

Geoff Pollott

Royal Veterinary College, Royal College Street, London, NW1 0TU, UK

Headlines

The ability to shed wool controlled by an autosomal, dominant gene
The speed/extent of shedding is a polygenic trait
Heritability in lambs ~0.5; in adults ~ 0.2



1 Background and basic question

- In the UK, wool is a minor part of flock income
- Shearing can have a negative effect on profitability
- Certain sheep breeds shed their wool naturally
- What is the mode of inheritance of this wool shedding?

2 Shedding scores – wool shed from:

- 5 all of wool growing area (WGA)
- 4 over ¾ of WGA (some wool still present and not shed)
- 3 over ½ but less than ¾ of WGA
- 2 less than ½ of WGA but evidence of some shedding
- 1 No wool shed from WGA

3 Materials – data source

- Flock of composite animals based on original crosses between wool-shedding rams (Easycare, Dorper, Katahdin, Wiltshire Horn) and non-shedding ewes (Friesland, Lley, Suffolk, Texel)
- All lambs had shedding scores (August/September)
- Animals in the breeding flock scored every year (May)

4 Methods – analyses

- 1) **Mendelian trait** – the ability to shed
 - All 4 combinations of autosomal/sex-linked and dominant/recessive tested (see Table below)
 - Fisher's exact test used to compare observed and expected ratios of shedders:non-shedders
- 2) **Polygenic trait** – speed/extent of shedding
 - Animal model analysis of shedding score from *shedders*
 - Two datasets – lambs and adults
 - Various fixed effects fitted e.g. age, sex, birth type

5 Results

- A total of 2,527 wool scores were available from 1,467 animals recorded between 2007 and 2010
- 82 shedders failed to shed as a lamb (11% of lambs) and 15 animals were classed as non-shedders.

6 Results - Mendelian analyses

- Analysis of the F₁ data (261:13, shedders : non-shedders) eliminated sex-linked dominant, sex-linked recessive and autosomal recessive as the mode of inheritance for the ability to shed (P < 0.001)
- Most likely mode was autosomal dominant.
- Confirmed in the BC₁ data (683:1, shedders : non-shedders; P > 0.05).

7 Results - Polygenic analyses

- Based on a pedigree file of 2,018 animals
- Lamb analysis: all fitted effects were significant (P < 0.01) except dam age
- Females had higher score than males (3.19 v 2.77), Singles > twins/triplets (3.26 v 2.88) Older animals > younger animals.
- The heritability of wool scoring in lambs was:
 - 0.45 ± 0.08 when breed type was fitted
 - 0.55 ± 0.07 when breed type was excluded.
- Adult analysis the heritability of wool scoring was:
 - 0.10 ± 0.05 when breed type was fitted
 - 0.26 ± 0.06 when it was excluded
- All fitted fixed effects were significant (P < 0.05) with similar differences within effect as for the lamb analyses.

Expected segregation ratios from crossing non-shedding ewes with shedding rams under four modes of single-gene inheritance

Male genotype (Shedder)	Female Genotype (Non-shedder)	F ₁ -offspring genotype	Expected shedder to non-shedder ratio
<i>Autosomal recessive</i>			
Ss*	SS	All Ss	0:1
<i>Sex-linked recessive</i>			
sY	SS	1Ss:1SY	0:1
<i>Autosomal dominant</i>			
SS	ss	All Ss	1:0
Ss	ss	1Ss:1ss	1:1
<i>Sex-linked dominant</i>			
SY	ss	1Ss:1sY	1 (female):1 (male)

*S and s denote the dominant or recessive form of the single gene; Y denotes the male chromosome.

8 Key points

- Fleece loss in wool shedding breeds is genetically controlled
- Not all lambs which subsequently shed do so as a lamb
- There is an autosomal dominant gene 'switching on' the ability to shed
- The speed/extent of shedding is a polygenic trait
- Wool shedding is more heritable as a lamb than as an adult
- Shedding trait is not always expressed as a lamb

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Come and talk to me about these results, or see the full paper in the *Journal of Animal Science*, 2011. 89:2316-2325.

gpollott@rvc.ac.uk