Resilience to internal parasites
Part 2. Protocol for measurement & genetic evaluation

SIL Technical Note

Relates to: Selection to reduce the impact of internal parasites on sheep performance
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Critical factors in the genetic evaluation of resilience

1. Consistency in challenge, measurement and recording maximise evaluation accuracy.
2. Follow the data collection protocol and record data into appropriate variables on SIL.
3. Measure 20+ progeny per sire.
4. Identify 3-5 groups varying in the time at which a worm challenge reduces growth rate.
5. Register for the service by contacting Neville Amyes at AgResearch (details at end).

Aims

Resilience in the face of a challenge from internal parasites (worms) is measured as no noticeable reduction in performance. Parasite loads are not relevant, even though some resilient animals may carry large worm burdens. The important thing is that they perform as well as animals without parasites.

Breeders contemplating selection to increase resilience to parasites should be aware that assessment of resilience requires more work than for assessing resistance to parasites.

Other issues related to reducing the impact of worms are considered in documents on the SIL website (www.sil.co.nz). This document only describes the protocol for assessing resilience.

The parasite challenge

Level of worm challenge is important. Assessment of resilience should take place under a "good" challenge. Assessing challenge objectively can be carried out by faecal egg counting a small number of animals in the challenge mob. The first resilience assessment after weaning should be when challenge animals average of 800 eggs per gram in faeces. You can test again later to monitor the worm challenge. You can do faecal egg counting on-farm. To get details telephone 0800-FECPAK (0800-332-725) or go to the FECPAK website (www.fecpak.co.nz).

Animals may be resilient at low levels of challenge but succumb to the challenge or exhibit resistance at higher levels of challenge. A long-term selection programme for resilience should aim to have consistent challenges across years and across groups (mobs) within a year.

Ideal conditions for the assessment of resilience combine high quality pasture to promote lamb growth and moderate to high levels of pasture contamination with worm larvae. Unfortunately conditions that lead to high quality pasture (rapid growth of young leafy material) are often not associated with high concentrations of infective larvae.

Assessing impact of the challenge

Measuring performance under challenge is the key to selection for resilience. The best time to do this is after weaning and the most practical criterion is liveweight gain. SIL uses a protocol developed by AgResearch through research and work with breeders around the country.

Setting a performance benchmark:

The benchmark for assessing performance is best obtained by having a small number of control animals (c.20) that are regularly drenched so that they do not carry worms that reduce performance. These animals need to be drenched every 28 days throughout the challenge period, starting at weaning. Alternatively control animals can be given an anthelmintic bolus at weaning. Both challenge animals and controls must be run together.

Growth of challenge animals is compared to average growth of the control group.

Ideally, all animals in the control group should exhibit continous and high rates of growth for the conditions. Individual animals in the control group that show a significant drop in growth for unknown reasons may need to be excluded from the calculation of average growth. If feeding conditions decline such that the controls only maintain weight or show small gains, the performance of non-resilient sheep can still be compared to them.

1. *The critical threshold:*

At each point that the impact of the challenge is assessed, animals that have grown below 80% of the average rate of the control group are deemed to have fallen below the resilience performance threshold. These animals are then drenched and their IDs recorded along with other data (see later section).

2. *Assessment time-line:*

    a. Weaning - all animals to be challenged are drenched at weaning and liveweight is recorded. This is stored on SIL as WWT together with the date of this event.

    b. It is wise to monitor the size of the parasite challenge to mob of lambs. With low levels of challenge, it is harder to identify the most resilient animals.

       This is best done by collecting faecal samples (they can be picked up off the ground) for 10 animals, a few days prior to when you plan to bring them in. Egg counts on these samples can be done on-farm, using the FECPAK kit, by your local vet or by sending them to the AgResearch WormFEC service.

       If egg counts are around 800 per gram, you can get animals in for weighing soon after the faecal samples were collected. If egg counts were a lot lower, you can delay getting animals in for a week or so, but it is wise to monitor the egg counts regularly throughout the challenge period. This may be at 5-15 day intervals, depending on the level of challenge.

       The first FEC samples should be collected 3-4 week after weaning.

    c. 28 days after weaning (or later if FEC samples have low counts), all animals are weighed. Control animals are drenched every 28 days during the challenge period.

       If few animals gain 80% or less than the controls, return animals to the paddock and carry this out again 7-14 days later. (When few animals show a drop off in growth the ability to identify better genetics for resilience is weak).

       When a group of animals gain 80% or less than the controls, draft them off, then raddle mark, drench and record their IDs. This is the first drench group. These animals are identified as DRENCH=1 on SIL together with the date this occurred. This group may be run separately or put back with the mob still under challenge. Effectively, these animals have been identified as “non-resilient” and drenched to help them overcome effects of the worm infection.

Liveweights for ALL lambs are recorded at the time DRENCH=1 group is identified. This LW can be recorded as LWD (liveweight at drenching) or LW6. SIL prefers it to be recorded as LW6 for reasons outlined later.

d. 7-14 days later, depending on severity of the parasite challenge, the challenge mob is weighed again (you do not need to weigh animals from earlier DRENCH groups). Animals that gain 80% or less than the controls are, marked, drafted off, drenched and their IDs recorded. This is the second drench group. These animals are identified as DRENCH=2 on SIL together with the date this occurred. This group may be run separately or put back with the mob still under challenge.

   There is no need to record liveweights from this event on SIL. However, these liveweights are used on-farm to assess growth over the next period.

e. 7-14 days later repeat steps outlined in (c). The DRENCH variable increments by 1 at each event when a group of animals fall below the 80% threshold.

   Repeat until 30% or less of the original challenge animals remain undrenched. Note that there MUST be some animals in this remaining group. Do not continue the challenge until no animals remain in this group.

   Typically the challenge period continues for 50-90 days from weaning time.

f. At the final event, those animals whose growth has fallen below 80% of the controls are identified as the DRENCH=n group (where n is the number of groups that have fallen below the 80% threshold over the challenge period) while those still growing above this rate must be identified as DRENCH=0 on SIL.

   Both groups can be drenched at this point as the resilience assessment is complete.

NB: Once animals have been assigned to a DRENCH group, no more data is collected from them for the assessment of resilience during the period other animals are still under challenge.

Number of animals to assess

A minimum of 20 progeny per sire should be challenged to obtain robust breeding values for resilience. Typically, all of one sex is challenged.

Variations to the method

1. Number of groups - Ideally, there should be 3-5 DRENCH groups or events of roughly equal size. If you have only 2 groups (i.e. DRENCH = 1 or 0) the power to discriminate for resilience is reduced. At the other extreme, more than 6 groups adds little to the genetic evaluation but creates more work on-farm.
2. You do not need to drench animals at weaning. It can be argued that you should, so all animals start on the same footing as some may have been exposed to greater challenges prior to this point and carry different parasite loads at the start of the challenge. Conversely it can be argued that non-resilient animals carrying a load into the trial should be identified early. However, ALL animals to be challenged must be treated in the same way at weaning i.e. either all drenched or all not drenched.

Collecting measurements for other traits

Undertaking a resilience challenge will mean you have to fit other trait measurements around this. SIL makes the following recommendations. At the time of DRENCH=1:

- Collect LW6 (an early autumn LW measurement),

- Ultrasound scan animals at the same time,
- Collect FEC1 (and FEC1B),
- Collect dag scores as DAG3 at or prior to this time.

Liveweight recorded on all lambs when the first susceptible group (DRENCH=1) are identified, should be recorded as LW6. It can be recorded as LWD (liveweight at drench) but this is not used to estimate genetic merit for growth. SIL prefers it to be recorded as LW6. This measures post-weaning growth for the challenge mob under the same management.

Genetic evaluation of resilience

Breeders need to be registered before their bureau can undertake Resilience evaluations. This is to ensure that data collected meets minimum standards. Critical variables are numbers of animals challenged, and the way data has been recorded. SIL will monitor data integrity.

Two breeding values are estimated – RGAIN BV and DRAGE BV. RGAIN is liveweight gain, under challenge, up to the point where the first group in the mob were identified as being non-resilient. DRAGE is the age when an animal is drenched to overcome the effects of a challenge on growth. For both BVs, higher values are better.

If DAG3 (dag score at 3 months or later e.g. at LW6) is recorded, it is also used to predict genetic merit. It has a negative genetic relationship with resilience (more dags=less resilient).

Reporting on Resilience

Both resilience BVs can be put on SIL reports. At present there is not a sub-index for resilience as we have no estimates for economic weights of these BVs to integrate them into standard SIL indexes.

SIL recommends using overall indexes (e.g. DPO or TSO) for other traits and adding one or both resilience BVs as indicators of genetic merit for resilience.

Appendices

Two tables are appended to summarise the sequence of events when assessing resilience on-farm (Resilience Challenge Calendar of Events) and to provide an example of the data that SIL requires for the genetic evaluation of resilience (Example of Resilience Data Recording).

Related information

See “Resilience to internal parasites: Part 1. Rationale”, a document on the SIL website (www.sil.co.nz).

Need more information?

- Contact your SIL bureau, local SIL adviser or call 0800-745-435 (0800-SIL-HELP) or email to silhelp@sheepimprovement.co.nz
- Queries related to collecting data, faecal egg counts (FEC), the genetic evaluation of resilience and registration for this service can be obtained from Neville Amyes at AgResearch (07-838-5421) or by email to neville.amyes@agresearch.co.nz

Resilience Challenge Calendar of Events

Event	Time	Action	Activity	RECORD on SIL	
				DRENCH	LW?
0	Weaning	a	Weigh & record all lambs, including CONTROL lambs	-	WWT
		b	Drench CONTROL group of lambs (about 20 animals)		
		c	OPTIONAL drench for mob about to start resilience challenge - NB: Either ALL animals in this mob are drenched or NONE are drenched		
1	28-35 days later	a	Weigh CONTROLS and work out average gain		
	see note 2 below	b	Drench CONTROL group of lambs (about 20 animals)		
	see note 2 below	d	Weigh & record ALL lambs in Resilience Challenge mob if starting drenching		LW6 see note 5
		e	Drench those that gain less than 80% of CONTROL group gain - mark this group (aerosol or raddle)		
		f	Record IDs of resilience challenge group that are drenched and code as **DRENCH (group) = 1** together with date of drench	1	
2	7-14 days later	a	Weigh CONTROLS and work out average gain		
		d	Weigh Resilience Challenge mob		
		e	Drench those that gain less than 80% of CONTROL group gain - mark this group (aerosol or raddle)		
		f	Record IDs of resilience challenge group that are drenched and code as **DRENCH (group) = 2** together with date of drench	2	
3	7-14 days later	a	Weigh CONTROLS and work out average gain		
	see note 3 below	b	Drench CONTROL group of lambs (about 20 animals) - NB: these are drenched at 28d intervals		
		d	Weigh Resilience Challenge mob		
		e	Drench those that gain less than 80% of CONTROL group gain - mark this group (aerosol or raddle)		
		f	Record IDs of resilience challenge group that are drenched and code as **DRENCH (group) = 3** together with date of drench	3	
	more weigh & drench events until less than 30% of original animals undrenched				
"n"	final event	a	Weigh CONTROLS and work out average gain		
	see note 3 below	d	Weigh Resilience Challenge mob		
		e	Drench those that gain less than 80% of CONTROL group gain - mark this group (aerosol or raddle)		
		f	Record IDs of resilience challenge group that are drenched and code as **DRENCH (group) = n** together with date of drench	"n"	
		g	Record IDs of resilience challenge group that do **NOT** require drenching and code as **DRENCH (group) = 0** together with the end date **- there must be some animals in this group.** These animals can be drenched as this is the end of the Resilience Challenge.	0	
	Autumn LW	h	Liveweight of all lambs		LW8/10
	Hogget LW	i	Liveweight of all hoggets		LW12
IMPORTANT NOTES					
1	The CONTROL group and the group under challenge should be run together on pastures known to carry adequate amounts of infective larvae.				
2	If lambs are drenched at weaning, the first assessment of LW after that should occur 28-35 days later. If no animals are below the 80% threshold, DRENCH=1 will be later still. Thereafter, weigh lambs at 7-14 day intervals, depending on severity of the parasite challenge.				
3	The challenge period should end when less than 30% of the original challenge mob remain undrenched.				
4	Once animals in the challenge group have been drenched they do not need to be run with undrenched animals in the challenge group.				
5	The LW recorded for all lambs at the DRENCH=1 event should be recorded as LW6. Autumn LW should be recorded as LW8 or LW10, well after the challenge period has ended. If the LW collected at DRENCH=1 is recorded as LWD, it will not be used in the genetic evaluation of Growth.				
6	Typically 3-6 events would be recorded. You can record only one (DRENCH = 1 or 0 for all animals under challenge) but there will be poorer discrimination for Resilience. There is little to be gained by having more than 6 events before less than 30% of animals have NOT been drenched.				

Example of Resilience Data Recording

ON-FARM RECORDING									RESILIENCE DATA TO SEND TO SIL							WHAT SIL CALCULATES	
		8-Jan		16-Feb	8-Mar	1-Apr	1-Apr						16-Feb				
Tag	date of birth	Weaning weight	Grazing Mob	LW	LW	LW	LW	drench	Flock	Id	Year Born	Mob	LW6 (or LWD)	Drench date	Drench Value	RGAIN	DRAGE
1	11-Sep-05	40.5	1	42			50	1	9999	1/05	2005	1	42	16/02/2006	1	1.5	158
2	11-Sep-05	39.5	1	41			51	1	9999	2/05	2005	1	41	16/02/2006	1	1.5	158
4	13-Sep-05	31.5	1	34	41	39	39	3	9999	4/05	2005	1	34	1/04/2006	3	2.5	200
8	13-Sep-05	37	1	39			46	1	9999	8/05	2005	1	39	16/02/2006	1	2	156
10	14-Sep-05	27.5	1	33	36		38	2	9999	10/05	2005	1	33	8/03/2006	2	5.5	175
11	14-Sep-05	39	1	45	51	**55**	55	0	9999	11/05	2005	1	45	**1/04/2006**	**0**	6	**500**
18	18-Sep-05	36	1	43	43.5		53	2	9999	18/05	2005	1	43	8/03/2006	2	7	171
19	18-Sep-05	38.5	1	40			48	1	9999	19/05	2005	1	40	16/02/2006	1	1.5	151
20	20-Sep-05	36	1	42	47	**52**	52	0	9999	20/05	2005	1	42	**1/04/2006**	**0**	6	**500**
21	21-Sep-05	38	1	47	51	49	49	3	9999	21/05	2005	1	47	1/04/2006	3	9	192
24	21-Sep-05	33	1	38	43	**48**	48	0	9999	24/05	2005	1	38	**1/04/2006**	**0**	5	**500**
26	21-Sep-05	31.5	**2**	33			37	1	9999	26/05	2005	2	33	16/02/2006	1	1.5	148
27	22-Sep-05	24	**2**	29	36	**42**	**42**	0	9999	27/05	2005	2	29	**1/04/2006**	**0**	5	**500**
33	24-Sep-05	36.5	**2**	38			41	1	9999	33/05	2005	2	38	16/02/2006	1	1.5	145
36	25-Sep-05	36	**2**	41	45	40	40	3	9999	36/05	2005	2	41	1/04/2006	3	5	188
38	25-Sep-05	37	**2**	44	50	**53**	**53**	0	9999	38/05	2005	2	44	**1/04/2006**	**0**	7	**500**
39	28-Sep-05	34	**2**	36			43	1	9999	39/05	2005	2	36	16/02/2006	1	2	141
40	28-Sep-05	32	**2**	38	39		40	2	9999	40/05	2005	2	38	8/03/2006	2	6	161
49	30-Sep-05	33	**2**	38	44	43	43	3	9999	49/05	2005	2	38	1/04/2006	3	5	183
50	30-Sep-05	32.5	**2**	38	38		40	2	9999	50/05	2005	2	38	8/03/2006	2	5.5	159

Event	Date	Recorded as
DRENCH=1	16-Feb	LW6 or LWD, DRENCH=1&date
DRENCH=2	8-Mar	DRENCH=2&date
DRENCH=3	1-Apr	DRENCH=3&date
DRENCH=0	1-Apr	DRENCH=0&date

SIL calculations	
RGAIN	SIL needs this information to calculate LW gain in first period, RGAIN
DRAGE	SIL needs this information to calculate Age at 1st drench, DRAGE
	DRAGE = **500** when **DRENCH=0**

Animals highlighted with grey background were drenched at date shown, because growth was slowing