Sustainable control of worms in sheep

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Sustainable worm control in sheep

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Sustainable **C**ontrol of **P**arasites in **S**heep

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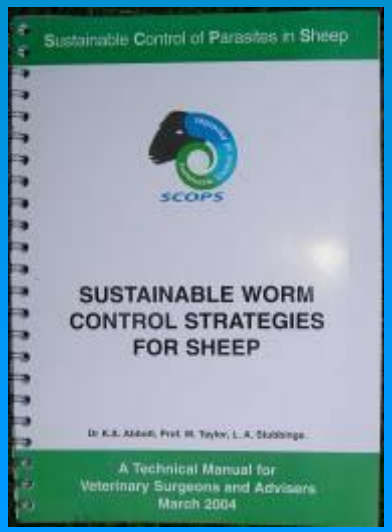

This 42 page manual is available free from www.nationalsheep.org.uk

Sustainable worm control in sheep

SCOPS is an industry-wide initiative including representation from

NSA (Chair)
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Sustainable worm control in sheep

The SCOPS terms of reference are :

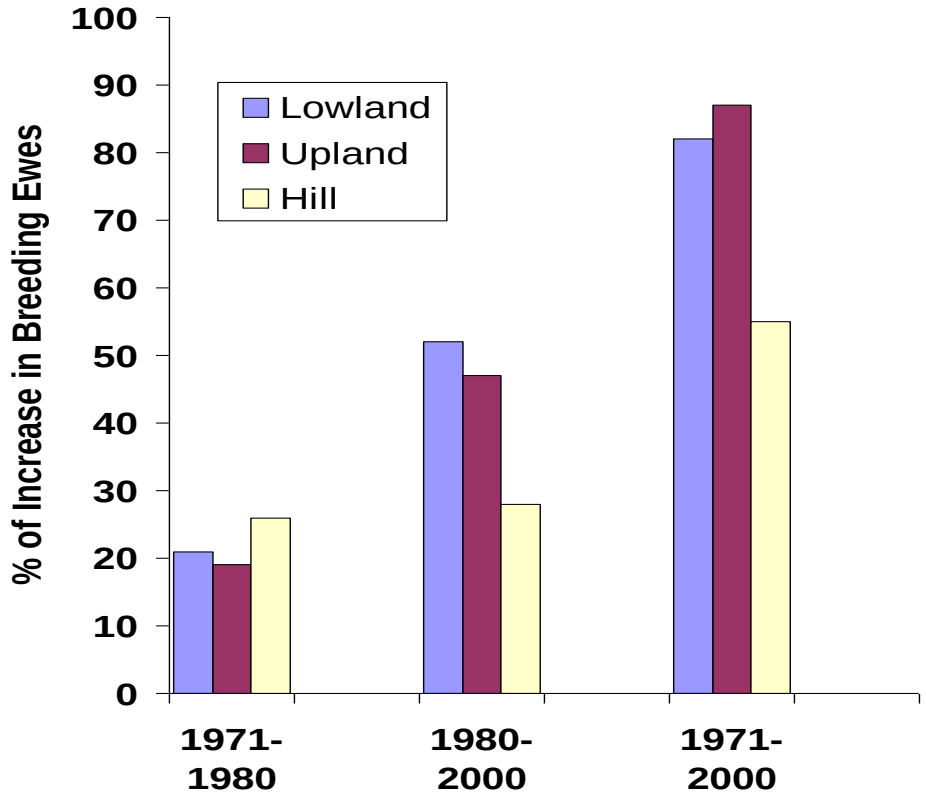
- To advise and disseminate new recommendations on sustainable parasite control to the sheep industry, initially concentrating on internal parasites
- To provide a forum for feedback from the sheep and animal health industries, veterinary profession and allied groups
- To consider new developments, feedback and information and revise the recommendations accordingly
- To facilitate mechanisms to inform all stakeholders in the sheep industry. Ensure that the messages have consistency and clarity.

Introduction

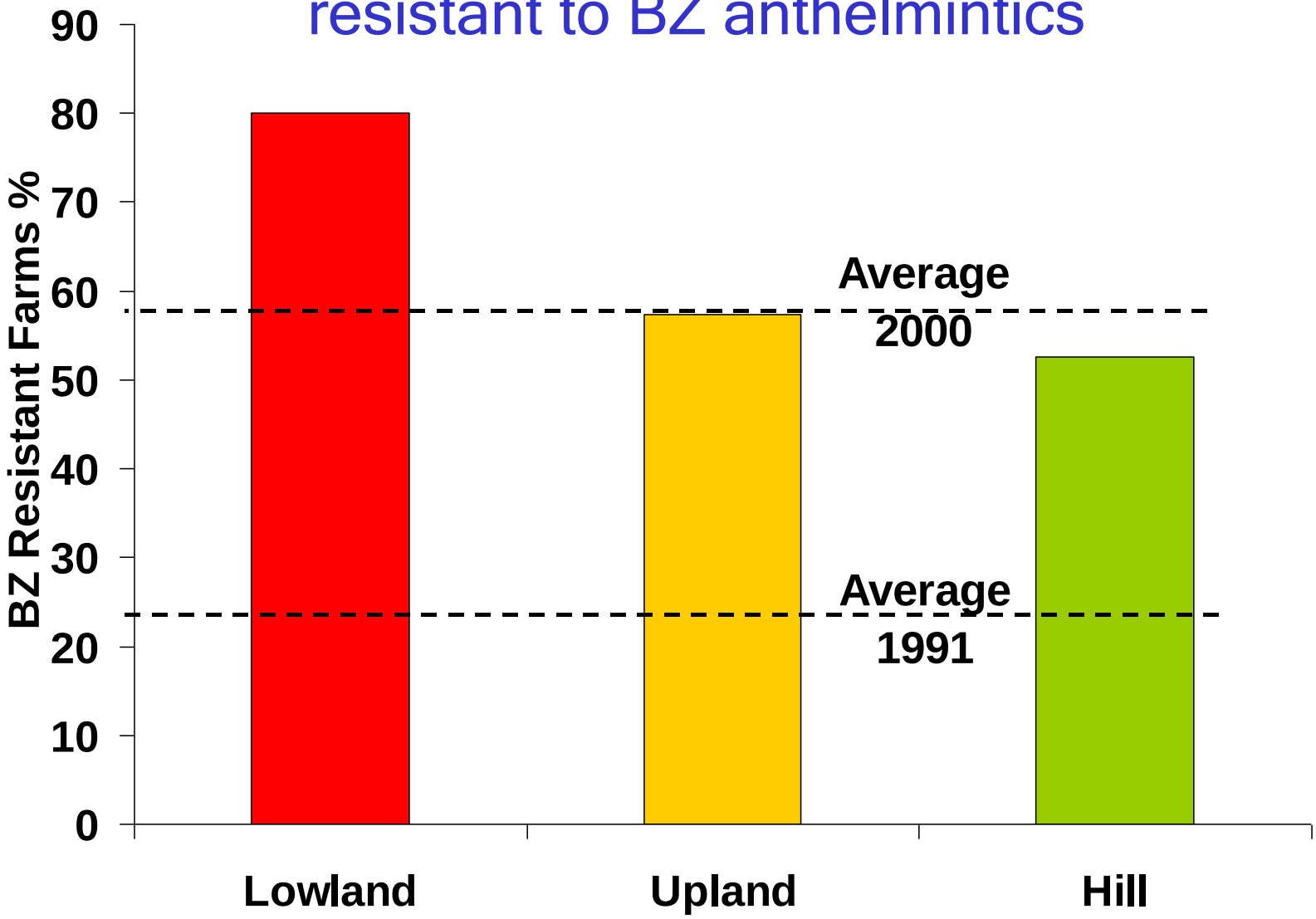
Over the past 20-30 years :

1. dependence on anthelmintic use has increased
2. anthelmintic resistance has emerged as a problem worldwide and, latterly, in the UK
3. parasite epidemiology has changed
4. there is new understanding of AR and its control
5. some of the strategies which have been recommended for worm control select for AR

The increase in ewe numbers by sector 1971 to 2000



The prevalence of farms with worms resistant to BZ anthelmintics



Data from Moredun Research Institute

The parasites

The major worm parasites of sheep in the UK include

- Gastrointestinal nematodes
- The trematode *Fasciola hepatica*
- The lung worms

The parasites

- This presentation is concerned with the gastrointestinal nematodes, and not the lungworms,

- and brief mention is made of *Fasciola hepatica.*

Anthelmintics

Broad-spectrum anthelmintics fall into three main classes:

- BZ
  - benzimidazoles
- LM
  - levamisole and morantel
- ML
  - macrocyclic lactones

What is anthelmintic resistance (AR)?

AR exists if

- the parasite can tolerate anthelmintic doses which are normally lethal
- the ability to do so is heritable

How is resistance measured?

- faecal egg count reduction trials (FECRT)
  - resistance is declared if dosing does not reduce FEC by at least 95%
  - anthelmintics may ‘appear’ to be still working even if reduction in FEC is only 60% to 80%
- resistance is also measured in laboratory-based larval development assays

How does resistance appear?

- resistance alleles pre-exist in most worm populations even before anthelmintics are ever used
- then, when the anthelmintic is used, the very few worms with resistance alleles are favoured
- resistance develops slowly at first, then more rapidly as allele frequency increases

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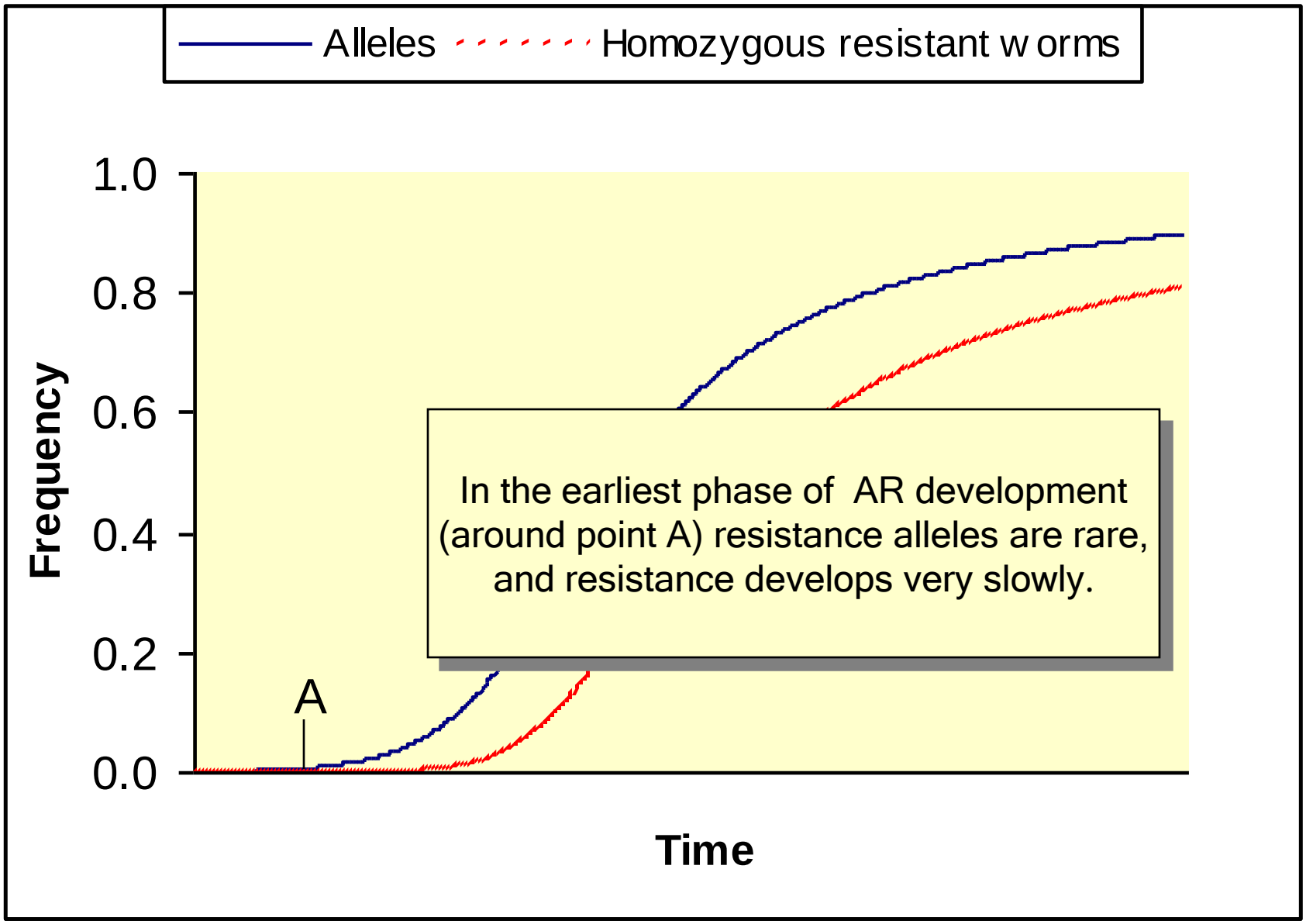
Frequency of resistance alleles and homozygous resistant worms in a worm population developing anthelmintic resistance



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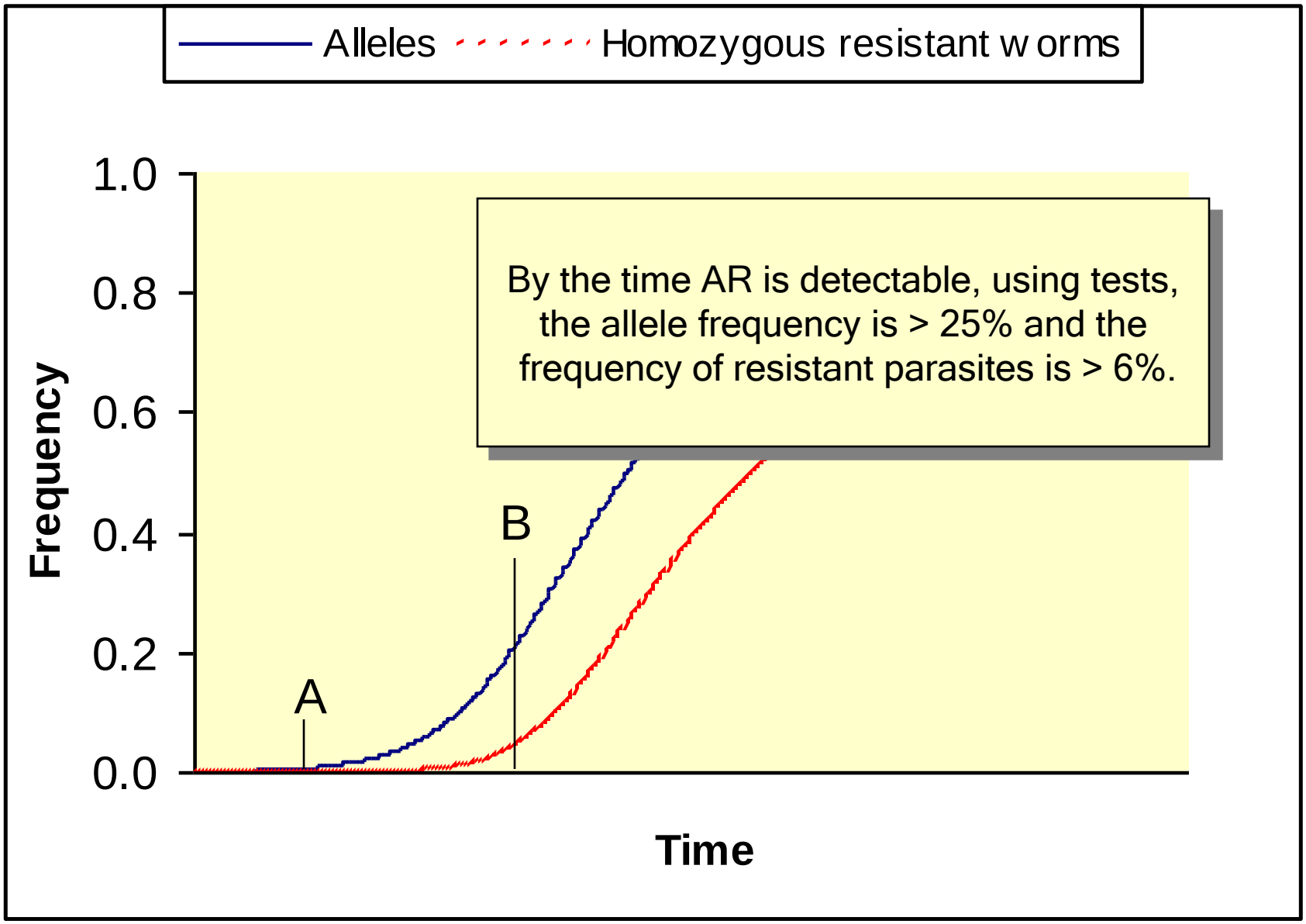

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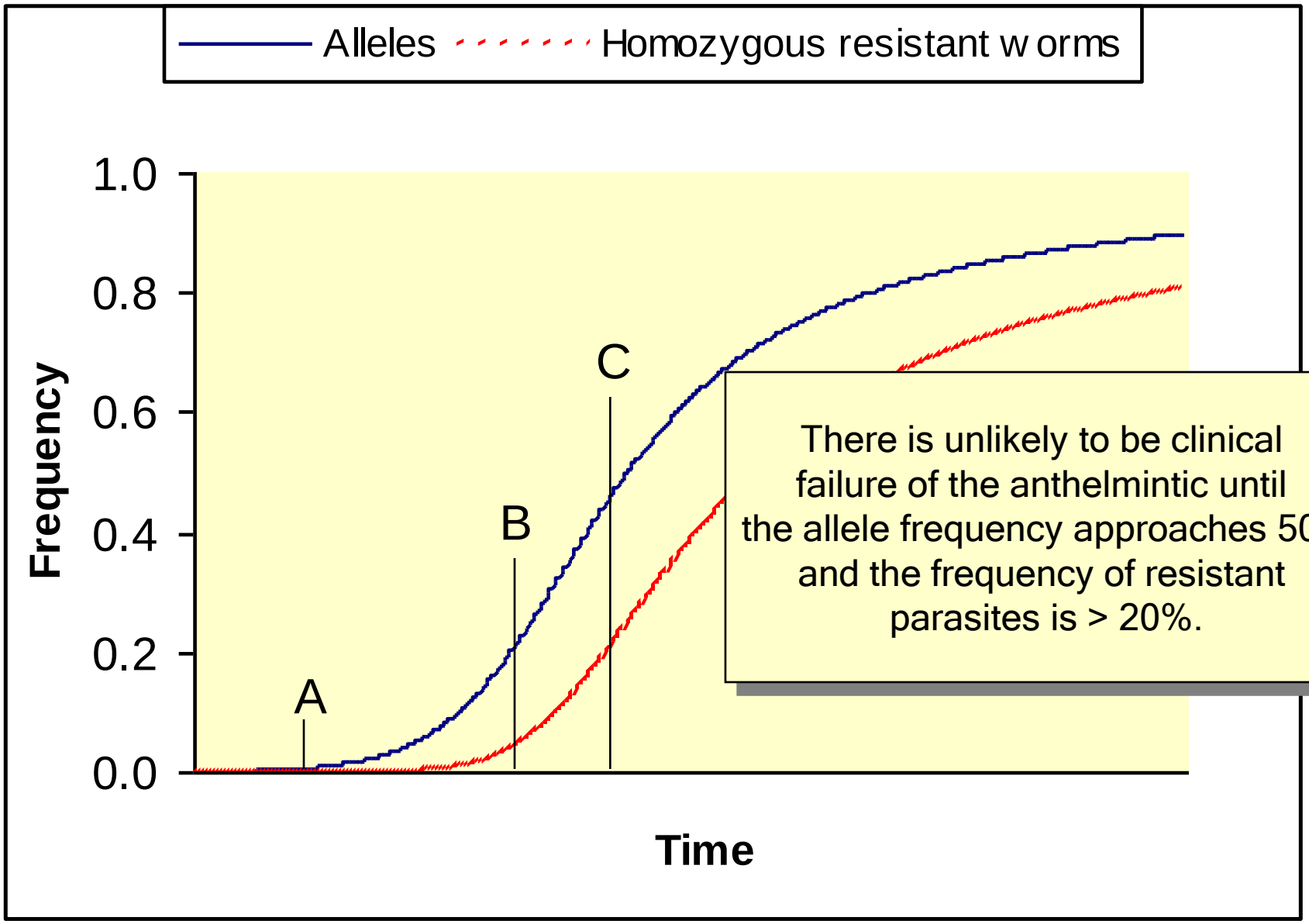
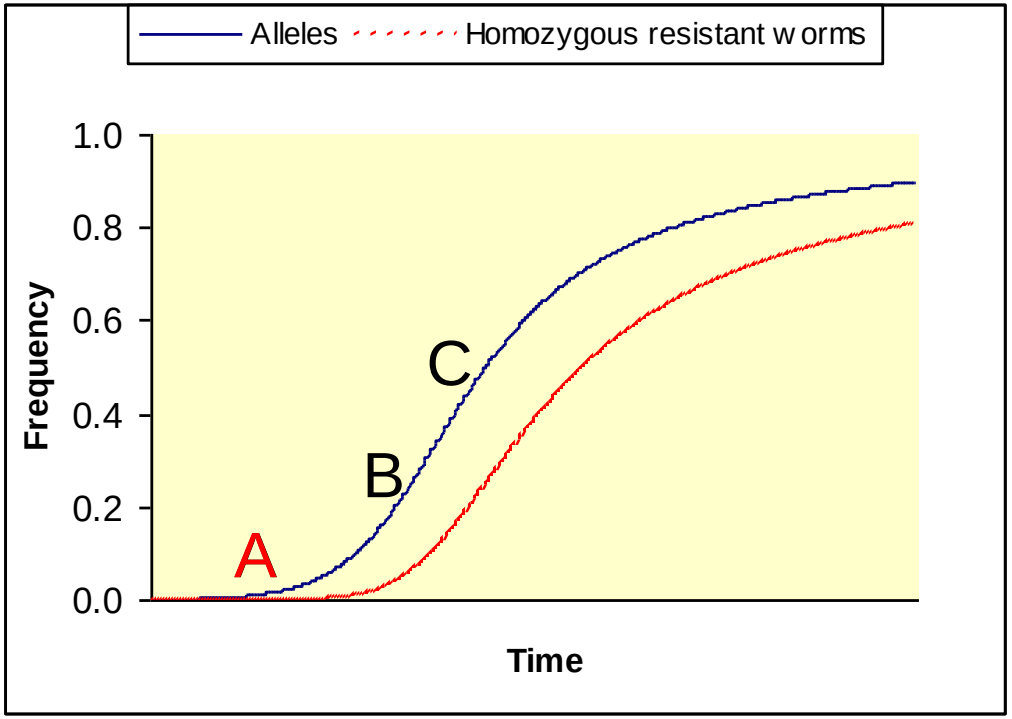


Will resistance go away if the farmer stops using the anthelmintic?

- the short answer is ‘No!’
  - once resistance to an anthelmintic emerges, reversion to susceptibility is unlikely to occur

Reversion to susceptibility

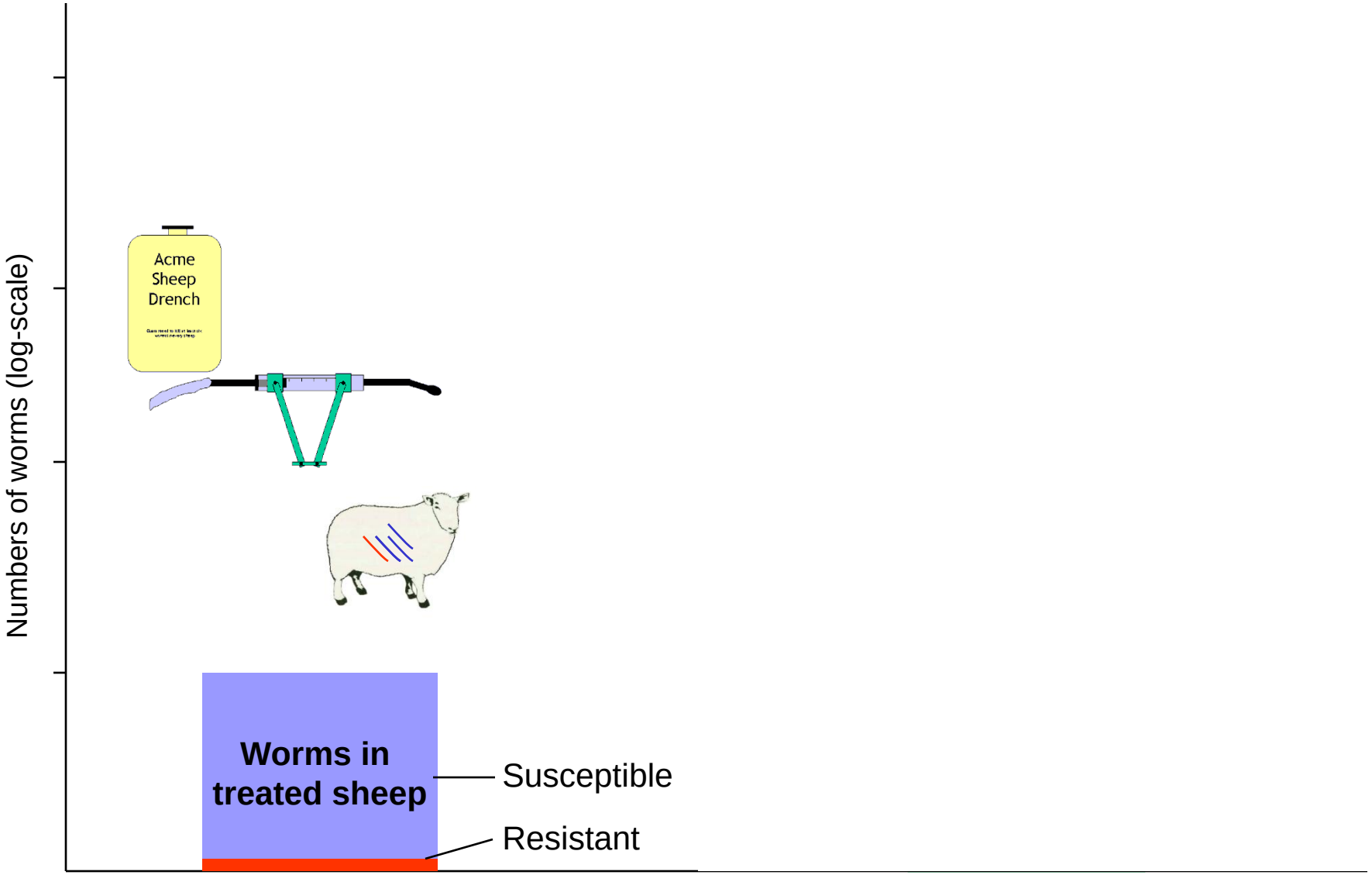
- Resistant alleles make worms less fit to survive in the absence of anthelmintic
- So, in theory, reversion to susceptibility should occur when the anthelmintic is not used
- Possibly, this happens in zone A
- It appears, however, that once AR is in zone B, co-adaptation to survival means that resistant parasites are equally fit for survival as susceptible ones.



What factors influence the rate of AR development?

1. The relative size of the *in-refugia* population.
2. Frequency of treatment
3. Rate of re-infection after dosing
4. Dose rates

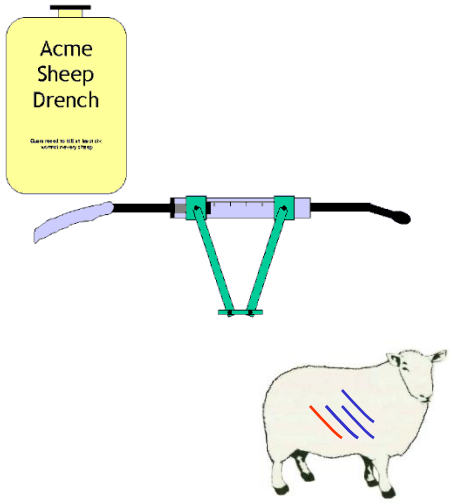
Exposed population



Exposed population

In-refugia population

Numbers of worms (log-scale)



Worms in treated sheep

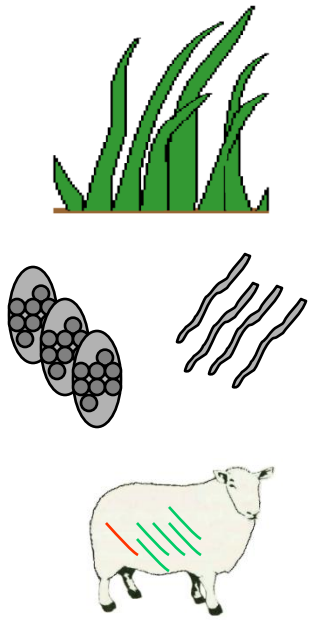
Susceptible

Resistant

Eggs
L1
L2
L3
on pasture,

and

worms in untreated sheep



Susceptible

Resistant

Factors influencing the rate of AR development

1. The relative size of the *in-refugia* population

- The larger the *in-refugia* population, relative to the exposed population, the slower AR will develop.
- When an entire group of sheep is treated prior to a move to a low-contamination pasture, the in-refugia population is relatively small.

What factors influence the rate of AR development?

1. The relative size of the *in-refugia* population.
2. Frequency of treatment
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4. Dose rates

Factors influencing the rate of AR development

2. Frequency of treatment

- More frequent treatment selects faster for AR
- Treatment is particularly selective when frequency approaches the pre-patent period
- Treatment gives the resistant worms a reproductive advantage over susceptible worms

What factors influence the rate of AR development?

1. The relative size of the *in-refugia* population.
2. Frequency of treatment
3. Rate of re-infection after dosing
4. Dose rates

Factors influencing the rate of AR development

3. Rate of re-infection after dosing

- After dosing, resistant parasites have a period of reproductive advantage
- The period is shorter if the sheep become quickly re-infected.
- If re-infection is delayed, resistant survivors have the advantage for longer.

Rapid re-infection after dosing

- The factors which influence re-infection rates after dosing are
  - the infectivity of the pasture
  - the susceptibility of the sheep
    - lambs >> ewes
- Dosing of immune ewes may be a significant factor selecting for AR

What factors influence the rate of AR development?

1. The relative size of the *in-refugia* population.
2. Frequency of treatment
3. Rate of re-infection after dosing
4. Dose rates

Factors influencing the rate of AR development

4. Dose rates

- Under-dosing encouraged the rapid appearance of AR to the BZ and LM anthelmintics
- Under-dosing allows heterozygous parasites to survive
- Full doses should kill all but homozygous-resistant parasites

What can be done to delay AR?

1. Rotations of anthelmintics
2. Combinations of anthelmintics
3. Prevent the entry of resistant worms onto farms from other farms.

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The new guidelines

- An 8 step strategy
- Many of the recommended steps are unchanged from previous guidelines
- There are some key new recommendations, as a result of research and experience in UK and other countries
- Importance of involving expert advice is emphasised

The new guidelines for anthelmintic use and worm control

1. Work out a control strategy with your veterinarian or advisor.
2. Use effective quarantine strategies to prevent the importation of resistant worms in introduced sheep and goats
3. Test for AR 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

1. Work out a control strategy with your veterinarian or advisor.

- The need for specialist consultation is greater now than before.

- Decisions about judicious use of anthelmintics in worm control programs are complex, and will require on-going consultations

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2. Use effective quarantine strategies

- Introduction of resistance alleles is considered a major cause of AR in UK flocks.

- The recommended strategy involves three steps:

2. Use effective quarantine strategies

- Step 1
  - Treat all introduced sheep and goats with levamisole plus an ML
  - Do not mix, dose sequentially
  - Give full doses of each drug

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2. Use effective quarantine strategies

- Step 2
  - After treatment, hold animals off pasture for 24-48 hours, to empty out any worm eggs
  - Supply feed and water during that time
  - Collect faeces passed during that time
    - do not apply to pastures
    - consider incineration, for example

2. Use effective quarantine strategies

- Step 3
  - Then place sheep on contaminated pastures
    - to allow dilution of eggs from any surviving worm parasites
    - to encourage rapid re-infection with worms endemic to the farm.

3. Test for AR on your farm

- Sheep farmers must be strongly encouraged to test for AR
- A knowledge of each drug's efficacy is fundamental
- Without this knowledge
  - adequate worm control may not occur
  - sensible drug rotations cannot be planned

4. Administer anthelmintics effectively

- Dose for the heaviest in the group
- Check the gun is working satisfactorily
- Administer the drug correctly

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5. Use anthelmintics only when necessary

- Carefully evaluate the need to dose ewes at tupping

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- If dosing ewes at turn-out
  - use highly efficacious treatments
  - leave some ewes untreated
  - treat well before the end of PPRI

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- Carefully evaluate the need to dose ewes at tupping
- If dosing ewes at turn-out
  - use highly efficacious treatments
  - leave some ewes untreated
  - treat well before the end of PPRI
- Use FEC monitoring to assist decision-making

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6. Select the appropriate anthelmintic

- Use narrow-spectrum drugs when possible
  - *eg*, closantel for *Haemonchus*
- Avoid off-target use
  - particularly in fluke-nematode combinations
- Rotate anthelmintics when appropriate
  - do not let rotation choice over-rule decisions about quarantine treatment, or narrow-spectrum drugs
- Consider risks & advantages of persistency of some anthelmintics

7. Preserve susceptible worms on the farm

- The dose-and-move strategy has been identified as potentially selective for AR
  - part-flock treatment is expected to reduce selection
    - leave 10% untreated (5% to 20%)
    - use highly efficacious treatments (>99% efficacy)
  - delay the ‘move’ after the ‘dose’

8. Reduce dependence on anthelmintics

- Use grazing management, rather than anthelmintics, to provide ‘safe’ grazing

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- Use grazing management, rather than anthelmintics, to provide ‘safe’ grazing
- Use rams selected for low FEC to breed ewe replacements

FEC Monitoring

- Faecal egg counts (FECs) can give a useful guide to the level of parasitism in a flock of sheep
- But, there are important limitations to their use as a monitoring tool

FEC Monitoring

- Sample size
  - At least 10 animals should be sampled to estimate a group mean FEC
  - A ‘group’ is a flock of animals of the same sex, age, reproductive status and treatment history, running in the same field
  - The faeces from 10 sheep may be pooled at the laboratory - it should not be mixed before then.

FEC Monitoring

- What is a suitable group?
  - Animals that are fully-fed and in satisfactory health
    - Results are reported as eggs per gram of faeces
    - If feed intake is impaired, faecal volume is reduced, and results are impossible to interpret

FEC Monitoring

- Collection of faeces
  - Gather the group, hold quietly in one area, then gather faeces from the pasture

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- Collection of faeces
  - Gather the group, hold quietly in one area, then gather faeces from the pasture
  - Place faeces in airtight container and cool
  - Deliver to laboratory within 48 hours

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Collecting faecal samples

- Gather the group into one place in the field.
- Remove the dog, and let them stand quietly.
- For a group of 200 ewes, 3-4 minutes is sufficient. Smaller groups require more time.

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Collecting faecal samples

- Let the sheep move quietly away.
- Pick up faeces from the pasture and place in a container or small plastic bag.
- Select only warm, freshly-dropped specimens.
- Keep each specimen in a separate bag or container.

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FEC Monitoring

- Interpretation of results
  - Interpret with local knowledge
  - Remember: FECs cannot ‘detect’ burdens of immature worms
  - Consider the different relationships between worm numbers and egg numbers in
    - different worm species
    - sheep of different age and reproductive status

FEC Monitoring

- Price and availability
  - A FEC test is available from a number of laboratories and veterinary practices
    - VLA labs offer a pooled test (10 samples) for £15.60 + VAT

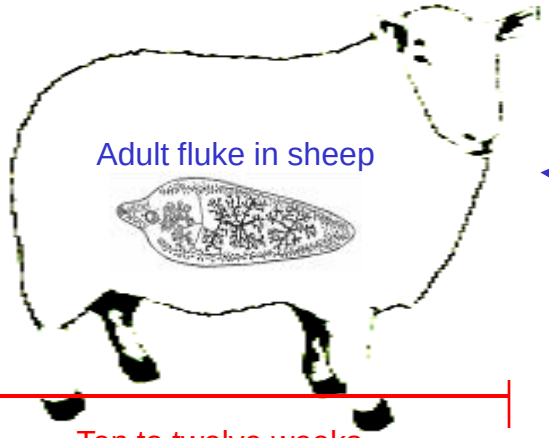
Faecal egg count reduction test (FECRT)

- FECs can be used to detect the presence of AR
  - Simple tests
    - 7 to 14 days post-treatment
    - A quick and easy test for the presence of AR
  - Formal tests
    - Set up with randomised groups, and controls
    - Calculate a percent reduction
    - < 95% reduction implies resistance

The liver fluke - *Fasciola hepatica*

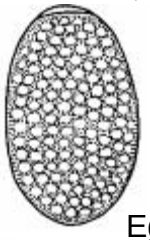
Liver fluke

- Liver fluke control is based on a number of drugs (fasciolicides) with different activities
- Resistance to some fasciolicides has developed in the UK and other countries
- Control programmes should consider the need to reduce selection pressure for resistance to these drugs
- Quarantine strategies should aim to reduce the risk of importing resistant fluke.



Adult fluke in sheep

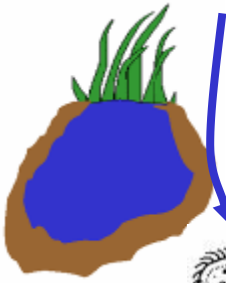
Ten to twelve weeks
before eggs produced



Egg

Ingested by sheep

Metacercaria



Five weeks to a few months, depending on temperature and moisture

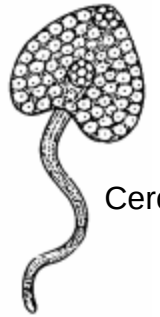
Encyst on herbage

Miracidium

Enter the snail

Sporocyst

Redia



Cercaria

Leave the snail

Multiplication up to 500 times or more in snail

Efficacy of fasciolicides available for use in sheep in the UK against susceptible fluke populations

(adapted from Fairweather and Boray, 1999).

	Age of fluke (weeks)													
Flukicide	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
Albendazole										50 - 70%		80 - 99%		
Oxyclozanide														
Nitroxynil							50 - 90%			91 - 99%				
Closantel														
Triclabendazole (TCB)		90 - 99%					99 - 99.9%							

Preventing the development of resistance to flukicides

- Rotational use of TCB, closantel or nitroxynil, where appropriate
- Consider the use of drugs other than TCB when fluke burdens are expected to be entirely or mostly of adult fluke

Quarantine treatments for liver fluke

Performed for one of three reasons

1. Farm has no snail habitat
   - treat to improve the health of the sheep

2. Farm has snail habitat, but no fluke
   - treat to prevent entry of all fluke

3. Farm has endemic fluke
   - treat to prevent entry of resistant fluke

Quarantine treatments for liver fluke

Develop a strategy after considering:

1. Resistance to TCB is still relatively uncommon in the UK
2. Treatment of TCB alone will not remove TCB-resistant fluke
3. Treatment with closantel or nitroxynil is expected to prevent the output of fluke eggs for at least 8 weeks
4. Resistance to closantel and to nitroxynil can occur.
5. Treatment with more than one product will reduce the risk of introducing fluke with resistance to any one product.
   - but the use of two products at the same time may be injurious to health

The end

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Sustainable Control of Parasites in Sheep.

See also www.nationalsheep.org.uk