



Sheep breeding: Heritability

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Heritability describes the proportion of differences between sheep that are genetic in origin.

The heritability of a trait is of vital importance in genetic improvement programs. It indicates whether selection will lead to improvement, and at what rate.

Generally, objectively measured traits are more heritable than those that are subjectively assessed. For example, clean yield in Merino hoggets is about 48 per cent heritable. This means 48 per cent of differences in clean yield are genetic in origin (Table 1).

Heritability is dependent on variation as described in the following equation:

$$\text{Heritability} = \frac{\text{genetic variation}}{\text{total variation}}$$

The genetic variation is always less than the total variation, and therefore heritability is always between 0 and 1.0.

Only genetic variations contribute to the next generation. These are the ones that are relevant to the selection process. The proportion of genes that relatives have in common accounts for the resemblance between them.

Table 1. Estimates of heritability for some traits in Merino hoggets in Western Australia

Trait	Estimate
Objectively measured	
Greasy fleece weight	0.35
Clean fleece weight	0.34
Clean yield	0.48
Average fibre diameter	0.59
Hogget liveweight	0.35
Subjectively assessed	
Handle	0.40
Lock	0.17
Wool character	0.25
Wool colour	0.18
Hocks	0.14
Neck wrinkle	0.27
Body wrinkle	0.15

Estimating heritability

Heritability is commonly estimated in two ways. One uses the resemblance between half sibs in sire groups (paternal half-sib estimates) and the other uses the resemblance between parent and offspring (parent-offspring regression estimates). Data for these methods are easy to obtain, merely requiring the collection of accurate pedigrees and details on the traits of interest.

Many observations are required to obtain heritability estimates with acceptably small standard errors (that is, acceptable accuracy). For example, a heritability of 0.40 would need about 1100 progeny from 100 sire groups to achieve a standard error of 0.10 under optimum conditions. In practice, about 30 to 50 per cent more are required to compensate for uneven sire group numbers.

Changes in population and environment influence heritability. Genetic variation can be changed if the environment is modified, since genes are switched on and off by changing conditions.

Values of heritability

Heritability is always expressed as an estimate, since it is always based on a sample of the sheep population. The sample will seldom equal the whole population. If it were possible to base calculations on the whole Merino population of Australia, the 'estimate' qualification would not be necessary.

Table 1 shows estimates of heritability for some common traits in sheep, using the Base Flock at Katanning as a sample.

Heritability and variation

Variation describes the range of differences between traits in any group of sheep. It is the sum of two parts - environmental variation (such as management or age), and genetic variation (see Farmnote No. 50/93 'Sheep breeding: Variation between sheep' [Agdex 430/30]) but may also include lesser components.

Total variation = environmental variation + genetic variation

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Heritability estimates are basically described as high, medium or low according to the following convention:

- high - greater than 0.30;
- medium - 0.10 to 0.30; and
- low - less than 0.10.

All the objectively measured traits in Table 1 have high heritability estimates, while all the subjectively assessed characteristics, except handle, have medium estimates.

Further reading

- Farmnote No. 61/93 'Genetic nomenclature and animal breeding terms' (Agdex 400/30).
- Farmnote No. 50/93 'Sheep breeding: Variation between sheep' (Agdex 430/30).

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