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Knowledge Based Strategies for Roundworm Control

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Summary

- Plan a strategic worming programme with your veterinary practitioner that will reduce unnecessary treatments. Where possible avoid frequent drenching with anthelmintic by integration with grazing management to provide some 'low-risk' pastures.

- Use parasitological and performance monitoring to gather data which will enable you to set performance targets for your lambs.

- Undertake a post drench efficacy check to determine whether the class of anthelmintic/wormer is still effective or whether drug resistance is present.

- Treat bought-in stock and animals that been grazed off farm with drenches from both the 2-LV and 3-ML class of drugs and where possible yard for at least 24-48 hours prior to turnout.

- Turn out quarantine treated stock onto dirty pastures to ensure that any resistant survivors form only a minor proportion of the total population.

- Do not underdose stock by underestimating liveweight. Weigh a small number of representative animals and base the dosing volume on the heaviest animal in the group.

- Accurately calculate the correct dose volume and check that the dosing gun is delivering the correct volume of drench prior to use. Administer all drenches over the back of the tongue.

Introduction

Worm control and anthelmintic resistance have been a regular focus of previous Moredun newssheets (see newssheets volume 2 Number 3, volume 3 number 2 and volume 3 number 18). However, as the incidence of anthelmintic resistance continues to rise in the UK it would be prudent to revisit this subject and highlight the important role that monitoring has on developing and managing sustainable worm control.

The principal parasite species involved in parasitic gastroenteritis are:

- *Teladorsagia* (brown stomach worm formerly known as *Ostertagia*)
- *Haemonchus* (barbers pole worm)
- *Trichostrongylus* (black scour worm)
- *Nematodirus*

The level of disease caused by these worms depends on the size of the challenge faced by the sheep and their susceptibility to infection.

In 2004 a committee was established to develop strategies for parasite control in sheep and to oversee the delivery of recommendations to the industry. A summary of the main recommendations from the Sustainable Control of Parasites in Sheep (SCOPS) initiative can be found at the end of this newssheet and can also be viewed on the National Sheep Association website.

In 2005 Moredun developed a practical four point ACME message which formed the central core of the SCOPS initiative and focuses on the role of quarantine drenching, checking anthelmintic efficacy, monitoring and following best practice. Details of Moredun's ACME message are at the end of this newssheet.

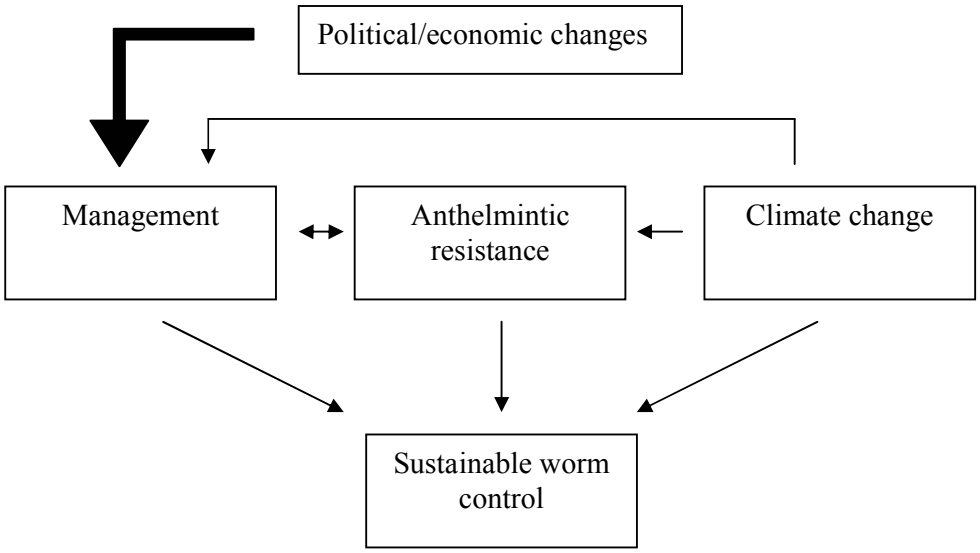
Factors Affecting Worm Control Strategies

There are a number of changes that have occurred and continue to occur on farm that make it necessary for producers to consider the subject of sustainable worm control and the important role that monitoring plays its development and management. Figure 1 on the following page outlines the important areas where changes are occurring and where an understanding of impact of those changes will affect how producers approach the development of sustainable roundworm control strategies.

Economics

The political and economic changes which directly affect farm income will always be the major drivers of change to farm management since they inevitably focus attention on minimising inputs whilst maintaining high levels of productivity.

Figure 1. Major factors that affect worm control strategies



Climate change

The last few years have seen changes in the climate which have resulted in milder winters together with warmer springs and autumns. These climatic changes have led to increased parasite numbers on pasture and thus increased the risk of roundworm disease.

Management

The UK has also seen an inexorable rise in drug resistance. Allowing resistant parasites to survive will contribute to higher pasture larval contamination. The conflict that can exist between the short and long term goals for roundworm control provides another example of the way in which farms differ and gives us another prime example of why worm control strategies need to be farm specific in order to resolve any conflict and why 'blueprint' approaches do not work .

Anthelmintic resistance

The incidence of anthelmintic resistance is rising in the UK. Surveys at Moredun have shown that 6 out of 10 farms have benzimidazole (white drench) resistance and that as many as 3 farms in 10 have macrocyclic lactone (clear drench) resistance. Several cases of multiple resistance (resistance to all three broad spectrum families) have also been recorded in sheep flocks throughout the UK.

All of the evidence suggests that once resistant worms are present on farm they can be considered permanent for all practical purposes. In 1983 Moredun Research Institute's own farm was found to have a population of worms resistant to benzimidazole (white drench). This class of drench was immediately withdrawn and the roundworm population was controlled using an annual rotation of the levamisole and macrocyclic lactone classes of anthelmintic instead. Since 1983 regular checks including a faecal egg count reduction test in 2006 have shown that benzimidazoles still don't work. These facts are highly pertinent when developing a worm control strategy and health plan.

Other diseases affecting productivity

Parasitic gastroenteritis is arguably the most important disease affecting productivity in lambs but it is important to recognise and diagnose which of the other 'ill thrift' diseases may affect the performance of lambs. Other common causes of ill thrift in weaned lambs include poor nutrition, cobalt deficiency, selenium deficiency, fascioliasis as well as other infectious diseases like lameness, sheep scab, coccidiosis, border disease and a range of respiratory diseases.

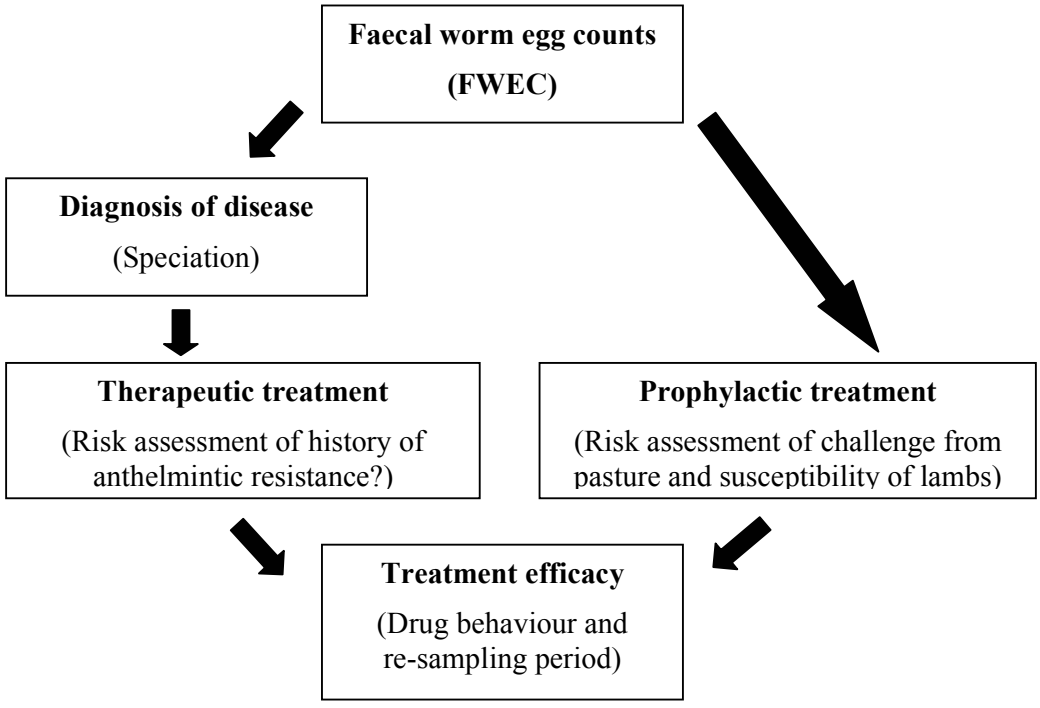
Knowledge based effective worm control

The development of effective worm control strategies capable of meeting defined targets whilst maintaining anthelmintic susceptibility is a challenging and complex task that involves integrating areas of general knowledge with farm specific knowledge acquired by monitoring. Although for some people the monitoring process starts and finishes with sample collection and its analysis the data gathered in this way on subclinical/chronic diseases like roundworm infections can only be fully exploited in developing sustainable control regimes if it is set alongside information on farm management, animal performance and defined performance and economic goals.

Why monitor?

Simple worm egg counts taken at the appropriate time from lambs can provide much more than just a number of eggs per gram of faeces which can be set against some defined threshold above which animals are treated. Figure 2 below shows the principal ways in which they can be exploited and some of the additional information which increases their value by allowing more accurate risk assessments to be made.

Figure 2. Exploiting Faecal worm egg counts



The interpretation of faecal worm egg counts (FWECs) is complex particularly since the egg counts of some parasites, such as the brown stomach worm *Teladorsagia* tend to be low and often do not reflect the size of the worm burden. For this species in particular the decision to treat based solely on egg count is difficult but the task becomes much easier if one also has information on the risk posed by the pastures that the animals are grazing, previous history of disease or anthelmintic resistance etc. The accumulation of parasitological and risk assessment data together with information on ewe performance, nutritional inputs and grazing management taken at different times within a season and over several seasons provides a true indication of the extent of threat posed by roundworms on a farm. Although this sort of monitoring comes at a cost, these costs can often be offset against the costs incurred in the short term through the inappropriate and/or ineffective use of anthelmintics.

Savings made by targeting anthelmintic treatments not only offer both an immediate economic gain but also have potential long term gains by reducing the selection pressure for the development of anthelmintic resistance.

Prophylactic treatment using Anthelmintics

At present there are only three broad spectrum anthelmintic families licensed for use in the UK. Each family or class has a different mode of action (see Table 1 below).

Table 1. Broad-spectrum wormer classes.

Class	Group names	Examples
1-BZ (white drenches)	Pro benzimidazoles Benzimidazoles	Febantel, Netobimin Albendazole, Fenbendazole
2-LV (yellow drenches)	Imidazothiazoles Tetrahydropyrimidines	Levamisole Morantel
3-ML (clear drenches)	Avermectins Milbemycins	Ivermectin, Doramectin Moxidectin

In addition to the 3 classes of broad-spectrum drugs there are drugs such as closantel with a narrow spectrum of activity against the blood-feeding roundworms and also against liver fluke. Closantel can be used to treat sheep infected with *Haemonchus* (the barbers-pole worm).

It is possible that within the next few years, the results of research by the pharmaceutical industry may bear fruit in the form of one or more new families of broad spectrum anthelmintics. If and when any new compounds do become available then, given the enormous costs of development and registration, it is imperative that everyone recognises how valuable a commodity they are and uses them sensibly.

Anthelmintic resistance

The capacity of parasites to adapt to a range of different selection pressures (e.g. anthelmintics) is well known and knowledge of the risks inherent in different control strategies is invaluable in developing sheep health plans. Recently the importance of maintaining a worm population unexposed to treatment (often referred to as a population *in refugia*) has been recognised as the most important means of maintaining the efficacy on farm of our current anthelmintics.

The genes that confer resistance occur naturally within the worm population as a whole and thus drug resistant worm populations arise through a process of selection. A variety of factors are known to influence the selection process, the key ones being the proportion of the population exposed to treatment, treatment frequency, and the use of the optimum dose rate.

Pasture Management

Periodic seasonal droughts that kill most of the worms on pasture are now recognised as making a major contribution to **t**he rapid emergence of wormer resistance in the Southern hemisphere.

If sheep are treated under these circumstances when almost all of the worm population is resident in the sheep then resistant worms that survive treatment are the major source for re-contamination of the pasture and resistance is selected very rapidly. A similar situation occurs with dose and move strategies where animals are drenched onto 'clean' grazing. If the 'clean' grazing has very few susceptible worm eggs and larvae on it then any resistant survivors of treatment in the sheep will provide the major source of recontamination. Although from a selection of resistance viewpoint dosing animals onto clean grazing carries a high risk it is still an excellent short term strategy for maintaining production. Dose and move provides another example of conflict between short and long term goals and is one where farmers and their veterinarians need to examine the potential for managing any adverse effects to minimize the risk. For example where lambs are finished using dose and move to clean grazing then it may be possible, once the lambs are finished, to manage those pastures in a way that minimizes the risk of transmission of resistant parasites.

For many years farmers have been able to maintain high levels of performance in lambs on heavily stocked permanent pasture simply through the intensive use of anthelmintics. Over time this approach has led to the steady accumulation of resistant worms within the population and eventually to resistance at a level where there is clinical failure of the drug or drugs being used. The increasing prevalence of drug resistant parasites on farms throughout the world confirms that this approach is not sustainable.

Quarantine Treatments

Although on farm selection is important, the movement of sheep containing drug resistant worm populations is also an important factor in increasing the prevalence of drug resistance. Quarantine treatments are intended to prevent the introduction of resistant roundworms with the introduction of new stock or the return of stock that has been grazed away from the main farm. The current advice given to farmers in order to minimise the risk of importing anthelmintic resistance is to treat with a macrocyclic lactone (clear drench) and a drug for a second class such as levamisole (yellow drench). These drenches should be administered sequentially not simultaneously; different drenches should never be mixed since they have different formulations and carriers which might not be compatible. If possible hold the animals off pasture (with access to feed and water) for 24-48 hours post treatment to allow the anthelmintic to work and thus minimize pasture contamination. Following this short quarantine period treated animals should be returned to contaminated pasture so that the eggs of any resistant survivors will be diluted by the susceptible population on pasture.

Checking anthelmintic efficacy

It is important that farmers know if their drugs are working effectively. Your practitioner can arrange a simple inexpensive post-drenching efficacy check in which samples are collected from animals 7-17 days after treatment. Normally 12-15 fresh faecal samples will be collected and pooled and a single egg count performed on the pooled material. If the drug is working effectively then very few worm eggs will be present in the post-treatment sample.

For testing animals treated with levamisole samples should be taken around7 days post-treatment and for those treated with a benzimidazole or a macrocyclic lactone then samples can be taken about 14 days post-treatment. The macrocyclic lactones sometimes inhibit egg laying in female worms for up to 14 days and thus it may be desirable to collect material from these sheep later around 17 days post-treatment.

Using Targeted Treatments

Targeting treatments towards those animals that are most prone to roundworm disease and/or those that are responsible for transmitting infection offers an obvious means of maintaining a population *in refugia*. The first and arguably the most successful studies in this area were conducted in South Africa on farms where multiple resistant *Haemonchus* a blood feeding parasite posed a serious problem. The first studies led to the development of FAMACHA a system that uses conjunctival colour as a marker of the anaemia that characteristically occurs with *Haemonchus* infection. Studies using this approach where only those lambs with evidence of anaemia were treated saw a marked fall off in the numbers of animals that were treated overall. Other French studies using dairy goats showed that the highest milk producers were also the animals that were most susceptible to worm infections and were responsible for the majority of the contamination on pasture. In the South African studies almost 70% of the lambs required no treatment but about 10% required 2 or more treatments.

The French studies where treatments were directed towards the older high milk producing animals saw about a one third reduction in the amount of anthelmintic whilst having no effect on the productivity of the herd. Sadly the markers used in the South African and French studies cannot be widely exploited in the UK simply because *Haemonchus* appears at least at present to be a sporadic problem and milk sheep are a comparative rarity in this country.

Researchers at Moredun were the first to identify the reduction in appetite that is a feature of infections with *Teladorsagia* (the brown stomach worm) which is the principal parasite involved in anthelmintic resistance in the UK. As any reduction in appetite and consequent change in liveweight gain occurs very early in the infection process before egg counts have raised to appreciable levels, there is potential to use these changes as markers for targeted selective treatments (TST). The development of automatic weighing and shedding systems coupled with the electronic identification of individuals provides a platform for the field testing of targeted treatment regimes.

Current studies at Moredun are examining the impact that TST has on lamb performance (using liveweight gain as an indicator) and the selection of anthelmintic resistance. Although still at an early stage the preliminary findings from these studies where the TST approach was compared to a monthly treatment regime showed a clear trade off between productivity and the selection of anthelmintic resistance. Post weaning lambs treated monthly gained about 15% more per day than those in the TST groups. However the efficacy of treatments given to the routine monthly treatment groups was lower by the end of the season (around 80% compared to over 90% in the TST group) and the TST groups were given 47% fewer treatments.

The initial results from these TST studies are reasonably encouraging and when the data is available on the genetic changes resulting from the application of targeted treatments, it should provide a model that will enable Moredun scientists to examine the most important benefits and disbenefits arising from this approach.

The Future

Although it now seems likely that we will, in the near future, have at least one other new broad spectrum drug family it is important that the knowledge that we have acquired with regard to the development and transmission of resistance are not discounted. The principals of resistance management must still be applied to any new compound including the all important monitoring procedures that are outlined in this article.

SCOPS Summary Recommendations

1. Work out a control strategy with your veterinarian or advisor
2. Use effective quarantine strategies to prevent importation of resistant worms in introduced sheep and goats.
3. Test for anthelmintic resistance on your farm.
4. Administer anthelmintics effectively.
5. Use anthelmintics only when necessary.
6. Select the appropriate anthelmintic for the task.
7. Adopt strategies to preserve susceptible worms on the farm.
8. Reduce dependence on anthelmintics.

Moredun's ACME Recommendations

Adopt a quarantine strategy to minimise the risk of importing anthelmintic resistance.

Check the efficacy of the anthelmintics you are using, using a post drench efficacy test.

Monitor flocks to decide when to treat and what parasites to treat for.

Ensure that you follow best practice advice regarding the use of anthelmintics.

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