

Hebridean Colour Genetics

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This is an adaption of a paper presented by Jon Parfitt and Andrew Sheppy at the 4th World Congress on Coloured Sheep held at York in July 1994.

Introduction

For some time now, some breeders of Hebridean sheep have been aware of the occasional occurrence of white sheep within their flocks. The occurrence, and subsequent notification of these white individuals has provoked a great deal of discussion among breeders regarding their authenticity. Rather than argue on principles or aesthetics, the authors decided to undertake breeding trials with a population of “white hebrideans” and registered, black Hebrideans.

The results of the breeding trials not only established the mode of inheritance of the white colouration, but also have major implications for the genetic make-up of the registered black population.

Breeding Trials

The Hebridean has traditionally been regarded as recessive black so that, in a cross with a pure bred white sheep all offspring would be white, and that no pure Hebridean could therefore carry the normal white gene. In order to explain the occasional occurrence of white lambs from black Hebridean parents, Burns and Allen (1986) suggested that a different and previously unreported white gene could occur in Hebrideans and that this was recessive to the black Hebridean gene and could, therefore, trace back to the original varicoloured population of sheep of the Hebrides. Others (Watson, 1986; Alderson, 1989) have suggested that the white gene found in some black Hebrideans is the white normally found in sheep, and that it is masked by the dominant black gene, normally associated with breeds such as the Jacob, Black Welsh Mountain, and Karakul.

During our breeding trials we have produced black lambs from two “white hebridean” parents, thereby proving that the white is not a simple recessive. (If it were, then all the offspring should also be white.) This suggested that the inheritance of black and white was relatively complex, relying on at least two entirely separate gene loci. At one of these loci the black allele is entirely recessive to the white allele whilst, at the other locus, a dominant black allele can be found. This complies with accepted colour genetics for sheep, where the A locus includes the alleles (alternative genes) Aa, the self colour gene, and Awt, the white gene; whilst the E locus includes the alleles E7, for normal expression of colour, and ED, the dominant black gene, which completely masks any white colouration caused by Awt at the A locus.

If this is the case in the Hebridean, then the carriers of the white gene must also carry a dominant black gene, to mask the effects of the white. It is easy to test for this by test-mating to pure-breeding white sheep breeds where, in the absence of the dominant

black gene, all offspring would be white. The production of a single black lamb would suggest the presence of the dominant black gene in the Hebridean parent.

Test-matings between black Hebrideans and white test breeds have so far produced 28 white lambs and 32 black lambs. This suggests that around three quarters of the Hebridean sheep in the test population carry the dominant black ED gene, since the gene frequency in the lambs is around 50%. Since the test population was made up of sheep from five different flocks, and since four of them have been proved to carry dominant black, the problem is obviously widespread and not confined to a couple of flocks.

Conclusions

It is therefore clear that we have found four genes, Aa, Awt, E7 and ED in the registered Hebridean population. It has been suggested (Watson, 1986) that the dominant black gene could have come from the original island population. However, examination of pictures of the first reported “white hebrideans”, plus anomalies in horn shape, fleece type and shade, tail length, and general character of the sheep being produced during the trials seem to us to indicate a more recent origin, through introduction of Black Welsh Mountain and Jacob blood. The full details of these anomalies are in the published paper (Parfitt and Sheppy, 1994). Furthermore, all the notified occurrences of “white hebrideans” trace back to three familial groups in just two flocks and generally go back to unregistered or provisionally registered sheep. We would therefore conclude that neither the white nor the dominant black genes are endemic, but are recent introductions.

Policy Options

It would be sensible to try to select against the dominant black gene since, without it, the white cannot be masked and so white lambs would cease to be produced from black parents. It would also mean that the breed would be as near to its original type as possible.

It is impracticable to test-mate all Hebridean sheep by crossing them with white breeds, since it requires between five and ten lambs to give even moderate assurance that a sheep is free from dominant black. It would, however, be relatively simple to test-mate rams, by putting them to half a dozen or more commercial white sheep. If only white lambs are born, then it can be assumed with reasonable confidence, that the ram is of the correct genotype for colour. Using only tested rams in a breeding programme will halve the occurrence of the dominant black gene (and more than halve the occurrence of the white gene) at each generation. Whilst not all breeders would wish to test-mate, a scheme for so accrediting rams would benefit breeders who choose to test, and would allow buyers to select tested rams.

Glossary

- **alleles:** genes which are alternatives for each other
- **dominant:** an allele whose effects are always shown
- **gene:** the basic unit of inheritance
- **gene locus:** a portion of the hereditary molecule where one of a set of alleles resides
- **recessive:** an allele whose effects are shown only when the dominant allele is absent

References

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Last update: 26 February 2011