BEST PRACTICE

IN PERFORMANCE RECORDING FOR SIL GENETIC EVALUATIONS

DRAFT DOCUMENT FOR REVIEW

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1. Why Best Practice?

Achieving genetic goals requires systems and practices that maximise accuracy of genetic data. The following best practice guidelines are to help breeders extract maximum value from the genetic evaluation of data recorded.

Genetic evaluation systems based on statistical analysis of pedigree and performance records are designed to distinguish genetic effects from known non-genetic effects. These non-genetic effects include farm, season, mob, date of birth, birth rank & age of dam. Making adjustments for such effects leads to more accurate estimates of "genetic merit" for individual traits (estimated breeding values or eBVs) and for profit (economic selection indexes).

Making fair comparisons between large groups of animals means we have to balance the additional work required to collect data for good genetic improvement with what is generally practical on-farm. An example of this is where a farmer may give lighter ewes better feed while for genetic selection it would be ideal for all ewes to have similar feeding levels.

Applying the principles of 'best practice' reduces bias in data collection and may detect recording errors close to the collection point (for example sex, tag reading double-ups). Biases also occur when we mistake environmental factors for genetic effects.

Genetic progress is faster when we work with larger groups of animals and general principles like this are described further on, together with how to collect enough data to make effective evaluations for the different performance traits.

Best Practice Principles

1. **Build genetic connectedness across flocks, years, management mobs and ewe age groups**
2. **Use accurate ID systems**
3. **Capture accurate pedigree and birth date**
4. **Manage sheep as larger mobs, use mob codes when groups are treated differently**
5. **Measure all animals**
6. **Measure all key predictor traits**
7. **Minimise data recording errors**
8. **Enter data onto SIL in a timely manner**

2. Best Practice Principles

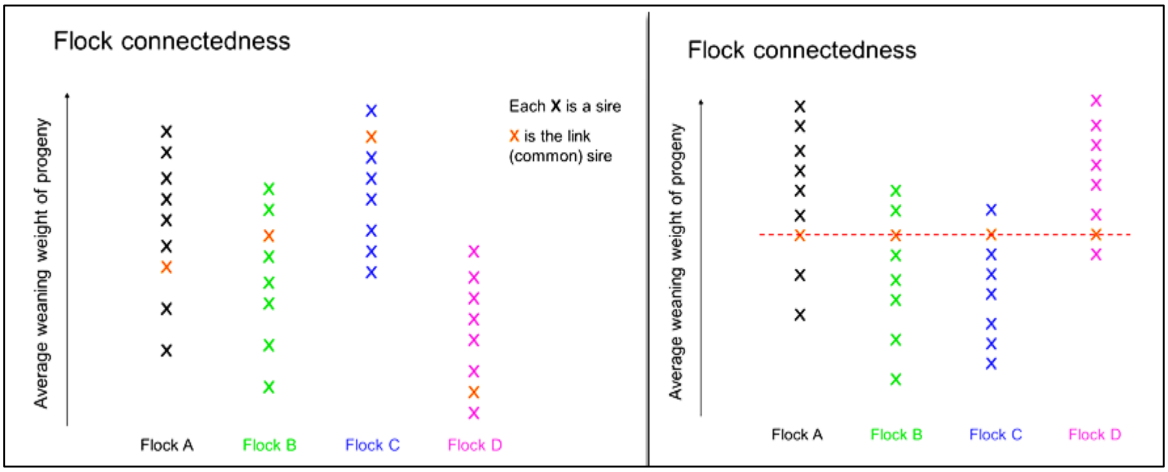
2.1 Genetic Connectedness

Non-genetic effects must be separated from genetic effects to allow accurate estimation of genetic merit. One way to do this is to use “link sires” to connect different groups of animals. It is recommended that link sires have a minimum of 25 measured progeny per group for the evaluation to make fair adjustments between groups for most traits. For low heritability traits, more progeny records would be desirable but may not be practical.

Across Flocks

In its simplest form, the best way to remove non-genetic differences between flocks is to have some animals in each flock with the same sire in the same year (a “link sire”). The link sire provides us with a benchmark to compare performance of animals and to account for non-genetic differences between flocks (location, climate, feeding).

Figure 1: Use of across flock connectedness to more fairly compare genetic merit of rams.



In the above example four flocks use common link sire (red X), which provides the benchmark for comparing the flocks (red dotted line). Progeny of homebred sires can then be ranked relative to the link sire.

SIL recommends use of 2 or more link sires each year on which the relevant traits are measured in all flocks to connect across flocks. The link sires should have 25 or more progeny measured for the traits of interest. For reproduction, retaining enough progeny to have 25 daughters with lambing records is critical.

Information on your flock connectedness, including 'traffic light' reports and 'participation and connectedness' table relating to the NZGE can be obtained from the SIL website, or by phoning 0800 SIL HELP (0800 745 435).

Consult your bureau or across flock manager for information on across flock group connectedness. Breeding groups should actively collaborate with B+LNZ Genetics to ensure their groups maintain connectedness with the rest of industry.

Across Years

To account for environmental differences between years, a link sire across years is required to account for non-genetic effects. Without a link sire, sire teams in each year cannot be validly compared.

SIL recommends use of 2 or more link sires each year on which the relevant traits are measured in all years to connect across years. The link sires should have 25 or more progeny measured for the traits of interest. For reproduction, retaining enough progeny to have 25 daughters with lambing records is critical.

Across management mobs

Progeny of link sires across management mobs are needed to correct for differences in feeding, animal health and management effects on measured performance. Lack of connectedness across mobs can result in under or over estimation of genetic merit for a trait if mobs have been treated differently.

SIL recommends spreading progeny of sires across management mobs and use of large mobs where practical,

Example: Avoid progeny of a sire being isolated from other progeny groups. A small group of ewes mated to an AI sire prior to the main mating and lambed separately and earlier than the main mob. Ensuring 25 (or more) are naturally mated to a sire that will also be used in the main mob and will be lambed with the AI ewes will provide connectedness between AI and main mob sires.

Best Practice Guide for recording management groups are discussed further on page 10.

Across Ewe Age Groups

In SIL there are generally three ewe age groups - hoggets, two-tooths, and mixed-age ewes. Younger ewes tend to have birth weights, lower reproductive performance and milking ability than older ewes. To account for this a link sire used across ewe age groups is required to enable correction for these non-genetic effects.

Table 1: A good example of across ewe age group connectedness

Year: 2016	Progeny Counts			
	Hogget	2-tooth	Mature	Total
Ram A	49	28	60	137
Ram B	27	9	74	110
Ram C	44	90	46	180
Ram D	2	78	49	129

Although RamB has only 9 progeny born to 2-tooth dams and RamD has only 2 progeny born to hogget dams, all four rams can be fairly compared as they share benchmarks with progeny born to similar age groups.

Table 2: A poor example of across ewe age group connectedness

Year: 2016	Progeny Counts			
	Hogget	2-tooth	Mature	Total
Ram E	137			137
Ram F		55	55	110
Ram G		120	60	180
Ram H			129	129

RamE is the only ram used with hoggets and he is not benchmarked with any other rams. He is "isolated". Similarly, RamH is the only used with mature ewes, but other rams are also benchmarked with mature ewes and so he can be fairly compared with RamG and RamF but not RamE.

SIL recommends use of 2 or more link sires each year on which the relevant traits are measured in all years to connect across ewe age groups. The link sires should have 25 or more progeny measured for the traits of interest in 2 or more age groups.

2.2 Use accurate ID systems

Each animal recorded in SIL must have a unique ID. The preferred and commonly used format is **flock.numerical tag/birth year (yy) -** E.g. an animal born in flock 4640 with tag number 1234 born in 2016 should be represented as **4640.1234/16**

(Note: full SIL ID also includes the birth year in full format 4640.1234/16.2016)

When an animal transfers to a new flock, a new current ID may be assigned reflecting the new flock. The format is **current flock.current tag/birth year (yy).** This does not change the birth ID information.

SIL recommends rams always be identified by their birth ID to avoid misidentification.

Use of EID

As well as visual numbers on tags, animals can be uniquely identified by their EID. There are generally two formats, one with a space after the first three digits (987 009999543210) or without the space (987009999543210) depending on which brand of recording equipment is used. SIL can accept either format but converts it to the 16-digit format with no spaces within SIL. Information can be printed in either format.

An EID can be added to an existing animal as a trait record on the animal or can be used as the primary unique ID with details of the birth flock and year.

Various tagging systems can be used where the aims are long-term retention of the tag by the animal and accurate reading by an operator. Retention is addressed by double tagging systems. Accurate reading has been greatly enhanced with the advent of electronic IDs and automated reading systems.

Methods for extra checking of IDs include use of pre-lists. This is where those animals considered to be in the mob are listed in pre-printed field notebooks or in electronic files and sent to electronic scale head units. Using these lists, animals that appear for assessment that are not on the list are flagged for checking and so a misread tag can be re-read or an error in that animal’s status can be fixed.

2.3 Capture accurate pedigree and birth date

Accurate parentage is critically important to the genetic evaluation system. The analysis places a lot of emphasis on pedigree (sire, dam and other close relatives). It has been shown that around 10% of animals have their dam, their sire or both wrong when recorded by traditional methods. The simple fact is that you cannot be present for every mating and lambing event to get 100% accuracy!

Options for recording parentage include

- **Mating records and tagging at birth**
- **Mating records, pregnancy scanning and observation of mothering of lambs (up to tailing age)**
- **DNA parentage**

Sire to sire links are of utmost importance in a genetic merit evaluation system. DNA testing of new sires can be used to verify parentage. Some breeding groups have already embraced sire paternity testing and have made it mandatory for all sires. This will lift the accuracy of their genetic evaluations and so accelerate genetic gain.

Sire paternity tests require DNA sample from the ram, the recorded sire and ideally the dam to verify the pedigree.

SIL recommends as Best Practice that flocks test for Sire Paternity of new sires.

Whole Flock DNA Parentage (e.g. Shepherd Plus)

Whole flock DNA parentage solutions rely on DNA samples being taken on all parents involved at mating. Sires in particular are vitally important, even those who are identified as backup rams that at the start of mating, that may or may not be used. Most occurrences of pedigree error are introduced at mating, not lambing.

DNA samples should be taken on all sires on entry and check that all have a DNA sample on exit of mating mobs. For majority of instances only one sample per animal is needed in its lifetime. Samples should also be taken on rogue rams that are discovered in mobs of ewes whether or not they were with the ewes for days or hours. All potential sires should be DNA sampled.

Ewes that have not been previously DNA sampled can be sampled at various times through the year but pregnancy scanning is an obvious opportunity. All lambs are DNA sampled usually at docking.

SIL recommends you consult your DNA parentage service provider for specific advice.

Birth date and fetal ageing

Knowing the birth date of a lamb is an important piece of information in a genetic merit evaluation system. Birth date is used to correct or adjust many weight and age related performance traits. Lack of an approximate birth date will result in over and under estimates of merit for early and late born lambs. For flocks that closely shepherd at lambing, birth date is relatively easy to record. When not tagging at birth, birthdate should be estimated within a 10 day period. A number of strategies can be used to refine the estimated birth date.

- **Record cycle of conception**

Use ram crayon marks and record marks or change colour weekly to identify week of conception.

- **Record fetal age**

Employ the services of a pregnancy scanner who can record fetal age (FAGE) at pregnancy scanning as well as the standard singles and multiples. Fetal age can be used to predict an estimate of the days from conception and therefore a likely birth date. This is best determined between D55 and D90 of gestation.

- **Record lambing group**

Shed un-lambed ewes away from lambed ewes when practical and update fetal age accordingly.

2.4 Manage sheep as larger mobs and use mob codes

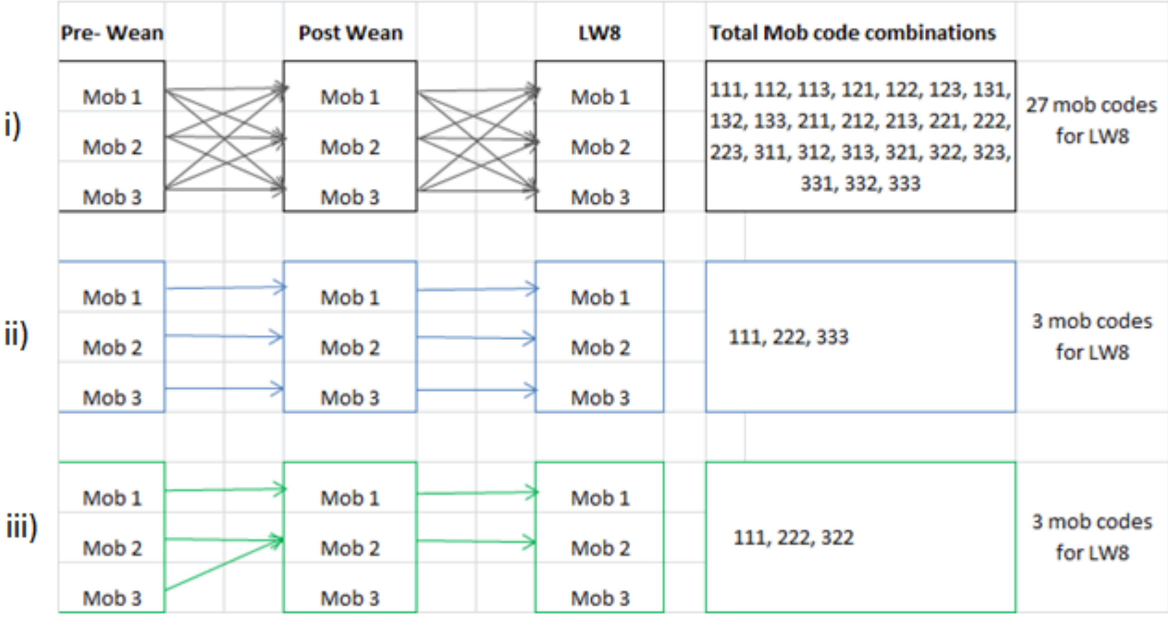
Comparisons of large numbers of animals under similar conditions are the best way of demonstrating the superiority of "better" animals. Separating some animals and running them in smaller mobs reduces the quality of genetic merit estimates as the animals are not being compared with the full range of variation that exists.

Where you need to divide and run separate mobs of animals, make sure they are coded as different mobs (e.g. mob 1 & 2 and higher) so SIL can remove the mob effect. This approach should be used when

- similar animals are run in separate mobs for a significant amount of time
- where a group of animals have been treated differently
- where a group of animals' performance are assessed by different operators.

Avoid random mixing (mobbing up) of animals at a later time. For example, if you have four mobs up to weaning and want to run just two after weaning, merge mobs 1 with 2 then 3 with 4, so that there are still 4 groups of animals that have been treated similarly. Otherwise, if you randomly mixed the animals before the creation of the two later management mobs, there would be 8 (= 4 x 2) different combinations of the early and later mobs. This would reduce the size of the groups that the evaluation system makes comparisons within.

Figure 2: Example of how management mobs accumulate from weaning to liveweight 8.



Think of this from the individual animal's perspective and imagine the animals being marked with raddle for each different management group it is placed in. The principle of the strategy for minimising the number of management groups by the time of liveweight at 8 months (LW8) is similar to thinking about minimising the amount of additional raddle marks needed to preserve the wool.

Management mob example - using Figure 2

Lambs are run prior to weaning in three different management groups (Red, Blue, Green). After weaning, lambs were drafted into three mobs with one fed lucerne (Yellow) one fed pasture (Purple) and one fed a mixture of both (Orange). Animals were kept in these mobs till liveweight at 8 months (LW8) when they were measured by three different operators (Black, Pink, Brown).

Example (i) - animals are mixed randomly so that the possible combinations for individual animals is 3 x 3 x 3 (27 different mob codes by LW8). An individual lamb would need three raddle marks (e.g. red-yellow-black) to match all the groups that individual has been in up until LW8.

Example (ii) - animals are kept in the same mob pre-weaning up to LW8. An individual would either be Red, Blue or Green and additional raddle marks are not needed.

- Red = mob one at wean, fed Lucerne post weaning and measured by operator one.
- Blue = mob two at weaning, fed pasture post weaning and measured by operator two.
- Green = mob three at weaning, fed a mix of Lucerne and pasture post weaning and measured by operator three.

Example (iii) - animals from the first wean mob that were fed Lucerne (Yellow) were kept in the same mob till LW8 was measured. Animals from the third wean mob (Green) were joined with the second wean mob (Blue) and fed pasture and kept in that mob till LW8. Again, there are only three possible combinations and no new raddle marks are needed.

- Red = mob one at wean, fed Lucerne post weaning and measured by operator one.
- Blue = mob two at weaning, fed pasture post weaning and measured by operator two.
- Green = mob three at weaning, fed a mix of pasture post weaning and measured by operator two.

> SIL recommends strategic merging of management mobs from weaning to liveweight 8. Fairer comparisons of animal performance will be achieved by avoiding random assignment of animals into mobs. Instead consider combining all animals from one mob with another or keeping animals in the same mobs all the way through where possible.

2.5 Measure all animals

It can be tempting to measure just the better animals to save time or money. However, the superiority of these animals is not shown to best effect if they are only compared to other good animals. To get the best estimates of true genetic merit you need to compare animals against a group that represents the full variation in the group.

Sometimes this is not practical or is too costly to do. Where you assess just some animals, minimise bias by including a common measurement made on all animals that is related to the measurement(s) you are making on just a few, and which is included in the genetic evaluation as a predictor trait.

For example, all ram hoggets may be ultrasound scanned and the best of these sent for CT scanning. The evaluation will use the ultrasound information on all animals to adjust the eBVs that also use the CT scan data.

To get good estimates of merit on sires requires 20-25 measured progeny. If you are not measuring all animals, then SIL advises using a representative percentage of each sire (>15%).

Weaning weight is one of the most important measurements. The presence of a wean weight is used to inform the number of animals present at weaning and account for culling and selection on later recorded traits. A weight on all live lambs at weaning is required.

2.6 Completeness of recording

SIL recommends all breeders record the key traits in the New Zealand Maternal Worth (NZMW) or New Zealand Terminal Worth (NZTW) indexes as a minimum.

Table 3: Sub indexes included in NZMW and NZTW indexes

New Zealand Maternal Worth	
Reproduction	DPR
Survival	DPS
Lamb Growth	DPG
Adult Size	DPA
Wool	DPW

New Zealand Terminal Worth	
Survival	TSS
Lamb Growth	TSG
Meat Yield	TSM

Each sub index has its own specific key traits that should be measured (e.g. wool should measure fleece weight at 12 months (FW12), meat requires an autumn ultrasound measurement of eye muscle width and depth and fat depth (EMW, EMD, FD) and an associated liveweight (LW6/8/10). Where some key traits are not recorded, the evaluation can still produce estimates of merit for a trait but with lower accuracy and with poorer discrimination from other traits. For example, NZMW includes lamb growth and adult size. If no adult liveweights are recorded, they will be predicted from early liveweights with less accuracy than if an actual measurement was recorded.

Table 4: Key traits to be measured within production sub index groups

	Reproduction	Survival	Growth	Adult Size	Meat Yield	Wool
Required		WWT	WWT	WWT	WWT	WWT
	NLB	NLB	LW6/8/10	LW6/8/10	LW 6/8/10	LW 6/8/10
				LWMATE	EMW	FW12
					EMD	
					FD	
Optional	PREGSC		LW12	LWSCAN	ViaScan	
				LWWEAN	CTSCAN	

Table 5: Key traits to be measured within health sub index groups

	Facial Eczema	WormFEC	Dag	Bareness	BCS	STAY
Required		WWT	WWT	WWT	WWT	WWT
	NLB	NLB	LW6/8/10	LW6/8/10	LW 6/8/10	LW 6/8/10
				LWMATE	EMW	FW12
					EMD	
					FD	
Optional	PREGSC		LW12	LWSCAN	ViaScan	
				LWWEAN	CTSCAN	

Some health traits have prescribed protocols that need to be followed (e.g. Facial Eczema and WormFEC) and breeders need to be registered with SIL for these traits to be evaluated. Refer to the SIL website for further instructions - www.sil.co.nz.

2.7 Minimise data recording errors

The aim should be to employ systems that facilitate error checking and allow for correction where these are detected, preferably close to the time and place the error is made. Electronic data capture will help because it eliminates manual recording of animal ID and performance. However, a full electronic system itself does not eliminate all sources of error. Animals can do things that introduce errors, such as two animals with feet on the weigh scale base plate.

Non-electronic systems can pick up a lot of errors, but require the people employing them to be vigilant and aware of possible errors or issues that need to be addressed.

Where practical, checks should be put in place for the following;

a. **Duplicate tags.** Use of pre-lists or ID files in electronic systems help eliminate these at the time of recording.
b. **Calibration of measuring equipment.** Scales can be checked prior to weighing using a known weight.
c. **Data outside reasonable limits.** Checks need to be in place for the limits expected for a mob or for performance relative to a previous performance record.
d. **Mismatch of performance with visual assessment**. Small sheep are seldom heavy - and vice versa. Animals with wide eye muscles usually have deep eye muscles.
e. **Expected animals not present.** Fates and statuses should be updated.
f. **Unexpected animals present** – was tag misread or has that animal been mistakenly fated as “not present”. Dead animals can be “resurrected”.
g. **Wrong sex** – often animal tag position indicates sex, but errors can occur at tagging. Where an animal has the wrong sex, this needs to be updated and, if necessary, the animal needs to be moved to the correct management group.
h. **Minimise or eliminate the number of times data is handled by a human**. This includes data collection, transcription to sheets for data entry by another party and data entry onto the computer.

It is worth noting that data entry is a skilled job which involves carrying out checks as part of the process. SIL helps this by providing tools to flag errors and to summarise data. These summaries can be used to detect some types of data error. The sooner a data error is detected, the easier it is to correct. In some cases, it may not be possible to identify the source of the error and so setting data to “missing” rather than supplying an unreliable data point may be the best option.

2.8 Enter data onto SIL in a timely manner

Genetic evaluations cannot benefit from data that is not available. With the national evaluation now including all flocks, data should be entered onto SIL in a timely manner so regular evaluations always have access to the latest data. Modern data capture systems make this a lot easier to achieve than previously. Best practice will see data added to SIL within 10 working days of the data being completed.

2.9 Main data types and their characteristics

a. **ID, Parentage and pedigree** – Parentage is the building block for pedigree. SIL constructs pedigree from ID information on the parentage of individuals. It also constructs some derived traits like litter size from parentage data.

b. **Fates and statuses** – These are used to record what happened to an animal at some stage of its life. It may impact on its current status (present or absent) or tell us how it was different to others e.g. progeny of AI sire, reared by a foster ewe or that it was an ET ewe. Constant vigilance with fates and statuses is needed and can be readily updated following observation in the field for animals you do not expect to see but do as well as animals expect to see but do not. Mating is a good time to update live animal status for mating pre-lists.

c. **Measurements** – These are measures of performance, usually on a continuous scale. They are usually weights, linear or area dimensions, and most often collected by a "machine" e.g. weigh scales, ultrasound or CT scanner. Test the scale weigh accuracy with known weight before starting (e.g. water filled drenched containers, tractor weights)

d. **Scores** – These are assessed by a trained operator and relate to a defined scale that is pictured or described in simple terms. Examples are body condition score (BCS) or dag score. Typically, this information is manually recorded or manually entered onto a data capture device. Scores usually exhibit some degree of operator bias. For this reason, when more than one operator is employed to collect such data, operators should be identified by different "mob codes".

e. **Counts** –This may be for low number ranges like number of lambs or higher numbers like faecal egg counts.

f. **Derived traits** – These are traits derived from other performance and pedigree data in the SIL database. For example, survival is derived from the number of lambs born per ewe and the presence/absence of a weaning weight for those lambs. Sometimes data errors in component traits are only detected when these traits are derived.

A key part of performance assessment is <u>linking ID with recorded performance</u>.

High quality data involves using routine checks for data consistency. Simple checks like maximum/ minimums, averages and the standard deviation (a measure of average variability) can pick up many errors.

3. Reproduction - Adult

3.1 Natural mating

Why

Mating is a key event. Although mating data is not directly used for genetic evaluation, it can be useful to troubleshoot for errors in assigning parentage for lambs by; (i) recording the ID of rams mated with a single sire (MRAM) or sire group (MATEGP) or; (ii) recording the mating period including ram introduction (MDATE) and removal (MGPEXIT).

When

Rams are typically introduced to ewes for 2.5 cycles (= 45 days) in the autumn.
SIL allows for ram introduction at any time of year and for any length of time, therefore specifying the mating dates and mating regime (single sire, or a group of sires) is needed.

How

When the ram(s) are introduced to the ewes, record MATEGP and MDATE for all ewes and rams. For assisting pedigree assignment, it is recommended to record the date of ram removal (MGPEXIT) at the end of mating.

Record

Multiple sire mating (required for DNA parentage)

- **MATEGP - for ewes and ram(s) when multiple sires were grouped together at mating.**
- **MDATE – date the rams were introduced to the ewes.**
- **MGPEXIT – recorded on ewes and rams on the date they are removed.**

3.2 Pregnancy scanning and fetal aging

Why

Determining the number of fetuses the ewe carries is a recommended management tool for providing appropriate feed for ewes carrying single, twin and triplet (or more) lambs. It also provides a measure of number of lambs born and lamb survival for flocks that are not tagging lambs at birth (e.g. un-shepherded at lambing, or tagging lambs up to tailing age) or which rely solely on DNA for identifying parentage. Pregnancy scanning information can also be used when lambing information is missing (e.g. abortion).

When

Skilled operators can detect pregnancy as early as day 30 of gestation but identifying the number of foetuses, particularly twins versus triplets, is optimal between days 70 and 90 of gestation. Consult with your operator for specific advice on timing for best accuracy.

How

For DNA parentage flocks, fetal age (FAGE) must also be determined at pregnancy scanning which is the estimated number of days since conception at the time of pregnancy scanning.

Be aware that pregnancy scanning operators that measure FAGE effectively will need extra time. Where practical, extra aids for determining the 10 day window of birth date is such as ram crayon changes at mating and shedding out during lambing can be used to improve the accuracy of date of birth estimation.

Record

- **PREGSC per ewe as dry (0), single (1), twin (2), or triplet (3)**
- **Include date of measurement**
- **If more than one scanner, use a different mob code for each scanner.**
- **FAGE as the estimated number of days from conception at the time of pregnancy scan.**

It is essential to enter records for dry (non-pregnant) ewes (PREGSC = 0) on SIL.

Table 6: An example of good and poor practice for recording pregnancy scanning.

	15 ewes	difference from average	15 ewes	difference of average
dry	5	-1	-	0
single	5	0	10	-0.5
twin	5	+1	5	+0.5
Average	100% lambing		150% lambing	

By not recording the dry ewes the average is over estimated at 150% making ewes with singles below average while dry ewes are treated as average and appear better than singles.

4. Reproduction - Hogget

4.1 Hogget Fertility

Why

Producing lambs in the first year of life is a predictor of fertility as an adult ewe. However, pregnancy and rearing lambs is a significant challenge to the young ewe while she is still growing. Hogget lambing can have an impact on a number of traits including adult size so it needs to be recorded in a way that the appropriate adjustments in SIL can be applied.

When

Although individual farm practices may vary, a typical period for mating hoggets is 1.5 cycles starting 4 weeks after the mature ewes. Pregnancy scanning (between day 35 and 90 of gestation) should be carried out to determine pregnancy status for hogget fertility (HFER) and number of foetuses present for hogget fecundity (HNLB). In flocks where close shepherding at lambing is possible, the number of lambs born could also be recorded.

How

Introduce mature rams to ewe hoggets 1:70 (1 ram to 70 ewe hoggets). Use of ram hoggets with ewe hoggets is not recommended as they can be less successful at mating.

It is recommended that all mated hoggets are pregnancy scanned. Experience shows that some 'unmarked ewes' can be pregnant and the consequences of pregnancy for a hogget are considerable. SIL evaluations that include HNLB also need to know the litter size a ewe hogget is carrying.

It is essential to record pregnancy scanning results for all mated hoggets, including those that are not pregnant (PREGSC = 0).

Record

- **Record all hoggets put to the ram.**
- **Autumn liveweight (LW8/LW10 which is equivalent to LWMATE in adult ewes.**
- **BCS cannot be accurately recorded for hoggets at mating.**
- **PREGSC, include records for mated (i.e. those exposed to the ram) with dry hoggets = 0. SIL will automatically generate a missing value for PREGSC of all unmated hoggets.**
- **EXITFATE for hoggets that are culled based on hogget performance (e.g. dry hoggets)**

Additional records

Additional records could include the following, but are not currently part of hogget fertility or later reproduction evaluations:

- HNLB at lambing as well as BWT and WWT of lamb progeny.
- Weight of hoggets at lambing (LW12) and weaning (LWWEAN). For these weight measurements, hoggets that were "not mated" or "mated but not pregnant" and "mated and pregnant" need to be recorded as separate management groups.

Best practice for hogget lambing: see *'Hogget performance: Unlocking the potential'* available as a pdf at www.beeflambnz.com.

Type "hogget performance" into the search box and filter by documents.

Example:

When recording hogget lambing there are three common scenarios;

a) All lambs recorded alive and dead (i.e. conventional tagging at birth)
b) Only some of the lambs are tagged at birth and subsequently recorded
c) No lambs tagged at birth or subsequently recorded.

For scenario a) - follow standard recording practices.

For scenario b) - a DFATE of X (multiplier ewe) on the hogget and a BFATE of X (multiplier lamb) on the lamb is required. This indicates incomplete recording for reproduction and survival, flagging that information should not be used for survival analysis.

For scenario c) - a DFATE of U (lambed unrecorded progeny) should be used.

5. Survival

Why

Currently, simple survival data (present at birth and alive/dead by weaning) is used in the SIL genetic evaluation. No other variables are used to predict lamb survival BVs.

When

Lamb ID should have been matched with dam ID at lambing or by DNA parentage through tagging and collecting a tissue sample at docking. For flocks that shepherd at lambing and supply the number of lambs born (SNLB), dead lambs must be recorded to get an accurate measure of lamb losses around this time. For DNA parentage flocks the number of lambs the ewe carries (effectively NLB) is informed by the litter size at PREGSC with lambs missing at docking assumed to have died since lambing. The accuracy of Shepherd PLUS means that it is very unlikely a ewe will be assigned more lambs from those at weaning than she was scanned with – it is more likely that such disparities are due to errors in counting the number of foetuses at scanning.

How

<u>For flocks that shepherd at lambing;</u>

Lambs tagged at birth with visual tags and/or EID tags. Dead lambs should be assigned a unique ID, although an actual tag is not required. Record dam fate (DFATE) and lamb birth fate (BFATE) codes – refer table one. The data evaluation requires a unique ID even for dead lambs.

<u>For flocks that are un-shepherded at lambing;</u>

DNA samples should be taken from all lambs at tailing so that parentage results are likely to be available for use by weaning time. Tissue sampling units (TSU) and a hole-punch device , or paired TSUs already paired with RFID tags can be purchased from your tag (e.g. Allflex) or DNA service provider (e.g. Zoetis). Note it is recommended to sample all possible sires <u>at mating</u> and un-tested dams <u>at pregnancy scanning</u> to ensure all potential parents of progeny have a DNA profile for accurate parentage assignment.

Your DNA service provider will be able to give you instructions on how to link tissue sample ID with animal ID as part of their service.

Record

Shepherded at lambing flocks

- Lamb ID (Birth flock.Birth tag/Birth year and/or EID tag) matched to Dam ID.
- Date of birth (DOB), number of lambs born (NLB)
- Lamb fate codes (BFATE) and for ewes, dam fate codes (DFATE) and EXITFATES for ewes/lambs leaving the flock due to reasons such as culling or death.
- Relevant comments (REMARK)
- Birth weight (BWT) can be recorded, but currently this is not included in SIL evaluations.

Pregnancy scan data is used to derive litter size (NLB) for the lambing of a ewe and consequently birth rank of her lambs. However, you can record an actual litter size as well and request your bureau to enter this as "SNLB" which will override the derived NLB value.

Essential extra information for Lamb Survival is birth fate (BFATE) codes. These are used to determine if a lamb died before or survived to weaning. Some BFATE codes are used to credit the right dam for a lamb's survival (e.g. a fostered lamb fate code).

Due to compatibility with historical recording systems, there are a number of different codes that code a lamb as died. SIL groups these such that the survival calculations are simply based on whether a known lamb is dead or alive at weaning.

The fate of the dam, for ewes that are to be culled or that foster a lamb, should be recorded under DFATE.

If the ewe exits the flock at or around lambing, an EXITFATE should be recorded. Note that the EXIT code is not the same thing as a DFATE. Your bureau can provide advice on how to efficiently record the two variables.

Full sets of lamb fate codes (BFATE), dam fate codes (DFATE) and ewe exit codes (EXITFATE) are available from your SIL service provider.   Ewes can be given more than one DFATE i.e. AI and aborted = AT, and lambs more than one BFATE i.e. AI and born dead = LJ

Table 7; List of Lamb Fate Codes (BFATE) and Ewe Fate Codes (DFATE)

Lamb Fate Codes = BFATE	
Fate code description	
E	ET progeny
F	Fostered
H	Hand-reared
J	Born dead
J3	Died within 3 days of birth (autopsy)
K	Died between birth and rearing
L	AI progeny
M	Died misadventure
P	Born dead - Premature (autopsy)
R	Born dead - Rotten (autopsy)
X	Multiplier lamb
1	Died between rearing and weaning
4	Culled at birth (alive but not tagged)

Ewe Fate Codes = DFATE	
Fate code description	
A	AI dam
B	Barren
C	Foster mother
D	ET donor
G	Assisted
N	Not mated
O	Natural Mating
P	Pen mated
R	ET recipient
S	Screened in ewe
T	Aborted
U	Lambed, unrecorded progeny
X	Multiplier ewe
Y	Multiple ram joining group

6. Lamb Growth

6.1 Lamb weaning weight (WWT)

Why

Liveweight of the lamb at weaning is the measure of growth due to a lamb's own potential, its mother's potential and other effects. We use this data to estimate lamb (direct) and ewe (maternal) genetic effects (WWT and WWTM eBV). Weaning weight is a predictor for a number of other traits and to account for selective culling for later recorded traits. It is essential ***all*** lambs are recorded at weaning

When

Weaning is typically at 10-12 weeks of age but it is common to wean earlier or later than this, particularly when grass growth demands this for good pasture management. Animals need to be treated in a way that is consistent within mob. Avoid measuring some directly off pasture and some several hours later when part of the same management group.

Birth date (actual or estimated from FAGE at scanning) is used to adjust weaning weight. All animals within a management mob must be measured on the same day. For animals assessed on different days, there may be effects that occur between the two time points that advantage one group relative to another, and simply adjusting for birth date will not take this effect out.

How

Weigh all lambs, minimising time they are off pasture.

Record

- **Date**
- **WWT for lambs**
- **Management groups if managed differently in the preceding period.**

Example of correct management group use

Mob recording is VERY important. If groups have been managed separately so that there may be a feed/management difference between mobs, they should be recorded as separate mobs.

Mob codes

Ewe lambs and ram lambs are treated as different mobs in SIL, so a mob code doesn't need to be specified on the basis of sex. Only animals in the same management group can be compared directly. These are called a "contemporary group" and have experienced the same feed and conditions. The mob codes set up the "contemporary groups" for all traits, not just growth traits, so it's important to correctly identify different management groups.

Weaning sets the initial mob code for an individual in an analysis – after that, mobs are cumulative. For example; there are three mobs up to weaning, and after weaning the ram lambs are run in two mobs to LW6. By combining the weaning and LW6 mobs there are 6 possible contemporary groups for the ram lambs – 1 1, 1 2, 2 1, 2 2, 3 1 and 3 2 (WWT mob followed by LW6 mob).

Whenever practical, when combining mobs after weaning try to combine whole mobs. E.g. in the example above all lambs in pre-weaning mobs 1 and 2 were combined to make one of the LW6 mobs and the second LW6 mob is all of pre-weaning group 3 (possibly the later born lambs).

Genetic link between mobs

There should be a genetic link (one or more sires with progeny across the different mobs) between mobs to allow for the calculation of the appropriate mob correction. An example of isolated mobs could be an outside sire mated to some ewes before the usual mating time, or AI ewes run separately at lambing from other ewes. This means SIL cannot accurately separate mob from sire effects.

Too many small contemporary groups can create issues

Having many small contemporary groups can create issues in the genetic evaluation if groups have very small numbers, or there are no links between the groups. To avoid creating many small contemporary groups, consider when a feed or management difference may warrant a separate mob code and when groups of animals have experienced similar conditions and could have the same mob code. For example; lambing through to weaning on hill paddocks versus flats would warrant separate mob codes, but one hill block versus another, which is similar, may not.

SIL selection objectives

Selection for fast growing lambs favours genetics that produce large ewes as adults. This has implications for flock feed requirements as larger ewes generally eat more. SIL selection objectives for maternal sheep are designed to favour animals that produce large fast-growing offspring for a given size of ewe. You get a better index by having lower than expected ewe size for a given lamb growth potential, or faster lamb growth potential for a given ewe size.

Measuring liveweight (LW) and body condition score (BCS)

For ewes, it is preferable to measure LW and BCS (LWWEAN & BCSWEAN) during the week lambs are removed, but it is acceptable to record these up to 3 weeks later.

Liveweight and condition of ewes at weaning will only contribute to genetic evaluation of adult size if LWMATE and BCSMATE have not been measured. However, there is interest in the extent to which ewes that change LW and BCS a lot during the season are more or less productive, or last longer or shorter times in the flock. Measuring LW and BCS of the ewes at weaning may help investigations in this area.

Weigh and condition score all ewes, this can be straight off pasture (full weight) or following 24 hours without feed (empty weight). Consider coding ewes on the basis of how long they are off pasture. There can be big differences between ewes straight off pasture and those held and emptying out for 3-4 hours.

Best practice is to measure weaning weight of lambs as the priority on the day of weaning, and ewes at a time when you can minimise variation in the time they have been held off pasture.

6.2 Autumn liveweight (LW6, LW8, or LW10)

Why

Liveweight measured in autumn is the key measure of post-weaning lamb growth. This liveweight measure is usually associated with ultrasound scanning and is also used to derive meat yield eBVs.

When

The SIL Lamb Growth evaluation analysis uses just one liveweight measurement, either at 6months (LW6), 8 months (LW8) or 10 months (LW10) depending on which occasion had more animals measured in a mob.

Note this liveweight is relevant for both males and females. It is acceptable to only record one of these liveweights for ewes and one for rams, and ultrasound scanning is done at, or close to, the same time.

Ultrasound scanning of eye muscle and fat occur for both sexes. In large flocks, it is sufficient to measure just rams, but in small flocks it is recommended that ewes are also measured to get sufficient progeny measured per sire. More detail is given in the section on Meat Yield.

How

Weigh all animals. Preferably all animals should be measured on the same day, otherwise as close as practicable with the use of management codes as it is not appropriate to weigh animals on separate dates if they are of the same management group.

Record

- **Date and liveweight for LW6, LW8 or LW10.**
- **Management groups (mob code) if managed differently in the preceding period.**

REMEMBER: If you measure autumn liveweight multiple times, the genetic evaluation will use the measurement with the greater number of animals measured.

6.3 Ewe adult size and body condition score

Why

Measuring liveweight (LW) and body condition score (BCS) will help determine ewe's maintenance feed costs and genetic potential to hold condition.

When

For management purposes it can be valuable to measure BCS, and adjust feed accordingly, at multiple times of the year (Premating, Mating, Pregnancy Scan, Lambing, and Weaning).

For genetic evaluation purposes we need at least ***one*** record of ewe BCS ***per annum*** with a ***liveweight*** recorded at the same time.

Best practice is to measure LW and BCS of ewes at mating (LWMATE/BCSMATE). More precise estimates of merit come from measuring these traits in all ewes, every year at this time. The ideal time to record these measurements is close to the beginning of mating but it is acceptable to measure them up to 3 weeks either side of ram introduction.

Optional; BCS and ewe liveweight measured multiple times in the year may be used in future research to determine whether ewes that fluctuate in BCS and/or LW are more productive or last longer than ewes that maintain BCS and/or LW, and what genetic advantage there is to such patterns of change.

How

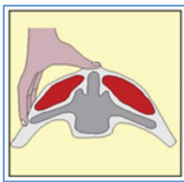
Weigh all animals.

Assess BCS in the range 1 to 5 with 0.5 increments at the same time as liveweight. Note that BCS data without an associated LW is not used to predict the BCS BV. You must have both collected at the same time.

Guidelines on how to assess BCS can be found on the B+LNZ website (beeflambnz.com). Type "body condition score" into the search box and filter by documents. A simple summary is given below

Where possible use one BCS assessor per farm. Record each assessor as a separate mob code when multiple BCS assessors are used.

Record



- BCS 1 – no fat and no muscle, animal emaciated and consider euthanasia.
- BCS 2 – animal skinny but some fat and muscle detected.
- BCS 3 – animal prime with good amount of fat and muscle detected.
- BCS 4 – animal overweight with considerable fat and muscle detected.
- BCS 5 – animal obese, difficult to feel bones.

7. Meat Yield

7.1 Live animal measurements – Ultrasound (EMA) and CT scanning (CTSCAN)

Why

Production of meat is a major source of income from sheep farming. There are several scanning technologies that can currently be used to predict meat weight and yield in live animals and have the data used in SIL genetic evaluations, namely ultrasound and computed tomography (CT) scanning.

Ultrasound scanning is relatively inexpensive on a per animal basis and can be done on farm, but is only moderately accurate at predicting the weight of meat and fat in the carcass. CT scanning is very accurate, but is expensive to measure and animals must travel to special facilities to be evaluated. Both can be used in breeding programmes to improve meat yield. Best practice guide for both are given below to outline how genetic progress can be maximised while minimising investment in scanning.

When

The aim is to evaluate animals at a time and liveweight similar to normal slaughter age and weight. The best time to ultrasound and CT scan is at or around the same time as autumn liveweight is measured. Later measurements (e.g. the following spring) will increase the differences between animals, but there is no guarantee that the animals have not changed ranking through the winter.

How

Ultrasound scanning provides moderate accuracy of prediction for individual animals, so breeding value accuracy is greatly improved by scanning many animals. Ultimately breeders will decide how much investment they are willing to make into ultrasound scanning, so the following principles apply to maximize the return on that investment.

- Scan as many ram lambs as possible. If a selection of ram lambs is scanned to save costs, then the top ranked ram lambs (based on breeding values) should be scanned, but with all sire lines getting similar representation (i.e. scan a similar number of rams from each sire line).
- Up to an additional 30% genetic progress can be made by ultrasound scanning ewe lambs. If ewe lambs are scanned, then there should be similar representation across sire lines, and selection for scanning should be on the basis of performance (based on breeding values)

With CT scanning, meat yield is measured very accurately, but at a high cost. Best practice for cost effective use of CT scanning involves the practice of two-stage selection. This is where animals a screened using ultrasound scanning to find the top ranked animals, and then only CT scanning the top group to give the best ranking of these elite rams. The proportion of rams to CT scan again depends on the investment a breeder is willing to make.

Best practice is to scan between 5 and 10% of ram lambs each year. There is little additional economic benefit in CT scanning more than 15% of ram lambs, and very little benefit from scanning less than 5% of ram lambs. Whatever percentage scanned, breeders should try and balance numbers from each sire line.

Record

Ultrasound Eye Muscle

- **EMD Eye muscle diameter (cm)**
- **EMW Eye muscle width (cm)**
- **FD Fat depth (mm) directly over the point where EMD is measured**

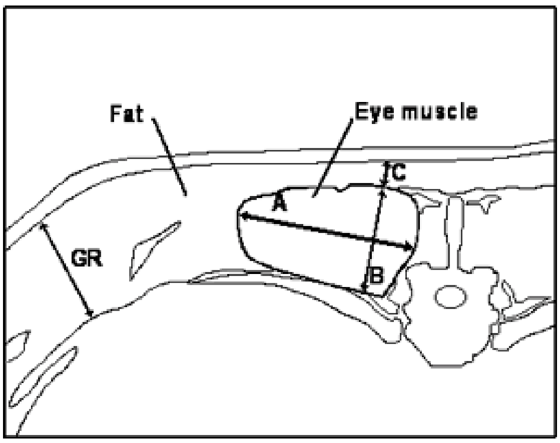
There are some differences between scanner operators in the ultrasound scanning site. Consistency of measurement site within a flock is more important than where the actual measurement site is located, i.e. it is best not to change the measurement site once it is established in a flock. If more than one scanner operator is used, a separate management code should be recorded.

CT Scan

- **HQLY Hind Quarter Lean Yield**
- **SQLY Shoulder Quarter Lean Yield**
- **LQLY Loin Quarter Lean Yield**
- **FATY Fat Yield**
- **LEANY Lean Yield**

Cross-section view of the loin as is scanned by ultrasound:

- A is Eye Muscle Width (EMW)
- B is Eye Muscle Depth (EMD)
- C is Fat Depth (FD)



7.2 Measurements post slaughter - Carcass weight (CW) and VIAscan

Why

Actual carcass weight and meat yield measurements at slaughter are the most accurate information on dollar value of progeny produced and is directly relevant to payments commercial breeders will receive. However, best practice would require measurement of an unbiased sample, as is achieved by killing all progeny (or all male progeny) in progeny test situations. CW and VIASCAN information on cull animals can still be of value if these principles are followed.

How

In 2016, the only slaughter measurements that have been calibrated for inclusion in meat yield evaluation are VIAScan measurements from Alliance. Research in developing calibration of additional meat processor measurements of meat yield (calibrating to CTSCAN measurements) is currently underway and expected to be useable by 2018.

Ideally, to assess meat yield merit of sires, the majority (>80%) of progeny should be measured on the one date. Carcass weight and meat yield in young animals is particularly sensitive to differences in age, nutrition, gender and general management prior to slaughter and so attention to recording accurate management groups is vital.

When

Assessing genetic merit is best served when animals are most variable. Carcass weight and meat yield is also best assessed when progeny have had time to express their own merit separate to the maternal environment. For these reasons, carcass weight and meat yield measurements are recommended to be taken around 4 to 6 weeks post weaning.

Record

- **Carcass weight (hot or cold) CW**
- **VIAscan measurements**

VSCWT	VIAscan Carcass Weight
VSLEG	VIAscan Leg Yield
VSLOIN	VIAscan Loin Yield
VSSHLD	VIAscan Shoulder Yield
VSMOB	VIAscan Mob

8. Wool

8.1 Bare Belly + Bare Breech

Why

A desire to select animals that are bare around the points and belly is valuable to reduce crutching costs and reduce tendency to produce dags.

When

Bareness of wool from the breech can be measured relatively easily around the time of weaning. It could also be assessed when either DAG3 or DAG8 is being measured whereas assessing belly bareness may fit best with crutching lambs over the board or shearing of ewes at FW12. Repeat measurements are not required.

How

The date and score (1-5) for each individual animal should be recorded under the appropriate trait names (below) relative to age of measurement. Again, noting management groups such as mob, operator and whether the some animals have been crutched within the previous 6 weeks should be noted.

Record

Belly Bareness	BBELLY	as a lamb = preferred record.
	BBELLY18	at 18 months
	BBELLYMA	at mixed age
Breech bareness	BBREECH	as a lamb = preferred record
	BBREECH18	at 18 months
	BBREECHMA	at mixed age

Breech bareness score

Belly bareness scores

8.2 Wool - Fleece weight and fibre diameter

Why

Wool value index is estimated from Lamb fleece weight (LFW), hogget fleece weight (FW12) and adult fleece weight (EFW) measured annually. Wool fibre diameter (FDIA) can also be used by some evaluations for mid-micron and finer wool.

When

Hogget fleece weight is a more reliable predictor of genetic merit for wool production than lamb fleece and is preferred for best practice. Hogget fleece weight is typically measured when the animal is at 12 months of age (FW12).

How

Wool value index is estimated from hogget fleece weight (FW12). If FW12 is not measured, it can be predicted from lamb fleece weight at 6 months (FW6) if available. Wool fibre diameter (FDIA) and clean fleece weight (CFW12) are also included in the evaluation if available.

FDIA is measured by taking small samples from the side or fleece of a sheep and is measured with a portable instrument such as an OFDA2000 (Optical Fibre Diameter Analyser); or a mobile instrument system called a Fleecescan.

Record

- **LFW Lamb Fleece Weight**
- **FW12 Fleece Weight at 12 months (most common)**
- **EFW Adult Ewe Fleece Weight**
- **FDIA Fibre Diameter**
- **Management groups if managed differently in the preceding period**

As long as all animals are treated the same, it does not matter whether animals are shorn as lambs or lambed as hoggets etc. prior to the measurement. If animals have been treated differently prior to recording fleece weight, a management group should be recorded.

9. Health Traits

9.1 Dag Score

Why

Removal of dags is a costly and bothersome exercise for farms. Identifying animals with a tendency to produce less dags is highly valued. Dag Score (0 = no dags and 5 = heavy dags).

Note: dagginess may be due to sensitivity to feed changes, consistency of fecal matter and is not directly related to parasite resistance or resilience. The economic weighting reflects the savings made with reduced dagging and crutching.

When

Record Dag Score on two occasions;

DAG3 occurs after weaning (Dec-Feb).

DAG8 occurs at the autumn liveweight (Mar-May) with LW8 preferred.

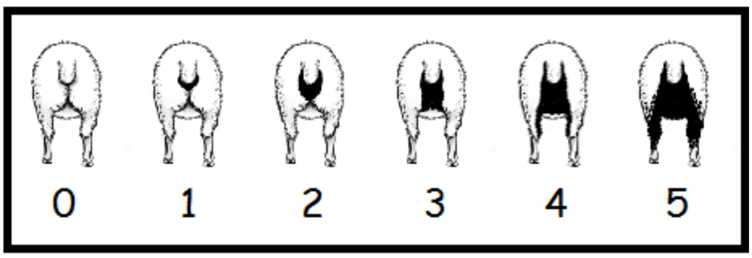
How

There is no need to avoid drenching in order to seriously challenge sheep to scour. In order to get the best discrimination for genetic merit for Dag Score, we should aim to get about 50% of sheep with a Dag Score greater than zero. The first opportunity is at weaning (DAG3) when typically lambs have NOT been crutched or drenched prior to being measured. The next opportunity is at autumn liveweight (DAG8) where it has typically been some time since animals have been drenched or dagged. You can crutch and drench sheep after scoring them.

Record

- **Date, Operator (if more than one)**
- **DAG3 - Dag Score at 3 months (weaning)**
- **DAG8 - Dag Score at 8 months (hogget)**
- **Management Groups if managed differently in the preceding period**

Common examples of management groups for this trait are whether some, but not all, lambs were crutched or drenched during the period when dags developed. If uncertain please speak to your SIL bureau.



9.2 WormFEC – recording for parasite resistance

This is a restricted trait that you will need to register with SIL and follow the prescribed WormFEC protocol. Details about how to register can be found on the SIL website.

Presented here is an overview of the measurements involved.

Why

Measuring how resilient animals are to a faecal egg count (FEC) challenge, or how resistant they are to allowing the eggs to develop are two traits of high value to the industry, to reduce the reliance on anthelmintics for supporting lamb growth.

When

The FEC test is carried out in Autumn. The test is best measured when the majority of animals are expected to experience a worm challenge, which typically starts four weeks after weaning. The worm burden may be allowed to develop over 6 weeks before drenching. For female lambs, consider the amount of time available for lambs to recover in time for hogget mating if this is to occur.

How

Most oral drench families are suitable (Levamisole, Ivomec etc.) but **<u>not</u>** Cydectin.
General technical advice can be found on the Techion Group website:
www.techiongroup.co.nz/products/fecpak

Note: Autumn liveweight should be measured before this test.

Mob faecal sampling - Collect fresh faecal samples expected to be from 30 different individual animals (~1 teaspoon per animal) which can be collected from mobs in the yards or cornering mobs in the field.

Individual stool sampling - Collect fresh stool directly from animal in the yards (~1 dessert spoon per animal)

Base Challenge - Collect mob faecal sample at a time when a worm challenge is expected and should be more than 500 eggs per count (epc). If not, delay the effectiveness test until the natural challenge is greater. Drench all animals.

Effectiveness of drench – sample 8-10 days after drenching and epc should be zero. If not, consult with your vet to investigate whether you have drench resistance and another drench family is required.

Challenge test - Sample the mob weekly and allow the average worm burden to build up to at least **800 epc** (eggs per count) which can be expected to take around 6 weeks to occur. Sample eight female lambs per sire individually (or all animals if preferred) recording EID to each sample (barcoding of samples is advisable) and send sample to testing laboratory (eg Techion). Drench animals as normal after test.

SIL recommends testing between 20 (minimum) and 30 (ideal) progeny per sire line to give an accurate representation of the breeding value of each sire.

Record

Test animals only once, but there are two options based on the timing of the test.

- **FEC1 – faecal egg count prior to March – preferred time.**
- **FEC2 – faecal egg count after March**
- **Management groups if managed differently in the preceding period.**

9.3 Facial eczema (FE) – RamGuard

This is a restricted trait that you will need to register with SIL and follow the prescribed RamGuard protocol. Details about how to register can be found on the SIL website.

Presented here is the overview of the measurements involved.

Why

Facial Eczema, (FE) is a disease that mainly affects ruminants such as cattle, sheep, deer, and goats. It is caused by the fungus *Pithomyces chartarum* which requires warm humid weather with night time temperatures of over 13°C (55°F) for several days, and dead matter at the bottom of the sward for rapid growth. The spores of the fungus release the mycotoxin Sporidesmin which affects the animal's gastrointestinal tract causing a blockage in the bile ducts that leads to liver damage. Elevated levels of GGT in the blood are indicative of liver damage and these will elevate before clinical signs of the disease are evident.

Protection from the toxin can be provided by zinc treatment (drench or capsule), spraying fungicides, growing crops or legumes and herbs. Genetic selection for tolerant animals is by far the most effective solution for the industry.

For up to date information on Facial Eczema: see *"Facing up to facial eczema"* available as a pdf at www.beeflambnz.com. Type "facial eczema" into the search box and filter by documents.

When

The best time to test animals in FE prone areas is in the spring when the animals will not be receiving a natural FE challenge. This also represents the time when the most important animal traits have already been recorded and the top animals (rams) for testing can be selected on indexes. The other option is to test animals after weaning and before autumn when the animals are yet to receive a natural challenge. The toxin dose is given as mg/kg liveweight therefore testing smaller animals is more cost effective.

How

Five lambs of the same sex per sire, including link sires, should be selected. The dose for the lambs will be predetermined by the FE testing status of the lamb's birth flock and the sire's flock FE status and previous results. FE status for SIL flocks can be found on the SIL website. Selected lambs are dosed by a veterinarian on the farm with blood collected for a base GGT enzyme level plus a second blood collected 21 days later that will measure GGT21 levels. Elevated GGT is indicative of liver damage and in this case is used to measure the response to the Sporidesmin dose.

To achieve FE Gold status, the flock must be able to tolerate dosing rate of 0.6 mg/kg liveweight without causing animal welfare issues (more than 1% deaths).

Record

- **GGT - GGT levels in the blood at dose treatment as a base level**
- **DOSE - the amount of sporodesmin given in the challenge (mg/kg of liveweight).**
- **GGT21 - GGT levels in the blood 21 days after dose treatment**

RamGuard Status Rating

Flocks are assigned a RamGuard flock status rating based on the dose rate they test at. The dose rate is affected by the number of years the flock has been testing and the degree to which the sheep tested each year react. RamGuard scientists determine the dose rates that flocks use each year and produce status ratings for flocks based on the table below.

The dose rate a flock is tested at is not used in the SIL genetic evaluation of Facial Eczema tolerance. So GGT21 breeding values may be similar for sheep tested at different dose rates. Using the flock status rating along with the estimates of genetic merit for individual animals (GGT21BV or DPX index) provides the means to rate animals for FE tolerance.

When animals have similar values for GGT21BV or DPX, those from a flock with a higher status rating are likely to be more tolerant to FE.

Dose rate mg/kg LW	Flock Status Rating
<0.20	*
0.20-0.29	**
0.30-0.49	***
0.50-0.59	****
>.60	*****

List of FE breeders that are testing at the high dose rate (ie 5-Star and FE Gold status) can be found at www.fegold.co.nz

Natural Challenge

Seek expert advice before considering recording GGT21 in response to a natural challenge.

9.4 Stayability (STAY)

Why?

The ability of the ewe to remain productive in her flock for longer than others is a desirable economic trait. The index reflects the cost of replacements when sheep exit the flock earlier than others.

When

Record EXITFATE as and when a ewe leaves the flock. Peak periods for culling are post weaning and post pregnancy scanning of dry ewes. Exit fates can be recorded for all age classes of stock. The eBV relates to the ewe stayability in the flock.

How

Currently this breeding value is predicted from the presence or absence of ewes in the stud flock at each age given she was present as a two tooth. In future, it is intended to distinguish between ewes that exit for commercial reasons and sound ewes that are removed from the stud flock for knowledge reasons usually only available to stud breeders.

Ewes will exit the flock for reasons including those that are un-avoidable (e.g. she died or went missing), standard commercial culling reasons (e.g. she was dry, had mastitis, lameness and faults) and culled as part of stud practise such as culling on breeding values or index values, or transfer for use in a commercial flock.

At minimum the date the ewe exited and the category (commercial, knowledge or unknown) should be recorded. It is optional to record the detailed reason for exit (refer table). The exact reason why she exited the flock is 'nice to have' information that may be used in further research development of this trait, but is not currently required for this research eBV.

Record

EXITFATE codes

At minimum, record as

- **C Commercial reason that would be obvious without performance records**
- **K Knowledge reason reliant on performance records (EBVs, Indexes etc.)**
- **U Unknown, use sparingly**

As a guide to defining C, K or U codes, more detailed codes are listed below. These may also be recorded, and will provide extra data which may enhance this trait given more R&D.

Commercial Categories

Died

D1	unknown time, not lambing
D2	at lambing
D3	pregnancy related
D4	other known disease
M1	Misadventure

Culled

M2	Misadventure
P1	failed to get pregnant
P2	mated late
P3	Wet dry
P4	bearing prolapse
P5	assisted birth
H1	poor condition
H2	excess condition
H3	non-fatal disease
H4	teeth or mouth breakdown
H5	feet or leg breakdown
H6	eye problem
H7	udder problem
H8	testicle problem
H9	other reason
A1	one of a few ewes aborting
A2	one of many ewes aborting

Knowledge Categories

Culled

L1	lambs born dead
L2	poor mother at lambing
L3	number of lambs/lambing
L4	lamb losses
L5	litter size recent
L6	total lamb wean weight
X1	lambs born with fault
X2	wool problem
X3	faults seen in relatives
X4	breed type fault
G1	animals own eBVs / indexes
G2	relatives eBVs/ indexes
G3	animals own gene test result
S1	Age
S2	when flock size reduced
S3	sold to other stud
S4	Sold for commercial use

10. Appendices

10.1 Chronological order for recording traits for each sub index

				Terminal Worth					Health Sub Indexes			
		Maternal Worth					Maternal Worth					
Age	**Month**	**Reproduction**	**Survival Maternal**	**Survival Direct**	**Growth**	**Meat Yield**	**Wool**	**Hogget Fertility**	**Dag**	**WormFEC**	**Facial Eczema**	**Stayability**
Lamb	Spring											
	Summer	*WWT	*WWT	*WWT	WWT	WWT	WWT	WWT	DAG3	WWT		
Hogget	Autumn	LW6/8/10			LW6/8/10	LW6/8/10 EMD, EMW, FD CTSCAN VIASCAN	LW6/8/10	LW6/8/10	DAG8	FEC1 or FEC2	LW6/8/10 GGT21	
	Winter							PREGSC				
	Spring						*FW6 FW12	NLB				
	Summer							*WWT				
Two tooth	Autumn	LWMATE BCSMATE			LWMATE BCSMATE							EXITFATE
	Winter	PREGSC (FAGE)	*PREGSC									EXITFATE
	Spring	NLB	NLB									EXITFATE
	Summer	WWT of lambs	WWT of lambs									EXITFATE
Mixed Age (repeat)	Autumn	LWMATE BCSMATE			LWMATE BCSMATE							EXITFATE
	Winter	PREGSC (FAGE)	PREGSC									EXITFATE
	Spring	NLB	NLB									EXITFATE
	Summer	WWT of lambs	WWT of lambs									EXITFATE

*WWT - presence of a wean weight is used to inform the number of animals present at weaning and account for culling and selection on later recorded traits

*PREGSC in grey - is optional and will be used to infer NLB if NLB is not supplied

*FW6 in grey - is optional and will be used to predict FW12 if FW12 is not measured

10.2 Summary of Indexes

Sub-index average, top and bottom values for April 2016 run GE 33500

	TSS	TSG	TSM	DPR	DPS	DPG	DPA	DPW	DPM	DPF	DPX	DPD
average	**+29**	**+642**	**+313**	**+272**	**+174**	**+1261**	**-506**	**+130**	**+94**	**+48**	**+566**	**+13**
top	+154	+1062	+642	+795	+546	+2100	+256	+334	+456	+533	+1145	+85
bottom	-96	-223	-16	-251	-198	+422	-1268	-74	-268	-437	-566	-59

Summary of SIL Indexes and weighting of the components they summarise

SIL Indexes	Equations
Terminal Worth	***TSG + TSM + TSS***
Maternal Worth	***DPR + DPS + DPG + DPA + DPW***
TS Growth	(* TSG) ¢ = 68 x WWTeBV + 195 x CWeBV
TS Meat	(* TSM) ¢ = 407 x LNLYeBV - 200 x FATYeBV + 271 x HQLYeBV + 136 x SHLYeBV
DP Reproduction	(* DPR) ¢ = 2231 x NLBeBV
DP Survival	(* DPS) ¢ = 9246 x SUReBV + 8378 x SURMeBV
DP Growth	(DPG+A) ¢ = 136 x WWTeBV + 121 x WWTMeBV + 374 x CWeBV - 119 x EWTeBV
DP Meat	(* DPM) ¢ = 752 x LNLYeBV + 501 x HQLYeBV + 251 x SHLYeBV
DP Wool	(* DPW) ¢ = 113 x FW12eBV + 261 x LFWeBV + 327 x EFWeBV
DP Health Facial Eczema	(* DPX) ¢ = -1433 x GGT21eBV
DP Health WormFEC	(* DPF) ¢ = -4.14 x FEC1eBV - 4.14 x FEC2eBV - 3.12 x AFECeBV
DP Health Dag	(* DPD) ¢ = -48 x LDAGeBV - 51 x ADAGeBV

10.3 Glossary: general terms, breeding values, indexes

General Terms	Description
Accuracy or reliability	A scale of relative accuracy for BVs and indexes. As more information is used in the prediction of the animals BV and Index, accuracy of the prediction increases. Traits or characteristics which are more heritable and more related to other predictor traits have higher accuracy.
Across flock analysis	A SIL evaluation that uses data from more than one flock. Use of 'link sires' (see definition) is needed to get 'genetic connectedness'. Connectedness is required to make comparisons of genetic merit between animals in different flocks.
Breeding Value	A measure of genetic merit for a particular trait (whether directly measurable or not), estimated from performance, pedigree and/or from DNA tests.
DNA Parentage	Flocks recording this are using DNA to assign both sire and dam of all lambs. This gives the most accurate (100%) pedigree compared to traditional methods (85-95%) so estimates of genetic merit are more accurate.
Dual Purpose Breed (DP)	Ewe breeds selected for lamb production and ewe maternal performance.
Genetic Connectedness	This is a measure of how well linked two flocks are genetically. Strong links are built by two flocks using the same sire in the same year. The progeny of such 'link sires' are used to benchmark genetic merit. Such connectedness is needed to validly compare the BVs or indexes for animals in different flocks.
Genetic Trends Graphs	SIL produced Genetic Trend Graphs show the genetic progress a flock is making. Accurate graphs require a flock to be using link sires between years i.e. the same sire is used in consecutive years to allow non-genetic effects to be removed and show how average genetic merit for a trait or index has changed.
Goal Trait Group	Breeding objectives are a combination of broad trait categories termed Goal Trait Groups. One or more breeding values contribute to a Goal Trait Group which has a corresponding sub-index. Combinations of relevant sub-indexes comprise summary indexes of merit (see Index section).

General Terms	Description
Index	Net value of genetic merit across a range of traits that relate to the breeding objective. Higher values are better for all SIL indexes. SIL DP indexes have units of cents per ewe lambing, while SIL TS indexes have units of cents per lamb born. Indexes can be separated into sub-indexes for general goal traits (see Goal Trait Group definition).
Link sires	Link sires have progeny in more than one flock in the genetic evaluation. This provides the essential benchmarking needed to allow us to compare genetic merit of animals from different flocks and from different years within flocks. Between year comparisons are used to produce Genetic Trend Graphs.
Outside sires	Sires from outside the flock(s) in the evaluation. Outside sires will have estimates of genetic merit (BVs and indexes) close to zero until progeny in the evaluated flock(s) have performance data.
Terminal (Sire) breed (TS)	Sheep breeds selected for meat production including direct survival and growth.
Within flock analysis	The analysis or evaluation uses all the information from one flock. For sires from other flocks (outside sires), estimates of genetic merit (BVs and indexes) will be close to zero until their progeny in this flock have performance data.
Maternal breed (DP)	Ewe breeds selected for lamb production and ewe maternal performance. (See Dual Purpose breed.)

Breeding Values		Description
Adult body weight	EWT	Liveweight of adult ewe
Adult dag score	ADAG	Adult dag score
Adult ewe fleece weight	EFW	Weight of ewe fleece
Adult faecal egg count	AFEC	Faecal egg count for adult ewes
Belly bareness score	BBELLY	Belly bareness score at weaning
Body Condition Score	BCS	Body Condition Score 1-5
Breech bareness score	BBREECH	Breech bareness score at weaning
Carcass weight	CW	Post-weaning growth rate, expressed in terms of carcass return
Eye muscle area	EMAc	Eye muscle area in 18kg carcass
Faecal egg count prior March	FEC1	Faecal egg count in lambs, late summer
Faecal egg count from March	FEC2	Faecal egg count in lamb, autumn
Fat yield of carcass	FATY	Fatness - above or below average for 18kg carcass
Fleece weight as a lamb	LFW	Weight of lamb fleece
Fleece weight at 12 months	FW12	Weight of hogget fleece
GGT at day 21 after dose	GGT21	Lamb GGT values 21 days after facial eczema challenge
Hind quarter lean yield	HQLY	Hind quarter lean yield in 18kg carcass
Hogget fertility	HFER	Ability of hogget to get pregnant
Hogget number of lambs born	HNLB	Hogget litter size
Lamb dag score	LDAG	Lamb dag score in summer or autumn
Lamb survival, direct	SUR	Lamb vigour birth through to weaning
Lamb survival, maternal	SURM	Ewe mothering ability
Lean Yield	LEANY	Average lean yield across carcass region in 18kg carcass

Breeding Values		Description
Liveweight at 12 months	LW12	Liveweight of hogget (12mo)
Liveweight at 8 months	LW8	Autumn liveweight - post weaning growth
Loin lean yield	LNLY	Loin quarter lean yield in 18kg carcass
Number of lambs born	NLB	Litter size in adult ewes (2-tooth & older)
Resilience, age at first drench	DRAGE	Lamb age at first drench under worm challenge for resilience
Resilience, liveweight gain	RGAIN	Lamb liveweight gain under worm challenge for resilience
Saliva carbohydrate larval antigens	CARLA	Antigens in saliva indicate an immune response to a worm challenge. Animals with high levels of antibodies are better at preventing worms establishing in the gut and so considered more parasite resistant.
Shoulder lean yield	SHLY	Shoulder quarter lean yield in 18kg carcass
Stayability	STAY	Ewes ability to remain productive longer
Tail bare skin length	TSKIN	Length of bare skin area on the underside of the tail
Tail length score	TLENSC	Tail length score at tailing/docking
Twinning rate	TWIN	More twin and fewer single or triplet lambs at given lambing percentage
Weaning (body) weight	WWT	Pre-weaning growth rate
Weaning weight maternal	WWTM	Ewe milking ability contributing to lamb weaning weight

Indexes		Description
DP Adult Size	DPA	A function of the adult ewe liveweight BV (EWT)
DP Bareness	DPB	The genetic propensity to have clear points (no wool) around the belly and breech (rear end). Based on BBELLY & BBREECH BVs.
DP Dag Score	DPD	Propensity to carry dags – based on LDAG (lamb) & ADAG (adult) BVs.
DP Facial Eczema Tolerance	DPX	A rating of an animal's ability to tolerate an FE challenge, based on the RamGuard system. The level of challenge can differ between farm so this index is most accurate for comparisons within farm and birth year. Based on GGT21 BV.
DP Hogget lambing	DPH	A function of ewe lamb fertility (holding to the ram) and litter size as a 1-year old dam. Based on 3 BVs - HNLB, HFER, & NLB
DP Internal Parasite Resilience	DPZ	An animal's tolerance and ability to perform under a parasite challenge. Based on 2 BVs for rate of liveweight gain (RGAIN) and age when drenching is required (DRAGE). This differs to resistant animals that actively fight a parasite challenge resulting in a lower faecal egg count.
DP Internal Parasite Resistance	DPF	Predicted from faecal egg counts (FEC) using the WormFEC system. Based on 3 BVs - FEC 1 & FEC 2 for lambs & AFEC for ewes.
DP Internal Parasite Resistance	DPF	Predicted from faecal egg counts (FEC) using the WormFEC system. Based on 3 BVs - FEC1 & FEC2 for lambs & AFEC for ewes.
DP Lamb Growth	DPG	A function of 3 BVs – pre-weaning growth and ewe milking ability (WWT & WWTm), and carcass weight (CW)
DP Lamb Growth + Adult Size	DPG+A	A function of 4 BVs in DPG and DPA

Indexes		Description
DP Lamb Survival	DPS	A function of 2 BVs – lamb vigour (SUR) & ewe mothering ability (SURM)
DP Meat (Yield)	DPM	A function of carcass lean yields in 3 carcass regions – shoulder, loin and hindquarter (BVs SQLY, LQLY, & HQLY). Yields are deviation for kg of tissue at a standard carcass weight (18kg). Fat yield (FATY) is not addressed in this index but there is a degree of relationship between fat yield and lean yields (high FATY tends to be associated with low lean yield).
DP Reproduction	DPR	The economic value of more lambs per litter, per year, for 2-tooth and older ewes. Based on NLB BV.
DP Stayability	DPL	Ewe longevity based on how many years they are able to stay productive in the flock. STAY is the BV that informs this index and is currently being field tested by industry.
DP Twinning	DPT	The tendency to produce more litters of 2 and fewer of 1 or 3. Based on TWIN BV.
DP Wool production	DPW	A function of fleece weight BVs (LFW, FW12, EFW).
New Zealand Maternal Worth	NZDP	An industry standard index for dual purpose sheep based on Reproduction, Lamb Survival, Lamb Growth + Adult Size, and Wool production.
New Zealand Terminal Worth	NZTS	An industry standard index for terminal sire sheep based on Lamb Survival, Lamb Growth and carcass Meat Yield.
Overall index	TSO or DPO	All goal traits in a genetic evaluation that are relevant for TS or DP sheep are combined in one "overall" index. Flocks vary in what they record and evaluate and so production indexes vary in what they include.

Production index	TSP or DPP	All goal traits in a genetic evaluation that are relevant for TS or DP sheep, except the health traits, are combined in one "production" index. Flocks vary in what they record and evaluate and so production indexes vary in what they include.
TS (Lamb) Growth	TSG	A function of 3 BVs – pre-weaning growth (WWT), post-weaning growth (CW) and ewe milking ability (WWTm)
TS (Lamb) Survival	TSS	A function of SUR (lamb vigour) BV.
TS Dag Score	TSD	Propensity to carry dags – based on LDAG (lamb) & ADAG (Adult) BVs.
TS Internal Parasite Resistance	TSF	Predicted from faecal egg counts (FEC) using the WormFEC system. Based on 3 BVs - FEC 1 & FEC 2 for lambs & AFEC for ewes.
TS Meat (Yield)	TSM	A function of carcass lean yields in three carcass regions – shoulder, loin and hind quarter (BVs SQLY, LQLY, HQLY). Yields are deviation for kg of tissue at a standard carcass weight (18kg). Fat yield (FATY) is not addressed in this index but there is a degree of relationship between fat yield and lean yields (high FATY tends to be associated with low lean yield). Eye Muscle Area calculated (EMAc) BV from width and depth of eye muscle as scanned by ultrasound is included.

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