Selection to increase resistance of sheep to internal parasites

SIL Technical Note

Relates to: Selection for low worm faecal egg counts
Written by: Mark Young
Date: 17 May 2006

Summary

- Resistance to internal parasites is moderately heritable (c.30%)
- Resistance incurs a small cost on metabolism, so resistant sheep may be slightly less productive and can be slightly more daggy.
- SIL offers selection indexes that work against these weak associations so that animals can be selected for that are more resistant while being more productive and less daggy.
- Genetic improvement through selection offers one of the best long-term solutions to the increasing problem of drench resistance in the internal parasites of sheep.

Background

Control measures for internal parasites, or worms, have a very significant effect on farm profit and on farm management. Susceptibility to worms leads to loss of production and to the maintenance of a large population of worm larvae on pasture that can reinfect stock later.

Many industry experts believe that the building resistance of worms to the drenches used to control them will soon lead to a very significant problem for farmers. Breeding sheep to be less susceptible to worms is one way to address this problem. Selection may be for "resistance" or "resilience" when faced with a challenge by worms.

Resistant animals mount an immune response to reduce or eliminate the population of worms in their gut. **Resilient** animals do not appear to mount any significant response and appear not to show reductions in productivity. By comparison, "**susceptible**" animals show marked decreases in productivity.

Some studies have shown that the resistance of sheep to worms has side effects. These need to be considered. Resistant animals may show slightly lower productivity and may be slightly more daggy when faced with a worm challenge. However, when not challenged we wouldn't expect to see these effects.

These associations with resistance are not strong and so it is possible to select for resistance without compromising production, and without increasing dagginess. In order to achieve this we need to consider all these traits when making selection decisions.

Resistance *versus* resilience

Some people advocate selection to increase resistance while others argue for resilience. The two traits are not so different under a selection system designed to improve productivity while reducing parasite loads and reducing traits such as dagginess. Other SIL Technical Notes discuss these issues in more detail.

SIL considers that in the context of sheep breeding, there are more similarities than differences between resistance and resilience.

Definition of resistance

In practice, resistance to internal parasites is measured as low faecal egg counts (FEC). Lower FEC is associated with animals mounting a challenge to the worm population in their gut and this challenge can reduce both the number of worms and the amount of eggs they produce.

As part of resistance, sheep mount an immunological response to the worm infection. This can be measured by assessing levels of an antibody in the blood of sheep that have been challenged. However, it is less well related to resistance than FEC.

FEC is the on-farm measure most commonly used by SIL breeders to predict genetic merit for resistance to worms.

Genetics of resistance

Resistance (FEC) is moderately heritable (25-30%). It is more heritable if two measurements are made at different times. This is because taking an extra measurement helps when it is not always possible to collect representative faecal samples from each sheep.

There are unfavourable, but weak, associations between resistance and production traits, and between resistance and dag score. Under a worm challenge, more resistance sheep can produce slightly less and be slightly more daggy. Fortunately there is a favourable correlation between dag score and production traits – more productive sheep have lower dag scores.

Unfavourable associations do not mean resistance is an unrealistic selection objective. Far from it. Since these associations are not strong it is quite reasonable to expect that we can simultaneously improve these traits through selection. The unfavourable associations just mean progress will be a little slower.

Measuring resistance as FEC

SIL uses the WormFEC protocol for assessing FEC as part of a breeding programme. Developed by AgResearch, information collected on farm following this protocol is used by SIL to produce estimates of genetic merit for resistance, the breeding values for FEC.

The genetic evaluation module used by SIL assumes FEC information has been collected under particular conditions. Details of this can be obtained from AgResearch (see contacts below). Briefly, this involves –

- Drenching lambs at weaning
- Collecting a faecal sample after a summer challenge of 6-8 weeks (FEC1 measurement), followed by a second drench
- Collecting a faecal sample after an autumn of 6-8 weeks challenge (FEC2 measurement).
- Sometimes a 2nd sample is collected a few days after FEC1 instead of a FEC2 collection. This is known as FEC1B. It is desirable to have a second sample measured later, but a compromise can be made to ensure a second sample is collected. Bear in mind that it is important to have repeat measurements on each animal.
- There is the option of taking a blood sample at 7-9 months of age and measuring the level of worm antibody. This method can reduce work and cost but genetic progress will be slower because it is less well related to resistance than two FEC measurements.

Animals need to be challenged. In some situations (e.g. dry seasons) the challenge period may need to be extended, to obtain higher average egg counts from which we can see variation

between animals. The period of challenge can be extended until the average FEC reaches around 800 eggs per gram (it is not recommended to collect faecal samples if the mob average is below 500 eggs per gram). Call SIL or AgResearch for advice relevant to your situation.

Faecal samples are sent to a laboratory accredited to produce WormFEC results. It is important that results are obtained following a standard method, and expressed in a standard way, so that the information derived is compatible with the SIL genetic evaluation module.

Worm eggs are counted as Nemotadirus (NEM) or "other" (FEC). This is because only Nemotadirus eggs are easily distinguishable from other worm species.

Contemporary groups – Animals may have had different drenching histories, or exposure to a parasite challenge. Where this can be identified as a mob effect, FEC samples or data should be recorded as being from such different management groups. This is to ensure that variation between mobs due to management does not bias or estimates of genetic merit for resistance.

The SIL genetic evaluation of resistance

SIL uses FEC and NEM data as well as information on body weight (WWT and autumn LW) and fleece weight (FW12) to predict resistance.

SIL evaluations will be most accurate if two samples are collected per animal, and if there are good numbers of animals tested. It is best to have 25-30 animals measured per sire family.

Breeding values are produced for FEC1, FEC2 and adult FEC (AFEC). The units of the breeding value are in percentage terms relative to the average FEC for that flock. For example, a figure of -20% says the animal has a FEC BV 20% below the flock average in the base year. Conversely, +45% shows an animal has a FEC BV that is 45% above the flock average in the base year. SIL uses a base year, when the average animal is 0%, to allow progress to be assessed. As gains in resistance accumulate, fewer animals will have positive breeding values or negative FEC sub-indexes.

Reporting on Resistance

SIL recommends using overall indexes (e.g. DPO or TSO), incorporating estimates of genetic merit for resistance. The overall indexes can be broken down into sub-indexes, one of which is for worm resistance or FEC. In the dual purpose index this sub-index is DPF. Previously this was named DPD (disease) but the abbreviation DPD is now used for Dag Score.

Breeding values can be placed on a report. Note that with the sub-indexes, positive is better for resistance, while with FEC breeding values, negative is better.

In dual purpose sheep the sub-index for FEC (DPF) incorporates breeding values for FEC1, FEC2 and AFEC. These are estimated from the information available for that genetic analysis run. For terminal sire sheep, the sub-index for FEC (TSF) is based only on breed for their value relative to other traits in the overall index.

For animals evaluated using the WormFEC system, SIL reports show a WormFEC logo.

Need more information?

- Contact your SIL bureau, local SIL adviser or call 0800-745-435 (0800-SIL-HELP).
- Details on the WormFEC service offered by AgResearch can be obtained from Gordon Greer (03-489-3809) or Neville Amyes (07-838-5421).