

# Sustainable Control of Parasitic Gastroenteritis in Sheep in Scotland

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Technical Note

## SUMMARY

TN577

ISSN 0142 7695  
ISBN 1 85482 830 4  
May 2005

- **The New Message:**  
**Due to the increase in anthelmintic resistant worms new control measures are recommended**

## ACMEWORKS

- **A**dopt an effective quarantine strategy
- **C**heck that your wormers are working properly
- **M**onitor worm egg counts (wecs) regularly and investigate ill-thrifty sheep
- **E**nsure best practice in using wormers
  
- **W**ork out your control strategy with veterinary input
- **R**educe dependence on wormers
- **K**ill worms effectively when using anthelmintics
- **S**elect strategies for your farm that help preserve susceptible worms

## The problem

Anthelmintic resistance is increasing in Scotland. In other major sheep producing countries in the world, worm populations resistant to all three wormer groups : Group 1 Benzimidazoles (BZ), Group 2 Levamisole/Morantel (LM) and Group 3 Avermectins/Macrocyclic Lactones (AV) are forcing farmers away from reliance upon wormers to control parasitic gastroenteritis (PGE). The strategy above is recommended to control gutworms in sheep and reduce the risk of the development of anthelmintic (wormer) resistance (AR).

## The Parasites

In Scotland, parasitic gastroenteritis (pge) is most commonly associated with the abomasal worm *Teladorsagia (Ostertagia) circumcincta* and the gutworms *Trichostrongylus* spp and *Nematodirus battus*. In recent years global warming, bringing warmer wetter weather and a longer grazing season, appears to be changing the epidemiology of helminth diseases in Scotland. Thus, *Haemonchus contortus*, hitherto recognised as a tropical parasite is increasing in importance as a cause of anaemia and death in ewes and unseasonal autumn outbreaks of disease due to *Nematodirus battus* have been reported in lambs and trichostrongylosis in ewes in spring and early summer.

### Life Cycle

- 1) Infective larvae (L3s) are ingested with the intake of 'dirty' grass
- 2) L3s develop via L4 to adult worms (L5s). This normally takes around three weeks for most

worms and is called the prepatent period. In autumn larvae may remain dormant in the gut wall at the early L4 (eL4) stage.

- 3) Adult worms lay worm eggs which are excreted with the faeces
- 4) Worm eggs hatch on pasture to release free-living L1 and L2 stages which develop to infective larvae (L3) in faeces on the pasture
- 5) Infective larvae (L3) migrate to grass and are eaten by sheep



Fig 1: Life Cycle of the Common Abomasal and Gutworms of Sheep.

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## Effects on sheep

Commonly PGE causes reduced appetite, weight loss or poor growth rates, diarrhoea, occasionally longbone abnormalities and deaths in ewes and lambs in severe cases. This is because large numbers of gutworms may affect digestion, absorption of nutrients, fluid and electrolyte balance and protein metabolism as well as reducing immunity to other diseases. PGE may be associated with other diseases such as liver fluke disease (fasciolosis), (SAC Technical Note TN557, November 2003), coccidiosis due to infection with the protozoan *Eimeria* spp. and cobalt (vitamin B12), copper, vitamin E and selenium deficiency, which may also impair the immune system. Less commonly, but increasingly, the blood sucking stomach worm *Haemonchus contortus* may cause deaths in ewes and older lambs associated with acute anaemia.

## Spread of Disease

A large proportion of gutworms causing PGE in sheep can survive on pasture overwinter either as eggs or larvae (L3s). The eggs and larvae of these worms develop most rapidly when temperatures rise above 10°C. Milder conditions during late autumn, winter and early spring associated with global warming allow larvae to develop to the infective stage during the greater part of the year, therefore PGE now occurs commonly throughout the year. The infective larvae (L3s) become available from a number of sources.

1. Overwintered L3s; cycled by ewes and lambs;
2. Hatching and development of over-wintered eggs;
3. Spring or periparturient rise (PPR) in nematode egg output by ewes;
4. Migration of L3s from soil.

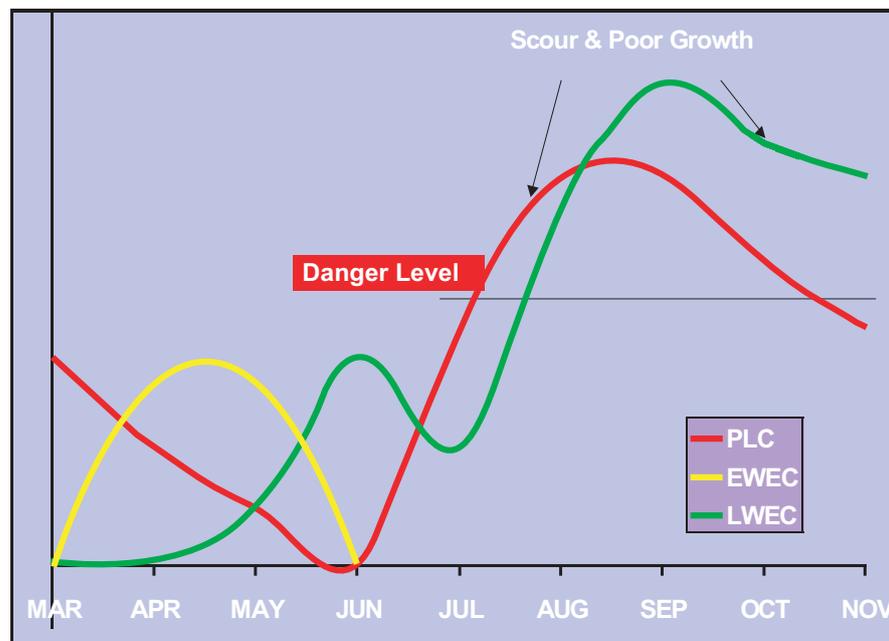


Figure 2: Spread of PGE in sheep.

EWEC= Ewe worm egg count  
LWEC= Lamb worm egg count  
PLC= Pasture Larval Count

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The “spring” or periparturient rise in ewe faecal egg output has been shown to be of major importance as an initial source of infection for lambs.

The breeding ewe is essentially resistant to re-infection at other times of the year, but a partial relaxation of immunity occurs in late pregnancy and early lactation (shown by monitoring ewe worm egg counts), which can allow the development of a substantial adult worm population.

This immunosuppression may be influenced by hormone levels and also exaggerated by nutritional/trace element deficiency especially in hill ewes in poor condition.

Overwintered L3s ingested by lambs in spring and summer develop into adults in the host animal in around three weeks (the prepatent period). On pasture hatching of eggs and development to infective L3s is relatively slow initially, but development time decreases given ideal moist warm conditions in late summer/early autumn (1-2 weeks); the so-called “concertina” effect, resulting in a rise in the number of infective larvae (L3s) in late summer/early autumn (annual peak).

The precise climatic requirements of different species vary. As a general rule *Nematodirus battus* provides the first worm challenge to young lambs in the spring with the stomach worm *Teladorsagia* (*Ostertagia*) normally providing significant pasture challenge from midsummer onwards. The other

species such as the stomach worm *Haemonchus* and the gutworms *Trichostrongylus*, *Cooperia*, *Oesophagostomum* and *Chabertia* spp. appear later in the season and through autumn and winter.

In this way as the season progresses lambs may be exposed to large numbers of L3s and if stocked heavily on a high production sward with humid microclimate, e.g. high clover content, acute parasitic gastroenteritis can occur. Lambs retained for breeding, store lambs and/or away-wintered lambs may also be at risk from gutworms causing ‘black scour’ and occasionally bone deformities, given mild conditions through the autumn and winter.

## Anthelmintics (wormers)

Wormers for sheep are generally simple to use and relatively cheap. Broad spectrum wormers kill most of the important species of worms and should give an immediate benefit. Despite the growing problem of AR, wormers are still the principal means of treatment and control of diseases caused by parasitic worms.

All broad spectrum wormers belong to one of three chemical groups. Narrow spectrum products are sometimes useful in PGE control. UK sheep wormer products are listed in Table 1 opposite.

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Table 1: UK Sheep Wormers : (After SCOPS Manual, Abbott et al 2004).

Compound	Spectrum of Activity	Active against Stomach and Gutworms	Liver Fluke	Comments
<b>Group 1</b>	<b>BZ</b>	<b>Benzimidazoles</b>	<b>White Wormers</b>	
Albendazole	Broad	Yes	Yes Adults only	Higher dose required for fluke
Fenbendazole	Broad	Yes	No	
Netobimin	Broad	Yes	Yes Adults only	Higher dose required for fluke
Mebendazole	Broad	Yes	No	
Ricobendazole	Broad	Yes	Yes Adults only	Higher dose required for fluke
Oxfendazole	Broad	Yes	No	
<b>Group 2</b>	<b>LM</b>	<b>Levamisole Morantel</b>	<b>Clear Wormers</b>	
Levamisole	Broad	Yes	No	
Morantel	Broad	Yes	No	
<b>Group 3</b>	<b>AV</b>	<b>Avermectins / Macrocyclic Lactones</b>		
Ivermectin	Broad	Yes	No	Active against some ectoparasites
Moxidectin	Broad	Yes	No	Active against some ectoparasites
Doramectin	Broad	Yes	No	Active against some ectoparasites
Cydectin	Broad	Yes	No	Active against some ectoparasites
<b>Narrow Spectrum</b>				
Closantel	<i>Haemonchus contortus</i>	No <i>H. contortus</i> only	No <i>H. contortus</i> only	Active against immature and mature <i>F. hepatica</i>
Nitroxylnil	<i>Haemonchus contortus</i>	No <i>H. contortus</i> only	No <i>H. contortus</i> only	Active against immature and mature <i>F. hepatica</i>

## Anthelmintic Resistance (AR)

In some of the major sheep producing countries worm populations are resistant to all three broad spectrum drug families. Although the situation is not as serious as yet in the UK, multiple resistance has been seen in both goats and sheep. In these situations farmers are forced away from reliance upon chemical control as the sole means of control

of worms. A survey in Scotland in 2002 showed that over 80% of lowland farms had BZ resistance, a threefold increase since the last survey nine years previously. The interim results from a small Scottish survey on avermectin resistance in 2004 suggests that around 30% of farms have worms that are resistant to this wormer group. In the next few years, the situation in Scotland is expected to deteriorate.

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The simplest definition of AR is “a heritable reduction in the sensitivity of a parasite population to the action of a drug”, which seems to be a pre-adaptive phenomenon, i.e., the genes that confer resistance already exist within the worm population as a whole.

Resistance tends to be polygenic, i.e., derived from multiple genes. Alternative copies of genes that can occupy the same locus on a chromosomal pair are called alleles. Homozygous individuals carry the same alleles e.g., SS (Susceptible) or RR (Resistant). Heterozygous individuals carry different alleles on relevant chromosomal pairs e.g., RS.

Before a drug is first used the prevalence of these resistance genes remains low and is maintained at that level until treatment. Survivors of the initial treatment which pass on their genes to their offspring gain some advantage and, for a short while at least, the only eggs passing onto pasture carry the genes for resistance. In this way there is a small increase in the prevalence of resistance genes. At any given time the relative proportions of the worm population within the animal as adults or L4s, and on the pasture as eggs and L1-L3 larvae will vary.

In Scotland, enjoying a temperate climate, large numbers of eggs and larvae can survive on pasture for many months, therefore this population tends to be relatively large and the rate at which resistance genes accumulate within the population is slow (figure 3).

There are many factors, listed below, which can influence the rate at which anthelmintic resistance can develop.

## Factors influencing the rate of development of AR

### Host/Management Factors

- Frequency of dosing
- Type of animal treated
- Underdosing
- Mode of action of individual wormers
- Seasonal/managerial factors affecting the relative number of worms on pasture and in the animal

### Parasite factors

- Adult and larval longevity
- Egg producing capacity of females
- Minimum interval between parasite generations

These factors have been taken into account in the ACME WORKS recommendations which are designed to avoid introducing resistance by quarantine measures and by using wormers more effectively and minimising their use where possible, to reduce the rate of AR development on the farm. For example, using an AV(Group 3) product against sheep scab will increase the selection pressure for resistance in gutworms. Therefore an integrated approach should be adopted to ectoparasite and endoparasite control.

For more information on ectoparasite control see SAC Technical Note TN567, January 2005.

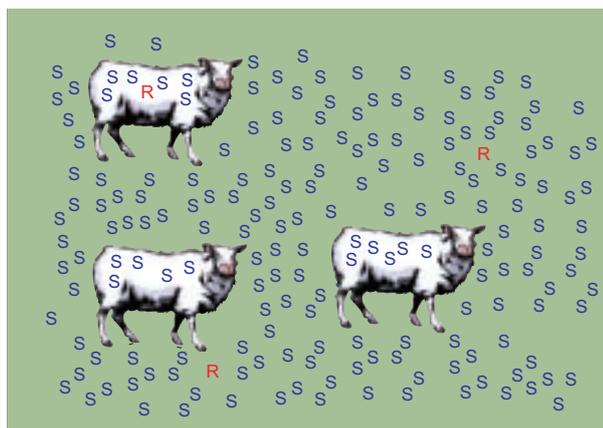


Figure 3: Large numbers of susceptible parasites on pasture – low AR selection pressure.  
S = Susceptible R = Resistant

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Frequency of dosing and underdosing influence the rate of selection of resistant worms. Suppressive treatment regimes where treatments are administered within the prepatent period of the parasite (around three weeks for many important stomach and gutworms) only allow homozygous resistant worms (RR) to survive and thus increase the rate of selection. Underdosing is also thought to increase the rate of selection by allowing heterozygote survival (RS).

It is therefore important when devising a strategy for management of AR to try to reduce the selection pressure for AR by retaining a population of worms susceptible to anthelmintic treatment and to attempt to increase the percentage of the total population on pasture.

## Nutrition and Genetic Selection of Animals

Nutrition can affect the ability of the host to cope with the consequences of parasitism and to contain and eventually to overcome parasitism. Research has also shown that resistance of sheep to roundworm infection has a genetic component and that the heritability of worm resistance in the UK is moderately high. Further information on these topics and their application in control of PGE and AR is available from SAC Beef and Sheep Select.

## Sustainable Control Strategies

ACMEWORKS for successful worm control.

### Adopt an effective quarantine policy

AR is readily spread from farm to farm through the movement of stock carrying resistant worms. For this reason it is vitally important that farmers use effective quarantine measures to minimise the risk of introducing resistant parasites onto their farms.

*Quarantine all stock brought onto the farm. Yard for at least 24 hours to reduce the risk of resistant worms contaminating pasture. Treat new arrivals with a group 2 (LM) and a group 3 (AV) product sequentially prior to mixing with the main flock*

**Turnout onto “contaminated” pasture**

### Check your wormers are working properly

Monitor PGE control and AR at least once a year by checking worm egg counts (wecs) before and after worming using post-dosing efficacy checks (PDECs) on faecal samples taken from a group of animals 7-16 days post treatment depending on the wormer used, to check on the number of eggs remaining after treatment.

*Use PDECs to determine effectiveness of wormers in use. The optimum time to check for resistance varies from 7 days post treatment (LM) to 14 days (BZ) and up to 17 days (AV).*

**SAC offers a Wormscan service for PDECs or routine monitoring on bulk faeces samples taken from groups of ten animals, to reduce costs.**

### Monitor wecs regularly and investigate ill-thrifty sheep

Monitoring the effects of helminth parasites is key to their effective control. Various laboratory and other tests can be used as above. Post mortem examinations, which can also detect other causes of ill-thrift and wecs on faeces samples are the most useful and cost-effective way of monitoring the impact of helminth diseases, reducing the cost of unnecessary dosing and controlling AR.

Blood samples may also be useful to check for other causes of ill-thrift such as trace element deficiency. Farmers should consult their veterinary surgeon or SAC Veterinary Centre for a detailed monitoring programme tailored to suit the particular farm enterprise.

*Investigate deaths and ill-thrift by post mortem examinations and blood tests*

*Check wecs before dosing to prevent overuse of wormers*

*Check wecs regularly to indicate pasture contamination*

*Worm egg counts of individuals or bulk samples can be used to provide treatment timings and check for AR.*

*Check for fluke eggs regularly (FECs) on wet pasture*

*Monitor abattoir returns regularly to estimate fluke control*

**Remember Wormscan.**

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## Ensure best practice in using wormers

Follow manufacturers' advice on the use of wormers and always check that the drenching gun is working effectively. Be aware of the risks associated with drenching animals onto "clean" grazing and underdosing. Narrow spectrum treatments should be used whenever possible to avoid unnecessary exposure to a wormer, increasing selection pressure for AR, e.g., the use of combination fluke and worm products should be avoided when fluke is the primary target.

*Important to dose animals based on weight; some animals should be weighed  
Dose rate should be based on heaviest animal in the group.*

### Check dosing gun

*Ensure dosing technique is correct  
Enhance the efficacy of resistance selected drugs by restricting feed intake prior to treatment, under veterinary advice, or by giving a split dose.*

## Work out control strategy with veterinary input

*Worm control is complex. Discuss it with your vet as part of your veterinary health plan.*

## Reduce dependence on anthelmintics

*Worm egg count monitoring for PGE and liver fluke has an important part to play in working out when and which sheep to worm.*

## Kill worms effectively when using wormers

### Ewes

*Ensure adequate nutrition of ewes particularly dietary protein for ewes bearing multiples  
Minimise the number of treatments given to livestock particularly ewes. Fit adult ewes may not need a roundworm treatment pre-tupping – CHECK wecs*

***Ewes do not always need to be treated in the pre-lambing period, leave 1 in 5 fit ewes untreated in each group.***

*Be aware that treatment for scab with an injectable AV product may increase the risk of wormer resistance*

***Remember Wormscan.***

### Lambs

*On permanent sheep pasture treat lambs for Nematodirus disease (May/June depending on forecast)*

*White Drenches (Group 1 : BZ) can be used for Nematodirus treatment(s) as currently there is no evidence of resistance*

*Treatment for stomach and gutworms should be determined by wec monitoring. It is unlikely that lambs under 6-8 weeks of age will require treatment.*

*Extend dosing interval whenever possible  
Infections of gutworms may continue into the winter months ("black scours") so monitoring should continue and treatment given as required.*

***Remember Wormscan.***

## Select strategies for your farm that help preserve susceptible worms

Seek a balance between effective worm control and reduction in selection for resistance. Aim to maintain a worm population susceptible to wormers by reducing treatment frequency or by only treating the most susceptible individuals in a flock.

*Dose ewes and lambs **after** moving to 'clean' grazing if possible*

*Be aware that although there may be production benefits associated with moving sheep to "clean" grazing after dosing, this practice may also carry an increased risk of selecting for AR.*

## Further advice on worm control is available from SAC Veterinary Centres

Aberdeen	01224 711177
Ayr	01292 520318
Dumfries	01387 267260
Edinburgh	0131 535 3130
Inverness	01463 243030
Perth	01738 629167
St Boswells	01835 822456
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Acknowledgements:

Helminth Group Scotland

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Dr J S Gilleard, University of Glasgow Veterinary School

N D Sargison, Royal (Dick) School of Veterinary Studies, Edinburgh

Dr J Vipond, SAC Sheep Specialist

Dr J Houdijk, SAC Research Scientist

**SAC receives funding from the Scottish Executive Environment and  
Rural Affairs Department (SEERAD)**