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Coping with anthelmintic resistance in ruminants



Key external stakeholders:

Sheep farmers, Sheep processors, Sheep meat consumers, Anthelmintic drug trade.

Practical implications for stakeholders:

- Anthelmintic treatment efficacy was tested, by means of a drench test, on 1446 farms in Ireland.
- In tests against strongyles, benzimidazole was effective in 31.5% of tests, levamisole was effective in 51.9% of tests and macrocyclic lactones were effective in 69% of tests.
- All anthelmintics were highly effective against *Nematodirus*.
- Macrocyclic lactone (ivermectin) resistance was confirmed on 2 Irish sheep farms by means of a faecal egg count reduction test.
- The ivermectin resistant species was *Teladorsagia circumcincta* (brown stomach worm) and it was multi-drug resistant, being also resistant to benzimidazole and levamisole.
- Part-flock anthelmintic treatment increased the population of worms *in refugia* but resulted in a lower average daily gain for untreated lambs.

Main results:

- Anthelmintic treatment efficacy was tested by means of a drench test, in which worm eggs were counted in a composite faecal sample from a group of lambs pre and post-anthelmintic treatment.
- There was a significant difference between the efficacy of the different anthelmintic classes against strongyle worms; with benzimidazole least effective and macrocyclic lactones most effective.
- All anthelmintic classes were highly effective against *Nematodirus* worms.
- Macrocyclic lactone (ivermectin) resistance was confirmed on 2 Irish sheep farms with the resistant species being *Teladorsagia circumcincta*.
- Ivermectin resistant *T. circumcincta* were also benzimidazole and levamisole resistant confirming multidrug resistance in Irish sheep worms for the first time.
- Part-flock treatment has been proposed as a strategy to slow the development of resistance by increasing the population of susceptible worms *in refugia*. Part-flock treatment was evaluated using weight as a criterion to select animals for treatment. While this strategy resulted in fewer worms being exposed to anthelmintics, untreated lambs had a lower growth rate than treated lambs.

Opportunity / Benefit:

Drench testing can be used on farm to establish the efficacy of anthelmintic treatment. Resistant worms, including ivermectin and multi-drug resistant worms, are present on Irish sheep farms and good biosecurity protocols are required to prevent buying-in resistant worms. Part-flock anthelmintic treatment can maintain susceptible worms *in refugia*, however, this is likely to lead to a production penalty for untreated lambs.

Collaborating Institutions:

DAFM, UCD.

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1. Project background:

Gut worms can cause ill-thrift and disease in lambs, and good worm control is currently highly dependent on effective worming products. However, a direct and unavoidable result of continuous use of wormers is the development of drug resistant worms. There are three commonly available classes of anthelmintic on the market in Ireland, benzimidazole (1-BZ; white drench), levamisole (2-LV; yellow drench) and macrocyclic lactone (3-ML; clear drench) and resistance to 1-BZ and 2-LV has been previously reported in Ireland. The presence of 3-ML resistance was suspected but not confirmed and multi-drug resistance had not been tested for. Therefore information on the level of anthelmintic treatment failure of each of the commonly used anthelmintic classes on Irish sheep farms was required as well as confirmation of the presence of 3-ML resistant worms and multi-drug resistant worms.

As part of a sustainable worm control strategy a susceptible population of worms, not exposed to anthelmintic treatment (*in refugia*), must be maintained. One option to maintain a proportion of worms unexposed to anthelmintic is to leave some lambs untreated, however the viability of such an approach in Irish lamb production systems has not been quantified.

2. Questions addressed by the project:

- How effective are the three commonly used anthelmintics, benzimidazole (1-BZ), levamisole (2-LV) and macrocyclic lactone (3-ML), on Irish sheep farms?
- Are there 3-ML (ivermectin) resistant or multidrug resistant worms on Irish sheep farms?
- Is targeted selective treatment of lambs, based on weight, a viable mechanism to increase the population of worms *in refugia* without affecting productivity?

3. The experimental studies:

Three separate studies were carried out

1. The objective of the first study was to determine the extent of anthelmintic treatment failure with each of the three commonly used anthelmintics on Irish sheep farms.
2. The objective of the second study was to establish if 3-ML resistant worms were present on Irish sheep farms and to determine if the 3-ML resistant worms were multidrug resistant.
3. The objective of the third study was to evaluate the effect of part-flock anthelmintic treatment, based on lamb weight in an Irish lamb production system.

4. Main results:

- As part of the Sheep Technology Adoption Programme (STAP) over 4,200 drench tests were carried out in which a composite faecal sample was tested for worm eggs pre and post-anthelmintic treatment.
- Information on the anthelmintic products used was available for 3771 tests, with 1-BZ used in 42% of tests, 2-LV used in 23.4% of tests, 3-ML used in 32.5% of tests and an inappropriate product (eg flukicide) used in 2.1% of tests.
- In total, 1446 tests could be used to calculate treatment efficacy and overall 51% of treatments were effective (ie resulted in a reduction in faecal egg count > 95%)
- There was a significant difference between the efficacy of the anthelmintic classes with 1-BZ effective in 31.5% of tests, 2-LV effective in 51.9% of tests and 3-ML effective in 69% of tests.
- All anthelmintic classes were highly effective against *Nematodirus* (338 tests).
- Four farms with suspected 3-ML (ivermectin) resistance were tested by means of a faecal egg count reduction test and 3-ML resistance was confirmed on 2 of the farms with *Teladorsagia circumcincta* being the resistant species on both farms.
- The 3-ML resistant *T. circumcincta* were further demonstrated to be resistant to 1-BZ and 2-LV identifying multi-drug resistant worms on Irish sheep farms for the first time.
- Part-flock anthelmintic treatment was evaluated as a strategy to preserve a susceptible worm population and the hypothesis that it would be preferable to leave heavy lambs untreated was tested.

The experiment was conducted across 4 flocks and 2 years and included 444 lambs post-weaning. At the start of the trial, light lambs had a higher faecal egg count than heavy lambs, indicating they would benefit more from treatment. However, treated lambs gained 109g/day while untreated lambs gained 59 g/day and there was no interaction with weight class (heavy or light).

5. Opportunity/Benefit:

Drench testing can be readily used on farm to establish the efficacy of anthelmintic treatment. Anthelmintic resistant worms, including ivermectin and multi-drug resistant worms, are present on Irish sheep farms and good biosecurity protocols are required to prevent buying-in resistant worms. Part-flock anthelmintic treatment can maintain a susceptible proportion of worms *in refugia*, however, this is likely to lead to a production penalty for untreated lambs.

6. Dissemination:

Keegan, J.D., Keane, O.M., Good, B., De Waal, T., Denny, M., Hanrahan, J.P., Fitzgerald, W. and Sheehan, M. (2016) 'A nationwide survey of anthelmintic treatment failure on sheep farms in Ireland' *Irish Veterinary Journal* (Under Revision)

Keegan, J.D., Keane, O.M., Farrell, L., Byrne, W., De Waal, T. and Good, B. (2016) 'Characterisation of ivermectin and multi-drug resistance in two field isolates of *Teladorsagia circumcincta* from Irish sheep flocks' *Veterinary Parasitology Regional Studies and Reports* 1-2: 3-9.

Keane, O.M., Keegan, J.D., Good, B., De Waal, T., Fanning, J., Gottstein, M., Casey, M., Hurley, C. and Sheehan, M. (2014) 'High level of treatment failure with commonly used anthelmintics on Irish sheep farms' *Irish Veterinary Journal* 67(1):16.

Keegan, J.D. (2016) 'Anthelmintic resistance in gastrointestinal nematodes of sheep: Molecular characterisation and management' *Ph.D. Thesis (UCD)*.

7. Compiled by: Dr Orla Keane