



Scrapie Resistance



Genetic susceptibility to scrapie appears to be influenced by variation in the prion gene (PRNP). In sheep, variation in the PRNP gene has been identified at a number of codons, but polymorphism at some codons is rare and only three codons (136, 154 and 171) have a reported linkage with the incidence of scrapie.

The association between ovine PRNP polymorphism at codons 136, 154 and 171 and scrapie susceptibility makes it possible to identify whether sheep are resistant or susceptible to scrapie by genotyping the PRNP gene.

Based on variation at these three codons, a number of different scrapie-related alleles in sheep have been identified.

Testing for scrapie assesses the combination of genetic markers that contribute together to provide resistance to the disease. The results of the test are reported as a type from scrapie resistant through to scrapie susceptible.

Testing for Scrapie Resistance

NEOGEN's Smart Flock Elite and Smart Flock Parentage products include panels to identify resistance levels to scrapie. This can be added to DNA test reports as an optional extra.

Scrapie is a progressive degenerative disease of the central nervous system that is fatal to sheep and goats. It is one of the 'prion' diseases, also called transmissible spongiform encephalopathies (TSEs). These diseases have long incubation periods during which an abnormal protease-resistant isoform of a prion protein accumulates in the central nervous system.

The main mode of transmission of scrapie is from mother to offspring immediately after birth and to other susceptible newborns exposed to the birth fluids and tissues of an infected animal.

There is no cure and no treatment for scrapie.

While Australia is free of scrapie, it is present in several European Union member states, including the United Kingdom, as well as Canada, the United States, Iceland, India, Japan and Brazil. Israel has also reported outbreaks of scrapie, with the most recent being in early 2007.

Testing for scrapie is not a priority for most Australian sheep breeders, however, it is of vital importance to breeders using imported genetics or breeders seeking to gain access to international markets for export.



The Role of Each Codon

The genetic markers captured in the DNA screening for scrapie are:

- Codon 136 codes for either the amino acid valine (V) or alanine (A);
- Codon 154 codes for either histidine (H) or arginine (R), which plays a minor role in scrapie susceptibility; and
- Codon 171 codes for glutamine (Q), arginine (R), lysine (K), or histidine (H). K has recently been found in a few Barbados sheep, its effect on scrapie resistance has not been studied.

Based on variations of amino acids at codon locations 136, 154 and 171, five different scrapie related alleles in sheep have been identified as follows:

136	154	171
A	R	R
A	H	Q
A	R	H
A	R	Q
V	R	Q

Key: Amino acids: A = alanine; H = histidine; Q = glutamine; R = arginine; and V = valine

Reporting of Test Results

Neogen reports test results in line with the following table developed by the United Kingdom National Scrapie Plan (NSP) (http://adlib.eversite.co.uk/resources/000/054/063/NSP_english.pdf).

The table shows the genotypes identified in sheep and their resistance or susceptibility to scrapie.

Genotype Result	Type	Degree of resistance/susceptibility
ARR/ARR	1	Sheep that are genetically most resistant to scrapie
ARR/AHQ ARR/ARH ARR/ARQ	2	Sheep that are genetically resistant to scrapie, but will need careful selection when used for further breeding
AHQ/AHQ AHQ/ARH AHQ/ARQ ARH/ARH ARH/ARQ ARQ/ARQ	3	Sheep that genetically have little resistance to scrapie and will need careful selection when used for further breeding. Sale and breeding restrictions apply in NSP flocks, ARH / ARH which are breed specific.
ARR/VRQ	4	Sheep that are genetically susceptible to scrapie and should not be used for breeding unless in the context of a controlled breeding program approved by NSPAC (National Scrapie Plan Administration Centre)
AHQ/VRQ ARH/VRQ ARQ/VRQ VRQ/VRQ	5	Sheep that are highly susceptible to scrapie and should not be used for breeding

* This table is subject to continuous scientific review

* The European Union requires Member States to introduce genotype based sheep breeding programs for resistance to Transmissible Spongiform Encephalopathies (TSEs), including scrapie, on a compulsory basis from 1 April 2005 (European Commission Decision 2003/100 EC).

* This compulsory ram genotyping scheme mean that Australian breeders wanting to sell genetics into the UK and Europe will have to be DNA typed.

* There are no breed restrictions, the Scrapie assays work across all breeds and are designed to account for flanking polymorphisms.

INFORMATION SOURCES:

<https://www.agric.wa.gov.au/livestock-biosecurity/scrapie>

https://www.aphis.usda.gov/animal_health/animal_diseases/scrapie/downloads/sheep-scrapieresistance.pdf

http://adlib.eversite.co.uk/resources/000/054/063/NSP_english.pdf

<https://bmcbvetres.biomedcentral.com/articles/10.1186/1746-6148-6-23>

Reveal your flock's potential – Contact us today to find out more!

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