determine the prevalence of resistance to drenches and to define those sheep management practices which encourage its development.

This article describes the survey which was conducted to assess the extent of drench resistance, what causes its build-up and how it can be controlled by using a combination of drenching programme changes and sheep management practices.

It has been estimated that drench resistance alone could cost the State’s sheep industry $4 million to $6 million a year in lost production, and, as this survey shows, there is potential for far greater costs if resistance continues to increase.

About the survey

Between July 1981 and December 1983, 116 randomly selected properties were surveyed. Half the properties selected were in the inland medium rainfall zone (less than 760 millimetres a year average annual rainfall) and the other half were in the higher rainfall coastal zone (more than 760 mm a year) where there is some summer rain and barber’s pole worm (Haemonchus contortus) can occur. In all areas the other worms present were the black scour worm (Trichostrongylus spp), the brown stomach worm (Ostertagia spp) and the thin-necked intestinal worm (Nematodirus spp).

A worm egg count reduction test was carried out on each property. The farmer was asked to provide 45 young sheep which had not been drenched in the past month. These were weighed, identified, sampled for faeces and allocated to one of three drench treatment groups:

- Thiabendazole (Thibenzole® at 44 milligrams per kilogram) was used to represent the benzimidazole (white or thick drenches) group.
- Levamisole (Nilverm® at 7.5 mg/kg) was used to represent the levamisole (clear drenches) and morantel group.
- Control—not drenched.

Drenches were given by an injection into the rumen to ensure accurate dose rates. Seven to 10 days later the 10 sheep with the highest egg counts in each group were resampled. Faeces were examined for individual worm egg counts and incubated so that third stage larvae could be differentiated into each worm type.

The resistance of each worm type was expressed as the percentage reduction in worm egg counts from the first to the second sampling. These were also adjusted according to...
changes in egg counts in the untreated control group. Worms were classified as resistant if there was less than a 90 per cent reduction in egg counts.

Each farmer was interviewed on his drenching strategies and sheep management practices which could then be related to the development of resistance in worms.

**Prevalence of resistant worms**

Drench resistant worms were found on 68 per cent of farms which was considerably higher than expected (Table 1). Although the prevalence of resistant worms was higher in the high rainfall area, it was also high in the medium rainfall area.

Fifty-two per cent of farms had thiabendazole resistant worms and 37 per cent had levamisole resistant worms. A significant number of properties had worms with multiple resistance. Multiple resistance develops when one type of worm is resistant to both drench groups. On other properties resistance to both drench groups occurred in worms of different types.

Table 2 shows the prevalence of resistance to both drench groups for each worm type.

The figure shows the distribution of severity of resistance to both drench groups used for each worm type. A reduction in egg count of less than 60 per cent was regarded as severe resistance; reductions of 60 to 90 per cent as slight resistance and reductions of more than 90 per cent as worms susceptible to drenches.

Seven per cent of properties had severely levamisole resistant worm populations for all worm types, with the highest proportion being in black scour worms. The percentage of worm populations with severe thiabendazole resistance was higher than for levamisole resistance, particularly in brown stomach worms (37 per cent).

Although 16 per cent of properties had severe thiabendazole resistance for all worms, this comprised about one-third of properties with resistant worms. About one-quarter of properties with levamisole resistant worms had severe resistance.

Resistance in barber's pole worms was low compared to the other types of worms studied.

Some farmers had observed sheep health problems that could be attributed to the effects of worms. These properties probably had highly resistant worms. The owners of properties with less severe worm resistance were probably not aware of worms in their sheep. However, the presence of resistant worms suggests that problems could develop with continued use of the drench to which the worms were resistant.
Resistant worms are widespread and can be found in all sheep farming areas in the South-West. The four most common types of sheep worms have shown resistance to members of the two broad spectrum drench groups available. In some cases, multiple resistance has been found.

As only two broad spectrum drench groups are available for worm control, other methods for reducing the further development of resistance must be found. The relationship between drenching strategies and sheep management practices used by farmers and the presence of drench resistance in their flocks was studied.

**Drenching strategies, sheep management practices and resistance**

There were enough results only for the brown stomach worm and the black scour worm to adequately test whether there was any relationship between drenching strategies, sheep management practices and resistance in worms.

**Flock and herd structure**

Resistance was more prevalent in small flocks (less than 2000 sheep) and large flocks (more than 5000 sheep) than in average-sized flocks. Flocks with more ewes were more likely to have brown stomach worms resistant to both drench groups.

Thiabendazole resistant brown stomach worms in sheep were more common on farms with less than 30 or more than 100 head of cattle.

**Management strategies**

All flocks run mainly for producing prime lambs had thiabendazole resistant black scour worms, probably caused by very frequent drenching.

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**Use of current drenching recommendations**

Farmers’ answers to survey questions relating to the development or prevention of drench resistance indicated that they had a moderate understanding of the problem of resistance.

Sixty-six per cent of farmers answered correctly that drenching more often would not delay the development of resistance, nor would changing drenches each time stock were drenched (51 per cent), or increasing dose rates (54 per cent). However, there were still many farmers who gave incorrect answers or no answers. In answer to these questions between 14 and 21 per cent of farmers replied: ‘Don’t know’.

Drenches were given by an injection into the rumen to ensure accurate dose rates.

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Table 1. Prevalence of resistant worms in properties surveyed.

<table>
<thead>
<tr>
<th></th>
<th>All areas (%)</th>
<th>High rainfall (%)</th>
<th>Medium rainfall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties with resistant worms</td>
<td>68</td>
<td>76</td>
<td>61</td>
</tr>
<tr>
<td>Properties with thiabendazole resistant worms</td>
<td>52</td>
<td>54</td>
<td>50</td>
</tr>
<tr>
<td>Properties with levamisole resistant worms</td>
<td>37</td>
<td>41</td>
<td>33</td>
</tr>
<tr>
<td>Properties with thiabendazole and levamisole resistant worms</td>
<td>18</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Properties with multiple resistant worms</td>
<td>17</td>
<td>18</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 2. Prevalence of resistance to thiabendazole and levamisole of each worm type.

<table>
<thead>
<tr>
<th>Worm type</th>
<th>Thiabendazole resistance (%)</th>
<th>Levamisole resistance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barber’s pole worm</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Brown stomach worm</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Black scour worm</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Thin-necked intestinal worm</td>
<td>43</td>
<td>10</td>
</tr>
</tbody>
</table>

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Resistance of the brown stomach worm and the black scour worm to both drench groups was highest on properties where ewes, weaners and wethers were set stocked.

Levamisole resistant black scour worms were more common on properties where sheep and cattle grazed the same paddock. This trend was not evident for thiabendazole or the brown stomach worm.

**Drenching strategies**

Resistant worms were more common on those properties where farmers drenched most often.

Thiabendazole resistant black scour worms were most prevalent where the drench dose rate was calculated at the average weight of the flock. This was not true for the brown stomach worm for both drench groups. Because the causes of resistance of different worm types to the two drench groups may not be the same, farmers may have to base drenching decisions on their knowledge of the type of worms present and the drench group being used.

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The two main thrusts of the Department of Agriculture's extension programme on controlling the development of resistance in worms have been to change drench groups yearly and to drench less often. These methods received only 22 per cent and 4 per cent of replies respectively. These answers were confirmed by farmers' drenching practices. One-quarter of the farmers changed their drench each year (Table 3) and another quarter changed drenches between nine months and two years. The remaining 49 per cent were outside this range.

Twenty-eight per cent of farmers drenched their sheep at the weight of the heaviest sheep in the mob. This has been the Department's recommendation for many years and has been poorly adopted.

### Preventing the development of resistance

**Drench less often**

Drenching frequency should be reduced to the minimum number of drenches needed to prevent production losses in the flock. The number of drenches required will vary with the average annual rainfall, the season, the worm type present and the age and sex of sheep.

Weaners should be drenched more often than ewes, which should be drenched more often than wethers.

The strategic timing of drenches is more important than the total number of drenches given and can reduce the total number required.

The drenching programme for the farm can be designed in consultation with a veterinarian.

### Know the resistance status of worms on the farm

The Department has been recommending that farmers change the drench group used each year to prevent the development of resistance. However resistance has developed on 68 per cent of farms and it is likely to increase. Therefore the alternation of drench groups can no longer be recommended. If, for example, thiabendazole resistant worms are exposed to thiabendazole every second year, the drench will not be effective. Worm control will be less efficient and the severity of resistance will get worse.

The key to a satisfactory worm control programme for a farm is to know the resistance status of the worms on that farm. Once this is known an effective worm control programme can be designed.

If a farmer does not know the resistance status of worms on the farm, the recommendation is to continue using the drench that has been used most often previously. The resistance status of the worms should be tested, particularly if the effectiveness of the drench being used is doubtful.

Resistance testing will enable resistant worm populations to be detected early. This ensures that the appropriate drench group and drenching and management programmes are used to delay the development of further resistance. The Department does not provide a resistance testing service for farmers, but some private veterinarians may and can help to formulate a drenching programme for the control of resistance.

### Test and treat introduced sheep

Because resistant worms are prevalent in sheep, and in particular goats, they could be brought on to the farm by introduced stock. The only safeguard against this is to test all stock for resistant worms before buying.

The alternative is to drench all introduced sheep or goats with a double dose of a drench from each group, that is, hold sheep in the shed and drench them twice at double the recommended dose with a drench from the thiabendazole group and then with a drench from the levamisole group. The drench groups should not be mixed. Sheep should preferably be kept in the shed for another 24 hours. They should not be held in holding paddocks near yards as this will allow contamination of the paddock with worm eggs which may be resistant.

Table 4 shows the drenches available and their groupings, with trade names in brackets.
Use narrow spectrum drenches
Narrow spectrum drenches should be used for sheep in coastal areas during summer to control barber’s pole worm. The use of narrow spectrum drenches reduces the number of times winter worms are exposed to the broad spectrum drenches and slows down the development of resistance.

The narrow spectrum drenches should not be used as a substitute for the two strategic broad spectrum summer drenches which are recommended as the basis for all sheep worm control programmes. They should only substitute for broad spectrum drenches which would be given in addition to these two strategic summer drenches and for the control of barber’s pole worm.

Dose for the heaviest sheep in the mob
The dose of drench given should be calculated at the rate of the heaviest sheep in the mob to ensure that all sheep get a full dose. Sheep should be weighed occasionally to ensure an estimate is correct. In the survey, many farmers were surprised to find their estimates of sheep weights, and therefore the dose given, were much lower than expected.

When calculating the dose rate for sheep which are heavier than the maximum weight listed on drench labels, be prepared to increase the dose rate according to body weight to ensure a full dose is given.

Use better management strategies
With the high prevalence of resistance to drenches, farmers should use those sheep management strategies which will allow them to drench less often and so preserve the efficacy of the two drench groups available. Such strategies include:

- Rotations between grazing sheep and cattle. Pastures grazed by one of these two animals are relatively ‘safe’ for the other as few worms affect both animals. The length of the rotation depends on the time of the year, but is generally about six months. The timing of the rotation also depends on the availability of pasture suitable for each animal and needs to be planned to fit the grazing system used.

- Use of cereal stubbles. Cereal stubbles are particularly ‘safe’ and can be used to graze susceptible classes of stock such as weaners.

- Use of ‘safe’ pastures. Paddocks grazed by weaners and lambing ewes carry the greatest numbers of infective larvae and those grazed by dry adult sheep carry the least numbers. The time taken for a contaminated paddock to become ‘safe’ varies with the time of year. Paddocks contaminated in winter may remain infective until the feed dries off in late spring.

However, during the hot dry summer paddocks may be ‘safe’ within weeks of contamination.

- Greater emphasis on the ewe flock. Strategies to delay the development of resistance in worms are of most importance in the ewe flock as this group has the greatest potential to spread worms. The survey results suggest that flocks with lower percentages of ewes are less likely to have resistant worms. This is yet to be confirmed. The economics of any changes in flock structure should be carefully considered.