

Project number: 6061
Funding source: EU FP7

Date: Dec 2015
Project dates: May 2010 – Dec 2014

Sustainable Solutions for Small Ruminants (3SR)



Key external stakeholders:

Sheep producers, Sheep processors, Sheep meat consumers, Department of Agriculture, Food and the Marine

Practical implications for stakeholders:

- This project aimed to mine sheep genomic information to understand the genetic basis of gastrointestinal nematode resistance in Texel, Suffolk and Scottish Blackface lambs and ovulation rate in Cambridge sheep.
- Meta-analysis of genome-wide association studies in 3 European sheep populations identified genomic regions associated with nematode resistance and 932 SNP markers in 8 genomic regions (OAR 3, 4, 5, 7, 12, 13, 14 and 21) were genotyped in Irish Texel, Suffolk and Scottish Blackface lambs.
- No SNP were significantly associated with gastrointestinal nematode resistance in Texel, Suffolk or Scottish Blackface lambs.
- Cambridge sheep are highly prolific and carry mutations in 2 genes known to affect ovulation rate (*BMP15* and *GDF9*). A third gene affecting ovulation rate is also segregating in the Athenry Cambridge flock. A genome-wide association study was carried out to map genes controlling ovulation rate in this flock.
- Homozygosity mapping identified 2 promising genomic regions on OAR2 and OAR8.

Main results:

- Phenotypes for nematode resistance were generated for Suffolk (n = 232), Texel (n = 231) and Scottish Blackface (n = 203) lambs.
- A panel of 932 genetic markers at 8 genomic loci previously associated with nematode resistance was generated.
- The markers were tested for association with nematode resistance in Texel, Suffolk and Scottish Blackface lambs.
- No SNP were significantly associated with nematode resistance. A small number of SNP were suggestively associated with nematode resistance.
- Cambridge ewes display extreme variation in ovulation rate and occasional ovarian hypoplasia consistent with the segregation of a major gene controlling this effect.
- Genotyping identified regions of homozygosity on chromosome 2 and chromosome 8 which may encode genes mediating this effect.

Opportunity / Benefit:

Phenotypes for nematode resistance were generated for over 650 lambs and DNA from these lambs was genotyped to identify genetic markers associated with nematode resistance. No single marker was significantly associated with nematode resistance in any of the three breeds, Texel, Suffolk or Scottish Blackface, however the panel of markers may be useful for identifying resistant animals. Mapping genes controlling ovulation rate in Cambridge identified promising genomic regions on OAR 2 and OAR8.

Collaborating Institutions:

INRA and Roslin Institute

Teagasc project team: Dr. Orla Keane (PI)
Dr Barbara Good

External collaborators: Professor Stephen Bishop (Roslin)
Dr Loys Bodin (INRA)

1. Project background:

Irish lamb production is predominantly grass-based and 80% of all lamb produced is exported. The Food Wise 2025 report aims to sustainably increase the value of primary production by 65% to almost €10 billion by 2025. The technical efficiencies required to meet this target will include improvements in animal health and increasing lambing percentage. The identification of genes controlling ovulation rate and nematode resistance can aid the breeding of prolific and robust sheep through genetic selection.

2. Questions addressed by the project:

- Can we identify genetic markers associated with gastrointestinal nematode resistance?
- Can we identify genetic markers associated with ovulation rate?

3. The experimental studies:

Two separate studies were carried out.

1. The objective of the first study was to quantify the nematode resistance status of Texel, Suffolk and Scottish Blackface lambs using faecal egg counts and associate nematode resistance with genetic markers at 8 genomic loci.
2. The objective of the second study was to map genes controlling ovulation rate in Cambridge sheep.

4. Main results:

- The nematode resistance status of Suffolk (n = 232), Texel (n = 231) and Scottish Blackface (n = 203) lambs was determined by a minimum of 2 faecal egg count measurements per lamb.
- A European genome-wide association study meta-analysis using over 4,000 animals and almost 39,000 SNP markers identified genomic regions associated with nematode resistance.
- A panel of 932 genetic markers in these 8 genomic loci was generated.
- The genetic markers were tested for association with nematode resistance in the Irish Texel, Suffolk and Scottish Blackface lambs.
- No single SNP was significantly associated with nematode resistance. A small number of SNP were suggestively associated with nematode resistance.
- Cambridge ewes from the flock in Athenry display extreme variation in ovulation rate and occasional ovarian hypoplasia consistent with the segregation of a major gene controlling this effect.
- Genotyping identified regions of homozygosity on chromosome 2 and chromosome 8 which may encode genes affecting ovulation rate in this flock.

5. Opportunity/Benefit:

Phenotypes for nematode resistance were generated for over 650 lambs belonging to the Texel, Suffolk and Scottish Blackface breeds. DNA from these lambs was genotyped with a panel of markers in genomic loci previously associated with nematode resistance in a European meta-analysis. No single marker was significantly associated with nematode resistance in any of the three breeds, Texel, Suffolk or Scottish Blackface, however the panel of markers may be useful for identifying resistant animals. Mapping genes controlling ovulation rate in Cambridge identified promising genomic regions on OAR 2 and OAR8.

6. Dissemination:

- Bishop, S.C., Riggio, V., Salle, G., Mandonnet, N., Usai, M.G., Casu, S., Keane, O.M., Poli, M.A., Carta, A. and C.R. Moreno 2013 Exploring resistance to nematodes in 3SR sheep and goat populations *64th annual meeting of the EAAP* S54: 2.
- Keane, O.M., Hanrahan, J.P., Tosser-Klopp, G., Sarry, J., Fabre, S., Demars, J. and L. Bodin 2013

Mapping a putative autosomal gene controlling ovulation rate and infertility in Cambridge sheep 64th annual meeting of the EAAP S54: 9.

- Keane, O.M., Mulsant, P., Mullen, M., Bodin, L. and J.P. Hanrahan 2011 Mapping a gene controlling ovulation rate in sheep *International Symposium on Animal Functional Genomics* p84: 103.

7. **Compiled by:** Dr Orla Keane.
