Selection to reduce drench requirements of sheep

SIL Technical Note

Relates to: Using SIL to select for resistance &/or resilience to internal parasites
Written by: Mark Young
Date: 18 June 2006

Summary

- Resistance and resilience to internal parasites are heritable traits. Resistance is more heritable.
- A proven method exists to select for resistance based on faecal egg counts (FEC)
- Work is continuing to develop a practical method for measuring resilience
- There are slight antagonisms for faecal egg counts (FEC) with production traits and with dag score. However, dag score and production traits are favourably related.
- Selection to genetically improve sheep by reducing their drench requirements MUST be undertaken in combination with selection to improve production traits
- A simple approach is to use an SIL selection index including the WormFEC sub-index. **This selects primarily for Resistance**
- An alternative approach is to use an SIL selection index including both the WormFec and the Dag Score sub-indexes. **This will select for both Resistance and Resilience**
- **SIL selection indexes are compatible with selection for Resistance AND for Resilience**

Background

Internal parasites (worms) are a significant cost to production. Experience of many breeders has shown that some family lines require less treatment for internal parasites than others. However, the way genetics affect an animal's susceptibility is complex and multi-factorial.

It is known that some animals mount a significant response to internal parasite infection while others do not. There are animals in each of these types that do not succumb to the infection. Animals that mount a response and reduce the level of infection are termed "resistant". Commonly, resistance is measured as low levels of faecal egg counts (FEC). There is a cost to mounting such a response which may divert resources from other productive traits.

Those that do not mount a noticeable "resistant" response, and which suffer no obvious loss of production, are termed "resilient". They may carry significant parasite loads and will be a source of contamination for other animals.

Ideally we want animals that do not put excessive effort into fighting infection, and so compromise production, but which do not carry significant parasite loads which are a source of infection for other animals i.e. we want both **resistance** and **resilience**!

Some farmers have observed that "resistant" animals carry more dags. Scientific research has shown a similar, albeit small, effect. This observation is one of the reasons some breeders think selection for resilience is better than selection for resistance. However in reality a multi-faceted approach to selection for reduced drenching requirements is a better bet than alignment with one of these two philosophies.

Many in the NZ sheep industry consider there is a looming problem of resistance by parasites to the drenches currently used to control them. Breeding sheep that require less drench will be a key part of the strategy employed to address this problem. Breeding takes time!

A review of this subject was published in 2001. Titled “Breeding sheep in New Zealand that are less reliant on anthelmintics to maintain health and productivity”, it was written by four leading scientists working in this area. A full citation is given at the end of this note.

Measuring resistance and resilience

Counting parasite eggs in faecal samples is the established method for assessing resistance. Under standard conditions for a parasite challenge, samples are collected after specified periods. Animals with lower FEC are considered to be more resistant.

Resilience is hard to measure without compromising animal productivity. It can be defined as the time from a fixed point when animals need to be drenched, under a parasite challenge. A criterion used to judge whether an animal needs to be drenched may be growth rate. When growth rate for individual animals goes below a critical threshold, they are drenched. Animals showing high growth rates for a prolonged period are said to be more resilient.

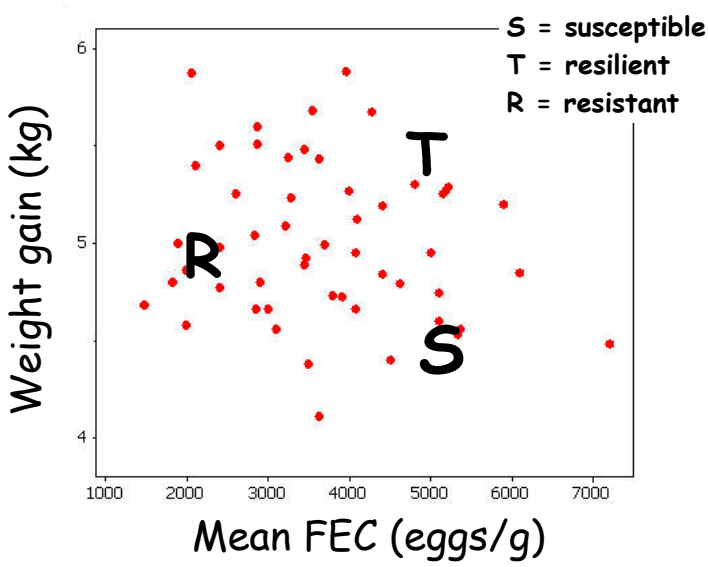
Unfortunately it is logistically intensive to collect information on resilience. Animals must be intensively monitored to check when growth rate (or some other criteria) indicates they need drenching. At present there is no easy to use, established method for use by breeders wanting to measure resilience. However, there are groups working to develop a practical method.

Genetics of resistance and resilience

Heritabilities for resistance are moderate (25-30%), higher if you use the average of two FEC measurements. Environment has little effect on rankings for resistance – so animals ranked in one environment will rank similarly in another.

Heritability for resilience is lower than resistance (5-15%). Higher values can be seen when good challenges are maintained within and across years.

There is a moderately strong genetic correlation between resistance and resilience in Merino sheep. This suggests we can select for resistance and obtain resilience. However, the relationship between resistance and resilience is less straightforward in NZ breeds. A key trial in Romney sheep found no correlation between resistance and resilience.



It is expected that there are animals that naturally have low productivity with high FEC, low productivity with low FEC, high productivity with high FEC and high productivity with low FEC (see diagram to right). Susceptible animals are in the lower right quadrant, resilient in the top right and resistant are to the left.

It is desirable to select for high productivity with low FEC (upper left quadrant in diagram) so that animal production is least affected while pasture contamination is reduced.

There is a slight, unfavourable correlation between growth and FEC. Low FEC (high resistance) can be associated with slightly lower productivity. This is argued to be due to the cost of mounting the challenge to the internal parasite infection.

Genetically low FEC is associated with higher dag score. So more resistant sheep are more daggy. However, high productivity is associated with lower dag score.

A favourable genetic correlation between resistance and reproductive rate has been observed. More resistant sheep had slightly more lambs born.

Selection for reduced FEC in young stock confers resistance on these animals later in life. So ewes will contaminate pasture less in the period post lambing, a major source of contamination for lambs.

Selection for reduced impact of parasites

MOST of the variation in animals ability to cope with parasite challenge can be explained by non-genetic "fixed effects" e.g. date of birth, birth rank, age of dam. This acts predominantly through its effect on weaning weight. So selecting animals that do well, or have lower FEC, will favour early born, singles from older ewes and is unlikely to lead to significant genetic change. It is better to use breeding values where such effects have been corrected for and where adjustments have been made to account for performance information from relatives.

Animal breeding theory has proven tools for working simultaneously with traits among which there may be some antagonisms. The selection index provides a means to optimally put pressure on the traits of interest and work against such antagonisms.

Given the NZ finding that resistance and resilience may be weakly correlated, selection for one trait may have little influence on the other. Since it is desirable to reduce pasture contamination through faecal egg production and reduce the impact of parasites on animal productivity, the best approach to the problem of internal parasites is to use index selection.

In the case of resistance, we can readily apply a selection index to select for productivity AND low FEC, despite the negative correlation between them. **Such an index will favour high productivity with low FEC**.

There is little evidence that dagginess will increase if animals are selected on an index combining information on production traits (e.g Growth, Wool & Reproduction) together with FEC under a parasite challenge. This is because while there is a small but positive correlation between dagginess and resistance (more resistance, slightly more daggy), there is a negative correlation between dagginess and productivity (more productive, slightly less daggy).

Where resilience is the prime concern, a selection index is still the preferred tool for effecting genetic improvement. Such indexes will include production traits, FEC and dag score. **Such an index will favour high productivity with low FEC and low Dag Score.**

When it becomes available, a practical Resilience test can be added to the SIL genetic evaluation and integrated into SIL index system.

Selection responses

Predicted responses to selection are estimated to be slow. It may take 20 years of selection to halve the average genetic susceptibility to internal parasites.

Marker assisted selection (MAS) could speed this up. Research is being conducted to look for genes (ideally) or closely associated genetic markers (also useful) to facilitate this based on

gene tests rather than challenge tests. MAS could be integrated into existing SIL evaluation systems to use this information optimally.

Selection strategies for specific systems

Low FEC animals survive better under challenges from internal parasites in a low drenching system BUT productivity is lower than when drenches are used to reduce the challenge.

Lower FEC early in life will lead to lower FEC later in life. Thus ewes will contaminate pasture less. This contamination is the major source of infection for your sheep.

These issues are important to consider for low input or organic systems.

Practical methods for selection

- SIL has two relevant options under "Disease" traits - WormFEC and Dag Score. These are not exclusive - selection can include both. Each has a sub-index that can be combined with those for productivity traits (eg. Growth, Wool, Meat, Reproduction, Survival) in an overall selection index. SIL has separate technical notes explaining the WormFEC and Dag Score selection in more detail.
- To select for **resistance**, WormFEC should be in the SIL selection index.
- To select for **resilience**, WormFEC **and** Dag Score should be in the SIL selection index.
- Where the WormFEC is included in the overall index, but DagScore is not, it is recommended that animals with low FEC that are daggy should not be selected.

Other reading

Easy to read

- Internal parasites of sheep and their control – now and in the future. Background information for farmers. 2006. by Clive Dalton. 40pp. Copies available from the author via website www.lifestyleblock.co.nz. Bisset, S.A.; Morris, C.A.; McEwan, J.C.; Vlassoff, A. *New Zealand Veterinary Journal* **49(6):** 236-246.

SIL indexes

- Index weightings from September 2004. August 2004. *SIL Technical Note*. Available from SIL website or your SIL bureau.

Technical

- Breeding sheep in New Zealand that are less reliant on anthelmintics to maintain health and productivity. 2001. by Bisset, S.A.; Morris, C.A.; McEwan, J.C.; Vlassoff, A. *New Zealand Veterinary Journal* **49(6):** 236-246.

Need more information?

Contact your SIL bureau or call 0800-745-435 (0800-SIL-HELP).