Genetic merit for twinning rate

SIL Technical Note

Relates to: Increasing numbers of twin born lambs at the same lambing percentage
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Summary
- Twinning rate is the propensity to have more twin litters per hundred ewes at the same average lambing percentage
- High twinning rate will mean fewer ewes have triplets
- While twinning rate is highly related to litter size, it can be selected for independently
- SIL can produce a twinning rate breeding value, TWINBV which is included in the Twinning Rate sub-index
- Progress will not be fast due to low heritability, the need to improve other traits at the same time and because it is based on measurements collected for 3 year old and older ewes.
- Selection for twinning rate is recommended in situations where triplet lamb survival is low or variable, or when lower weaning weights incur a significant financial penalty

Background

Modern selection methods, such as those used by SIL, have allowed breeders to increase genetic merit for litter size (or number of lambs born, NLB) significantly compared to gains made with earlier evaluation systems.

In recent years the lambing percentage (lambs born per ewe mated) of New Zealand flocks has increased from near 100% to above 120%. This is equivalent to an average litter size of 1.5 lambs born per ewe lambing after taking account of ewes that were barren or died and of lambs not surviving to tailing. The increases seen have been partly attributed to improved genetics and partly to changes in management. Many flocks regularly perform near 160%, equivalent to an average litter size of 2.0. This leads to more lambs born as triplets with lower birth weight. Triplet lambs have lower survival and take longer to grow to market weight.

Recent work in New Zealand and overseas has shown there is variation in the proportion of lambs born as twins, or as triplets, to the daughters of different sires after adjustment for average litter size. It is possible to select for a higher **twinning rate** at the same lambing percentage. This reduces the number of lambs born as triplets and as singles i.e. a higher proportion of ewes have twins at the same lambing percentage. Twinning rate is a valuable trait for most farms in New Zealand. More so when there is low or variable survival for lambs born as triplets or substantial penalties for weaning lighter lambs (e.g. summer dry areas).

Biology and genetics of twinning rate

Variation in the proportion of lambs born as twins (or as triplets) to the daughters of different sires is considered to reflect differences in embryonic mortality and in average ovulation rate. Thus at the same average litter size at birth, a line with higher embryonic mortality will have had to conceive more lambs at mating. This leads to more variation in litter size at birth. Conversely, lines with lower embryonic mortality show less variation in litter size at birth.

Reproduction traits typically have low heritability. Number of lambs born (NLB) is around 10% and twinning rate is about half that (Amer & Bodin, 2006). Furthermore, there is a very strong relationship between NLB and twinning rate such that **most variation in twinning rate is explained by the average NLB**.

Despite this, it is possible to select for higher twinning rate at the same average NLB. SIL uses a sophisticated analysis that separates NLB and twinning rate effects to produce two independent breeding values (BVs), TWIN (average twinning rate) and NLB (number of lambs born).

Studies of twinning rate have concluded that there may be major genes that influence embryonic loss. It is considered that these should not greatly impact on the evaluation of TWINBV. However, major genes for prolificacy (NLB) will impact on twinning rate since sires with one copy of a major gene for litter size will have two types of daughter – those with the gene lifting average litter size and those without having a lower average litter size. This leads to higher variation in litter size across the sire's daughters.

Measuring twinning

No new data need be collected in order to assess genetic merit for twinning rate. However, some data collection practices may need to be reviewed.

The "Twinning Rate" evaluation used by SIL relies on accurate pedigree information and benefits from reasonable numbers of observations for litter size in the daughters of sires. While 2 year old (2YO) lambing records are good predictors of NLB, they are not good predictors of twinning rate. So information from 3YO and older ewes is used to derive TWINBV (NLBBV does use information from younger ewes). Thus the best estimates of TWINBV come from sires with significant numbers of daughters lambing at 3YO or older.

Number of daughters is more important than number of daughter lambing records. Thus a sire with 20 daughters with 3YO lambing records will yield more robust BVs than a sire with 5 daughters each lambing 4 times when 3YO and older.

Breeding flock management should aim to assess reasonable numbers of daughters per sire and collect accurate information for litter size at birth. In practice this means keeping as many daughters as possible because few sires have the minimum of 20-30 daughters lambing that we would like.

Screening-in is not recommended as significant numbers of screened in ewes can adversely affect the genetic evaluation.

Genetic evaluation

SIL now offers three Goal Trait Groups (sub-indexes) for reproduction traits:

- Reproduction – this evaluation produces an estimate of litter size (number of lambs born) in adult ewes, NLBBV. It is estimated from litter size at birth data. Use of autumn LW as a predictor is optional (default is to use this). Reproduction must be selected if the evaluation will include Twinning Rate and/or Hogget Lambing.

- Twinning Rate – genetic merit for twinning rate (TWINBV) in adult ewes is estimated. This is adjusted for litter size effects and so is independent of NLBBV. Reproduction must be selected as well as Twinning Rate.

- Hogget Lambing – a new option analyses hogget ewe lambing traits at the same time as those for older ewes. It produces estimates of genetic merit for two traits – hogget fertility (HFERBV), whether a hogget ewe gets pregnant or not, and hogget fecundity

(HNLBBV), litter size for the hogget ewe that gets pregnant. Reproduction must be selected as well as Hogget Lambing.

Table 1 (appended) details various options and what these mean for the three reproduction modules. Reproduction must be selected in order to get Twinning Rate or Hogget Lambing.

Twinning rate is measured indirectly. Comparison is made of ewes with litters of 3 or more lambs to ewes with litters of 1 or 2. This infers twinning rate as ewes with fewer triplets at the same average litter size must have more twins over the range of litter sizes we typically see. Positive values are better for both the NLBBV and the TWINBV that SIL produces.

Across-flock evaluations may have adverse effects on the estimation of TWINBV for some sires where their ewe progeny lamb in different flocks at very different lambing percentages. In this instance, the twin lambing module will struggle to correctly account for the strong relationship between average litter size (NLB) and the percentage of twins.

Twinning rate versus number of lambs born

Many breeders wish to increase average litter size but would like to minimise the number of litters with three or more lambs. This joint objective can only be achieved by increasing both NLBBV and TWINBV. For this objective, more desirable animals are those in the upper right quadrant of Figure 1.

Breeders may wish to hold litter size at levels below 200% while increasing the number of ewes with twins. To do this they can select for increases in TWINBV while holding NLBBV. For this objective, more desirable animals are in the top half of Figure 1.
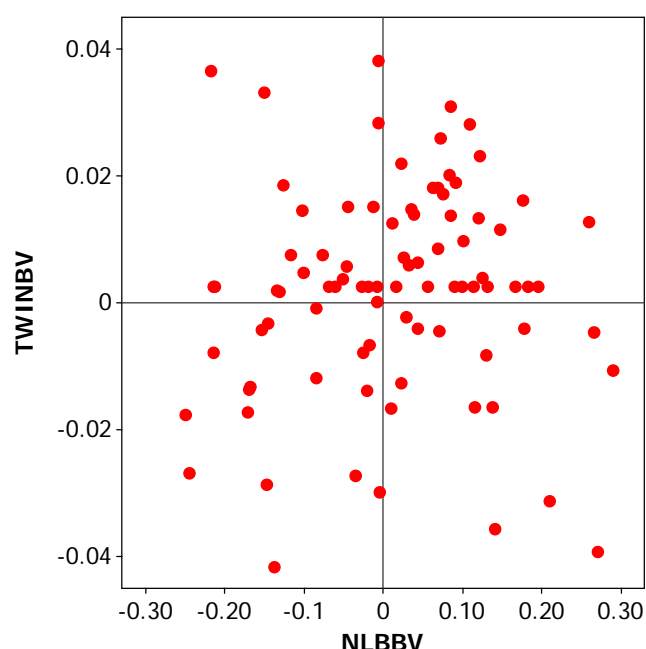
SIL indexes and reports

With Twinning Rate is selected for evaluation there is a sub-index (DPT). This and the Reproduction sub-index (DPR) are in the SIL Overall index (DPO). DPT contains the TWINBV while DPR contains the NLBBV.

Figure 1. Plot of genetic merit for twinning rate (TWINBV) versus litter size (NLBBV).

TWINBV has an appropriate weighting, relative to NLB, in the DPT sub-index. High BVs are favoured for both TWIN and NLB. Index weightings are detailed on the front page of SIL reports and in a separate SIL Technical Note. Adding Twinning Rate to an evaluation will increase variation in the overall index.

Twinning Rate does not influence SIL Terminal Sire indexes since these do not have a reproduction component. Genetic merit for twinning rate (TWINBV) is a trait expressed by the ewe and so is relevant where rams are to be used to breed replacement ewes.

SIL recommends use of sub-indexes when reporting on genetic merit wherever possible. This minimizes the amount of information presented while still characterizing key attributes of animals. Where it is desirable to distinguish between animals with high or low values for TWINBV, SIL recommends use of the DPT sub-index on reports.

Selection to increase rate of twinning

Incorporating more traits into a selection objective inevitably leads to reduced rates of gain in other traits, albeit with a greater rate of gain in overall index merit. Economic selection indexes are designed to give the best economic response taking account of relationships between traits and the economic environment in which farm income and expenditure occur.

Clearly progress to improve twinning rate through selection will be slow. However, it is a trait worth selecting for where triplet lambs incur a significant financial penalty on flock performance. DPT or TWINBV are best used to identify extreme animals i.e. high or low values. Accuracy is such that it does not discriminate well among those in between.

Traditional practices such as selecting rams or ewes that are born as twins have relatively little impact on flock twinning rate. This is because, with the low heritability, many animals from strongly twinning families are born as singles or triplets while many of those born as twins come from families with low rates of twinning. SIL recommends that DPT be used where the aim is to increase twinning rate through selection.

Screening in ewes that are twins, to improve lambing percentage and/or twinning rate has little effect on either trait. Again, genetic improvement will be much faster in these traits when selection is based on breeding values. Furthermore, screening in is likely to compromise genetic improvement due to the need for high numbers of replacement stock to maintain flock numbers, which leads to low selection pressure on other important traits.

Having good estimates of genetic merit for litter size (NLBBV) and twinning rate (TWINBV) provides the opportunity to tailor ram sales to the needs of particular ram-buying clients. Where lambing percentage is low, high NLB is desirable, but as lambing percentage rises, twinning rate increases in importance.

Genetic Trend Graphs

Given that Twinning Rate has not had a lot of pressure put on it in the past, Genetic Trend Graphs will not demonstrate gains being made until a number of years of selection have occurred. Even then, greater emphasis on other traits in an index mean gains in Twinning Rate may not be seen.

Other relevant technical notes

- SIL standard index weightings – June 2007
- Hogget lambing
- Accuracy - amount of data from sib & daughter lambing
- From farm measurements to SIL indexes

Need more information?

Contact your SIL bureau, send an email to silhelp@sheepimprovement.co.nz or telephone 0800-745-435 (**0800-SIL-HELP**).

References cited

Amer, P.R.; Bodin, L. 2006. Quantitative genetic selection for twinning rate in ewes. *Proceedings of the New Zealand society of animal production* **66:** 429-433.

	Breeding values			Data used in evaluation				
Goal Trait Group (sub-index)	NLB	TWIN	HFER	HNLB	Lambing data for 2-year old & older ewes	Hogget lambing data	Pregnancy scan data	Autumn LW as predictor	Notes
Reproduction	✔				Used to predict **NLB**	Default is NOT used **Option to also use this to predict NLB** **WILL** be used if Hogget Lambing selected	Default is NOT used **Can be used**	Default is to use **Can be switched off**	Can be run on its own OR with one or both of Twinning Rate and Hogget Lambing
Twinning Rate		✔			Only 3-year old and older ewe lambing data used to predict **TWIN**	Not used	Default is NOT used **Can be used**	Not used	Reproduction MUST also be selected
Hogget Lambing			✔	✔	Used to predict **HFER & HNLB**	Used to predict **HFER, HNLB**	Default is NOT used **Can be used**	Default is to use **Can be switched off**	Reproduction MUST also be selected

Table 1. These three Goal Traits Groups are used by SIL to provide a focus on female reproduction traits. Reproduction must be chosen for evaluation before either Twinning Rate or Hogget Lambing can be chosen. Reproduction can be run on its own.