

Research Project Summaries- Small Stock 2012/13

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Foreword

The first and foremost challenge of the South African Government is to alleviate poverty and ensure sufficient and safe food for our people. South Africa and thus the agricultural sector, is confronted with the additional challenges of the worldwide decrease in food production and subsequent effect on imports to South Africa (availability and price); the worldwide recession (job losses); the growth in malnutrition and HIV/Aids infected people in our country (loss of breadwinners); changes in climate (extreme and sporadic weather patterns). The message is clear: increase agricultural production to supply our needs, and safeguard against the impending effects of climate change. In order for agricultural producers (commercial and small holder) to increase their production, lower input technology (lower input cost) and higher output (production) technology is required. The role of research and development in these two factors is of critical importance. New and adaptive technology generated from cutting-edge research efforts will ensure that our producers are sustainable and competitive with limited natural resources (especially water) and are able to adjust to the changing environment (with regard to the effects of climate change). The aim is to secure the foundation to increase agricultural production by 10% over the next ten years.

Agriculture is one of the most important and largest knowledge based sectors in South Africa. Research and development with innovation focused on the farmers' needs is important to underpin agrarian economic growth and to ultimately address food security and rural development. The Directorate: Animal Sciences of the Department of Agriculture Western Cape is geared to meet these challenges. The dedicated group of animal science experts and supporting staff has established this research team as one of the most important and productive groups in South Africa. Three specialist scientists from the Directorate: Animal Sciences are appointed as professors extraordinaire at the University of Stellenbosch, Department of Animal Sciences. Their appointments endorse their outstanding professional and scientific status and their major contribution to human capital development in terms of post-graduate students and mentorship. The specialist scientists are recognized for their contribution to the international scientific community with both local and international research collaborations. Research is supported by extensive infrastructure and research support services.

Our support to and participation in the Cape Wools 9th World Merino Conference is indicative of our commitment to our respective agricultural industries and commodities and their research and development endeavors.

Dr Ilse Trautmann

**Chief Director: Programme: Research and Technology Development Services
Western Cape Department of Agriculture**

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1. The evaluation of raw materials in small stock

Project Leader: Prof TS Brand

The Swartland area situated in the winter rainfall region of South Africa is a cereal growing area with many farms producing autumn lambs. Pregnant and lactating ewes are therefore dependent on crop residues during the summer and early autumn before appearance of the first autumn rains. Cereal stubble refers to plant material that is available on the land after harvesting the grain and green herbage as a result of the germination of weed seeds and spilt grain following rain. During the dry summer months, supplementation on wheat and canola stubble lands grazed by reproducing sheep is essential. Low levels of nitrogen and available carbohydrates, poor digestibility and high cell wall content characterize wheat stubble. Wheat stubble cannot supply sufficient nutrients to fulfil the high protein and energy needs of the reproducing ewe, and this necessitates the provision of supplementary feeding for ewes grazing wheat stubble to provide additional energy and protein. Due to the low digestibility of wheat stubble and other crop residues, there is a reduced intake of the available stubble, which results in a larger decrease in the nutrient intake by the ewe. This project focuses on supplementary feeding strategies for small stock as well as feedlot experiments for the finishing of lambs. The study includes meat science studies that are executed in collaboration with the Meat Science Division of the University of Stellenbosch. The development and maintenance of NIRS systems to determine the chemical composition of feedstuffs for small stock form part of this program. Fistulised wethers to provide rumen liquid for *in vitro* analysis in the animal nutrition laboratory are also maintained under this project. Advisory services include the provision of literature on small stock nutrition as well as least cost ration balancing for producers and companies.

References for further information on this project:

Viljoen, M., Brand, T.S., Hoffman, L.C. & Manley, M., 2002. Gebruik van Naby Infrarooi Refleksie Spektroskopie (NIRS) om die chemiese samestelling van voere te bepaal. *Elsenburg Joernaal* 2002, 41-46. (In Afrikaans).

Brand, T.S., Cruywagen, C.W., Brandt, D.A., Viljoen, M. & Burger, W.W., 2003. Variation in the chemical composition, physical characteristics and energy values of cereal grains produced in the Western Cape area of South Africa. *South African Journal of Animal Science* 33, 117-126.

Viljoen, M., 2003. The use of near infrared reflectance spectroscopy (NIRS) for the chemical analysis of meat and feedstuffs. M.Sc. Thesis. University of Stellenbosch, Stellenbosch 7600.

Viljoen, M., Brand, T.S. & Hoffman, L.C., 2004. The use of near infrared reflectance spectroscopy (NIRS) for the chemical analysis of ostrich meat. *Meat Science* 69, 255-261.

Brundyn, L., Brand, T.S., Ferreira, A.F., Aucamp, B.B. & Durand, A., 2005. Rumen inert fat or starch as supplementary energy source for reproducing ewes grazing wheat stubble. *South African Journal of Animal Science* 6, 8-12.

Brundyn, L., Brand, T.S., Ferreira, A.V., Aucamp, B.B. & Durand, A., 2005. The effect of frequency of supplementation on the production of South African Mutton Merino ewes grazing wheat stubble. *South African Journal of Animal Science* 6, 13-18.

Brundyn, L., Brand, T.S., Ferreira, A.V., Aucamp, B.B. & Durand, A., 2005. The carry-over effect of supplementation in the previous year on the production of SA Mutton Merino ewes. *South African Journal of Animal Science* 6, 19-24.

Viljoen, M., Brand, T.S. & Hoffman, L.C., 2005. Differences in the chemical composition and digestibility of cereal straw and hay produced in a Mediterranean rainfall area of South Africa. *Plant and Soil* 22, 106-109.

Viljoen, M., Brand, T.S. & Hoffman, L.C., 2005. Prediction of the chemical composition of winter grain and maize with near infrared reflectance spectroscopy. *Plant and Soil* 22, 89-93.

Viljoen, M., Hoffman, L.C. & Brand, T.S., 2007. Prediction of the chemical composition of mutton with NIRS. *Small Ruminant Research* 69, 88-94.

Brand, T.S., 2007. Oorsig van kleinvee Navorsing. NWKV Inligtingsdag, Graafwater, Januarie, 2007. (In Afrikaans).

Brand, T.S., 2007. Stoppelweiding. *Suid-Kaap Landbou bylaag*, bls. 9. (In Afrikaans).

Brand, T.S., 2007. Kruipvoeding en byvoeding op stoppelweiding bekyk. *Landbou Burger* 13 April 2007. (In Afrikaans).

Brand, T.S., 2007. Beweiding op kanolastoppel en byvoeding ondersoek. *Landbou Burger* 27 April 2007. (In Afrikaans).

Brand, T.S., 2007. Weiding op graanstoppel verg byvoeding. *Landbou Burger* 25 Mei 2007. (In Afrikaans).

Brand, T.S., 2007. Oordrag-invloed van byvoeding in vorige jaar op produksie van oie. *Landbou Burger* 15 Junie 2007. (In Afrikaans).

Brand, T.S., 2007. Die invloed van ontdopping op die voedingswaarde van lupiene. Proteïen Navorsing Stigting, Junie 2007. *(In Afrikaans)*

Brand, T.S., 2007. Lupiene uitstekende byvoeding vir skape. *Landbou Burger* 28 September 2007, bls. 6. *(In Afrikaans)*.

Brand, T.S., 2007. Kleinveewenke. *Wolboer* Julie 2007, bls. 14. *(In Afrikaans)*.

Brand, T.S., 2007. Studies met verbyvloei proteïen bied nuwe insigte. *Landbou Burger* 13 Julie 2007, bls. 2. *(In Afrikaans)*.

Brand, T.S., 2007. Gesinkroniseerde lekke verhoog vertering. *Landbou Burger* 10 Augustus 2007, bls. 2. *(In Afrikaans)*.

Brand, T.S., 2007. Wes-Kaap nuus: Verbyvloei proteïen. *Wolboer* Augustus 2007, bls. 8. *(In Afrikaans)*.

Brand, T.S., 2007. Sheep and Goats. Overcome deficiencies. *Farming SA* December 2007.

Brand, T.S., 2008. Teling by skape en bokke. *Infopak*. Departement van Landbou. *(In Afrikaans)*.

Brand, T.S., 2008. Breeding in sheep and goats. *Infopak*. Department of Agriculture.

Brundyn, L., Brand, T.S. & Aucamp, B.B., 2008. Die waarde van kanolastoppel vir skape. *Elsenburg Joernaal* Maart 2008. *(In Afrikaans)*.

Brand, T.S., 2008. Sheep and Goats. How to make selections. *Farming SA* February 2008.

Brand, T.S., 2008. Reproduction management tips. *Farming SA* January 2008.

Aucamp, B.B. & Brand, T.S., 2008. Die benutting van laekoste oesreste vir die produksie van superfynwol onder ingekraalde toestande in die Wes-Kaap. *Elsenburg Joernaal* Junie 2008. *(In Afrikaans)*.

Brundyn, L., Brand, T.S. & Aucamp, B.B., 2008. The carry-over effect of supplementation in the previous year on the production of SA Mutton Merino ewes. *Elsenburg Journal* June 2008.

Van der Westhuizen, E.J., Brand, T.S. & Hoffman, L.C., 2010. The effect of age on fat distribution in Merino lambs. *South African Journal of Animal Science*, 40 (Issue 5, Supplement 1).

Brand, T.S., 2009. Teling by skape en bokke. *Infopak*. Departement van Landou: Wes-Kaap. (In Afrikaans).

Brundyn, L., Brand, T.S., Ferreira, A.V., Aucamp, B.B. & Durand, A., 2009. The effect of frequency of supplementation on the production of SA Mutton Merino ewes grazing wheat stubble. *Elsenburg Journal* 6, 1.

Brand, T.S., 2010. Voeding van reproduserende skape en bokke. *Infopak* Departement van Landbou: Wes-Kaap. (In Afrikaans).

Brand, T.S., 2010. Voeding van reproduserende skape en bokke. *Infopak* Departement van Landbou: Wes-Kaap. (In Afrikaans).

Van der Westhuizen, E.J., Brand, T.S., Hoffman, L.C. & Aucamp, B.B., 2010. The effect of age and gender on the fat distribution in Merino lambs. *South African Journal of Animal Science* 40, 459-461. Peer-reviewed paper: *Proceedings of the 43rd Congress of the South African Society for Animal Science*.

Terblanche, S., Brand, T.S., Jordaan, J.W. & Van der Walt, C.J., 2012. Production response of lambs receiving creep feed while grazing two different pastures. *South African Journal of Animal Science* 42, 535-539. Peer-reviewed paper: *Proceedings of the 44th Congress of the South African Society for Animal Science*.

Brand, T.S., 1996. The nutritional status and feeding practices of sheep grazing cultivated pasture and crop residues in a Mediteranean environment. Ph.D. Thesis, University of Stellenbosch.

Aucamp, B.B., 2003. Byvoeding van skape op aangeplante weiding in 'n Mediterreense klimaat. M.Tech. Tesis, Nelson Mandela Metropolitaanse Universiteit. (In Afrikaans)

Brundyn, L., 2003. Byvoeding van skape op graanstoppellande. M.Sc. Tesis. Universiteit van Stellenbosch. (In Afrikaans).

Viljoen, M., 2003. The use of near infrared reflectance spectroscopy (NIRS) for the chemical analysis of meat and feedstuffs. M.Sc. Thesis, University of Stellenbosch.

Van der Westhuizen, E.J., 2010. The effect of slaughter age on the lamb characteristics of Merino, South African Mutton Merino and Dorper lambs. M.Sc. Thesis, University of Stellenbosch.

2. Technical development of an accelerated breeding practice for intensive mutton production systems on irrigated Lucerne pasture

Project Leaders: Prof TS Brand and Mr S Terblanche

A study was conducted to evaluate the conception rate of Dohne Merino ewes in an intensive mutton production system with accelerated breeding applied. The study was conducted at the Kromme Rhee research farm, near Stellenbosch. Ninety two Dohne Merino ewes with a normal distribution with regard to age structure were used in the experiment and were allocated to irrigated Lucerne paddocks. The paddocks were divided into equal size of 0.85 ha and rotational grazing was applied at a stocking rate of 15 SSU (small stock units) per ha. Rams were allocated at a ratio of 1:50 and left with the ewes throughout the year. A self-formulated creep feed and lick were provided to the lambs and ewes respectively at an *ad libitum* basis and animals had access to fresh water. The experimental animals were weighed every second week and lambs were weaned at approximately 120 days of age. Analysis of variance (ANOVA) was performed on observed variables, using SAS. A probability level of 5% was considered significant for all significance tests. Pearson correlations were calculated to determine the degree of linear relationship that exists between observed variables and days to conception, as well as amongst each other. There was no significant difference in days to conception between ewes that gave birth to single, twin or triplet lambs ($P=0.53$) and also no significant difference in conception weight of the ewes bearing single, twin or triplet lambs ($P=0.68$). The statistical procedures identified that 65% of the ewes conceived before 80 days after lambing. Pearson correlations indicated no evidence of a linear relationship between any of the observed lamb variables and days to conception of the ewe. A positive correlation ($r=0.22$, $P=0.01$) between birth weight total and days to conception was obtained. Preliminary results indicated that a more rapid breeding system is achievable on irrigated pasture. However, the sustainability of such a system needs to be tested further.

Data are collected on a continuous basis, to determine the economic viability of the system as well as the effect of the accelerated breeding practice of the ewe on the live time production of the ewe.

3. Development of a model for lamb production for sheep and slaughter kids in goats: Determining the effect of dietary level on feed intake, production and meat characteristics and composition

Project Leaders: Prof TS Brand and Ms M Genis

The acceptability of meat is dependent on the toughness (chewiness and resistance), flavour and succulence (juiciness) of the meat. It is known that dietary energy as well as the inclusion of a β -adrenergic agonist influences the sensory, physical and chemical characteristics of the meat. To quantify the effect of these two parameters, one hundred and twenty South African Mutton Merino lambs, weaned at ca 120 days of age, of different gender were housed in individual pens for approximately 6 weeks (40 days). The treatments consisted of three different dietary energy level diets (high-12.7 MJ/ME/kg food; medium-12.0 MJ/ME/kg food; low-11.3 MJ/ME/kg food) with either the inclusion or absence of a β -adrenergic agonist (Zilpaterol hydrochloride, 8.6 g/ton) in the diet. The experimental design was a 2 x 2 x 3 factorial design with gender, β -adrenergic agonist and dietary energy as main factors. No significant differences ($P>0.05$) due to dietary energy level or the inclusion of the β -antagonist were found for the physical characteristics of the meat. There was however significant ($P<0.05$) differences found during the sensory testing for tenderness between gender (76.2% for ewes vs 72.0% for rams) and between the β -agonists groups (75.4% vs 72.9% for the inclusion of the β -antagonist). Sustained juiciness was also affected ($P<0.05$) by gender (68.0% for ewes vs 65.7% for rams) and the inclusion of a β -agonists groups (67.9% absent vs 65.8% included). Overall it was concluded that, of all three main effects, gender had affected the meat attributes the most.

4. An investigation into the use of entomopathogens as control option against the sheep body louse, *Bovicola ovis*, in South Africa

Project Leaders: Prof SWP Cloete and Dr AJ Scholtz

Five "lousy" sheep were purchased from industry sources and were maintained in a quarantine facility at the Langgewens Research Farm between Moorreesburg and Malmesbury in the Swartland. These sheep were maintained for the sole purpose to act as reservoirs for lice in the project. They will be referred to as carrier sheep. In addition twenty four Merino ewes (specialist wool breed), twelve SA Mutton Merino ewes (dual-purpose breed) and twelve Dorper ewes (meat breed) were maintained with the carrier sheep to ensure adequate challenge by natural infestation. These ewes received no treatment with insecticides and are referred to as infested ewes. Four contemporary animals of each breed (n=16) were also kept separately and were sprayed annually with a registered organophosphate dip to remain louse free (referred to as control animals). These animals were maintained to assess the impact of lice infestation upon wool traits and live weight on the infested animals. Lice on the carrier sheep were counted on four locations on each sheep on a monthly basis for a two year period; from mid-June 2010 to mid-May 2012. The wool was parted for 10 cm at each of four body locations, and all lice that were seen counted. Owing to extreme variation between animals, total lice counts were transformed to square roots prior to analysis.

Total lice counts per carrier sheep averaged 17.2 ± 3.6 during December 2010 and 15.5 ± 3.6 during December 2011. Shearing had a profound effect on total lice counts in both years. After shearing in December, total lice counts immediately dropped to below 3 lice per sheep during both years. Repeatability (\pm SE) was estimated at 0.34 ± 0.18 for total lice count, which is somewhat higher than the estimate reported in the previous progress report. Further research on larger numbers of sheep is needed to establish whether lice counts are repeatable and whether it could be used for the detection of lice, or for selection of sheep that do not get infested with lice, despite adequate challenge.

Previous results indicated that high levels of lice infestation failed to establish in Dorper sheep. Based on this result, ewes (16 – 1 dead = 15) from this genotype were excluded subsequently. No differences were accordingly found between the two Merino lines included in the study. These animals were therefore also pooled. The study was thus reduced to only include Merinos (representing woolled sheep) and SA Mutton Merino (representing dual-purpose sheep) kraaled together with the carrier animals. No louse control was practiced in these sheep.

The spread of infestation was monitored by the monthly counting of *B. ovis* specimens in four wool parts, as for the carrier sheep. Ewes were also weighed when lice were counted. Infested sheep and control sheep of the wool and dual-purpose breeds were shorn in July 2011 and 2012 when they had a one year wool-growth. Fleeces were weighed to obtain greasy fleece weight (GFW). At this stage wool samples were taken and send to the Wool Testing Bureau in Port Elizabeth to be analyzed for:

- Clean yield (CY)
- Staple length (SL)
- Fibre diameter (FD)
- Coefficient of variation of fibre diameter (CV of FD)
- Staple strength (SS)
- Clean fleece weight (CFW) determined

The spread of the infestation was initially slow from June 2010 and the first mentionable levels of infestation by *B. ovis* only became evident by October 2010. After a year (June 2011), geometric means for total lice counts (totalled over the 4 body locations) differed from zero. Lice counts also differed markedly between breeds, with Merinos recording markedly higher lice counts than SA Mutton Merinos (12.3 ± 1.2 vs. 0.43 ± 0.24 respectively). As in the carrier sheep, shearing resulted in a marked reduction in total lice counts in this breed, to ~4 lice in July 2011.

Sheep body louse infestation resulted in slightly lower live weights in infested sheep than in comparable control sheep, amounting to a ~9% weight difference at the end of the treatment period in May 2012. (Clean fleece weight (13%) and clean yield (3%) were also compromised.

Findings from this project confirms previous results suggesting that woolled sheep breeds appeared to be more susceptible to infestation with *B. ovis* than the dual-purpose breed. Based on this result, SA Mutton Merinos were also excluded from further studies, as the transient nature of lice infestation in these animals would complicate assessment of compounds administered to control lice infestation. The infestation was allowed to continue on the Merinos after shearing in July 2012, to allow for further studies on nematophageous fungi.

References for further information on this project:

Scholtz, A.J., Cloete, J.J.E. & Cloete, S.W.P., 2011. The effect of infestation with the sheep body louse on live weight and wool traits of Merino and SA Mutton Merino sheep. *South African Society for Animal Science (SASAS) 44th Congress*, Stellenbosch University, Stellenbosch, 11 – 14 July 2011. *Poster presentation*.

5. The establishment of a specialist fine wool line at Tygerhoek

(Final Project Report Summary 2012/2013)

Project Leader: Prof S.W.P. Cloete

A Merino line selected for a reduced fibre diameter (Fine wool line) was compared with a random selection control flock. Foundation sires in the Fine wool line were initially obtained from the parent stud at Craddock and industry, followed by within flock selection. Selection was for a reduced fibre diameter, while maintaining live weight. Data of ~2700 records of hogget live weight (LW), clean fleece weight (CFW), staple length (SL), staple strength (SS), and fibre diameter (FD) recorded from 1998 to 2009 were used to derive genetic parameters for all traits in a five-trait animal model. Genetic parameters were consistent with literature values. Estimated breeding values (EBVs) in each year provided genetic trends in the two flocks. In the Fine wool line, EBVs for FD were reduced by 1.01% per annum ($-0.19 \pm 0.02 \mu\text{m}$) relative to the phenotypic mean for FD. There was also some evidence of favourable genetic change in LW and CFW in the Control flock. Fine wool line progeny maintained their LW, but showed declines in CFW, SL and SS. The improvement in FD in the Fine wool line should be balanced against the deterioration of CFW and SS.

The accumulated outputs are described in the publication:

Cloete, S.W.P., Olivier, J.J. & Du Toit, E.E., 2013. Genetic trends in a Merino line selected for a reduced fibre diameter relative to an unselected control flock. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 20, 377-380.

6. The management, long-term conservation and selection of the South African Mutton Merino (SAMM) resource flock at Elsenburg Research Farm

Project Leaders: Prof SWP Cloete and Dr JJE Cloete

The project started on 31 March 2012 and data for only a single year is available. Initially, 55 ewes were mated with an average mating weight of 65.7 kg. Of these, 53 ewes were available after lambing. Lambing percentage per ewe mated amounted to 144% and weaning percentage to 109%. Corrected weight of lamb weaned per joining was 24.9 kg.

Average lamb birth weight amounted to 4.6 kg and weaning weight to 22.8, with a pre-weaning survival rate of 76%.

Note: Research on this flock has been published prior to the registration of the current project. For further information, please contact the project leaders.

7. The management, selection and long-term conservation of the Dormer resource flock at Elsenburg Research Farm

Project Leaders: Prof SWP Cloete and Mrs ACM Kruger

The project started on 31 March 2012 and data for only a single year is available. Initially, 132 ewes were mated with an average mating weight of 72.2 kg. Of these, 129 ewes were available after lambing. Lambing percentage per ewe mated amounted to 154% and weaning percentage to 137%. Corrected weight of lamb weaned per joining was 37.3 kg. Average lamb birth weight amounted to 4.4 kg and weaning weight to 27.2, with a pre-weaning survival rate of 89%.

Note: Research on this flock has been published prior to the registration of the current project. For further information, please contact the project leaders.

8. The management, long-term conservation and selection of the Merino sheep resource flock at Elsenburg Research Farm

Project Leader: Prof SWP Cloete

The project started on 31 March 2012 and data for only a single year is available. Initially, 147 ewes were mated in the H line and 40 in the L line. Of these, respectively 136 and 36 ewes were available after lambing. Lambing percentage per ewe mated amounted to 118% in the H line and 111% in the L line. Weaning percentages were 92 and 78% respectively, and corrected weight of lamb weaned per joining were 20.7 and 13.7 kg respectively.

Lamb birth weight amounted to 4.0 kg in the H line and 3.7 kg in the L line. Respective weaning weights were 19.2 and 23.7 kg and pre-weaning survival rates were 79% and 72% in the H and L lines respectively.

The better performance of the H line was expected, although previous experience suggested that a larger line difference is usually expected. Part of the reason for the smaller than expected line difference could be a high rate of barrenness (36%) in the ewes mated to a specific H line ram. This level of barrenness was almost double that of the worst faring L line lamb (19%), whereas the rest of the rams had barrenness percentages of between 0% and 13%. The poorer than expected performance of the H line ewes derived from embryo transfer may also have contributed. These results will be studied further in the following years.

Note: Research on this flock has been published prior to the registration of the current project. For further information, please contact the project leader.

9. The management, long-term conservation and selection of the fine wool Merino resource flock at Tygerhoek Research Farm

Project Leader: Prof SWP Cloete

The small stock industry relies mostly on meat and wool as sources of revenue for producers. Fibre diameter is the dominant quality trait in wool sheep that affects wool price. Sheep with a lower fibre diameter (finer wool) can be as profitable, or even substantially more profitable, than heavier-cutting sheep with stronger wool. The Australian wool industry produced superfine wool (<15µm) in fine-wool animals kept in sheds at below maintenance rations. However, this practice is being discontinued on welfare grounds. The remaining option is to breed superfine wool, using the high heritability of fibre diameter to drive genetic change. A fine-wool resource flock has been maintained at the Tygerhoek Research Farm since 1998, alongside a line selected for an increased fleece weight and an unselected control line. Fibre diameter in this flock was reduced by >1% per annum in this flock, leading to a 2µm reduction in fibre diameter since 1998. The further conservation of the flock is thus needed. The newly registered project started at 1 April 2013, and no results are available as of yet.

Note: Research on this flock has been published prior to the registration of the current project. For further information, please contact the project leader.

10. The effect of selection for clean fleece weight on production and reproduction of Merino sheep at Tygerhoek

(Final Project Report Summary 2012/2013)

Project Leader: Prof SWP Cloete

The project was terminated after 40 years in 2009. It resulted in numerous publications during the period it was operational. The final report can be summarized as follows:

Initial results involved three lines, namely a line selected for an increased clean fleece weight with a check on fibre diameter (CFW line), a line selected for an increased wool Secondary:Primary follicle ratio (S:P line), and an unselected Control line (Heydenrych *et al.*, 1984). Direct selection in the CFW line resulted in a 1.2 % per annum improvement in CFW relative to the overall mean, while indirect selection resulted in a correlated response in CFW amounting to 0.4 % per annum in the S:P line. Both ways of selection did not result in marked unwanted increases in fibre diameter. The S:P line was discontinued in 1982 and only the CFW and Control lines were retained.

Direct response to direct selection for clean fleece weight in the CFW line was reported to be 1.1 % per annum up to 1990 expressed relative to the overall mean (Cloete *et al.*, 1992), and 0.9 % per annum up to 1996 (Cloete *et al.*, 1998a). The control line showed some genetic drift, in particular for live weight (Cloete *et al.*, 1992; 1998a). This trend was related to unintended selection for size in the Control group rams, where low live weight rams performed poorly under hand-mating conditions (Cloete *et al.*, 1992). Low live weight ewes were also shown to be less likely to contribute progeny for replacements to the breeding flock, because of a greater likelihood of remaining barren. The flock also contributed data to a study investigating the heritability of total weight of lamb weaned per joining (TWW) as a reproductive trait (Snyman *et al.*, 1998a). Positive genetic correlations of TWW were found with live weight, while correlations with fleece weight and fibre diameter were positive, but not significant.

A few key references for further information on this project:

Cloete, S.W.P., 1986. A study of phenotypic and genetic aspects of reproduction rate in the Tygerhoek Merino flock. M.Sc. (Agric.) Thesis, University of Stellenbosch.

Cloete, S.W.P., Delport, G.J., Erasmus, G.J., Olivier, J.J., Heydenrych, H.J. & du

Toit E., 1992. Environmental and genetic trends in clean fleece mass, live mass and fibre diameter in selection and control flocks involving a selection experiment for increased clean fleece mass in South African Merino sheep. *South African Journal of Animal Science* 22, 50-57.

Cloete, S.W.P., Olivier, J.J. & du Toit, E., 1992. Linear type traits in a Merino flock subjected to selection for increased clean fleece mass and an unselected control flock. *South African Journal of Animal Science* 22, 70-73.

Cloete, S.W.P., Olivier, J.J. & du Toit, E., 2001. Blowfly strike of Merino sheep in relation to selection strategy, as well as to objective and subjective wool traits. *Proceedings of the Flystrike and Lice IPM Control Strategy Conference*, 22-25 June 2001, Launceston, Tasmania, pp 395-401.

Cloete, S.W.P., Olivier, J.J., du Toit, E. & Dreyer, F.H., 2007. Genetic analysis of faecal worm egg count in South African Merinos under natural challenge. *South African Journal of Animal Science* 37, 237-247.

Cloete, S.W.P., Olivier, J.J. & Olivier, W.J., 2007. Genetic change in South African Merino resource flocks. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 17, 320-323.

Cloete, S.W.P., Olivier, J.J., Snyman, M.A. & du Toit, E., 1998. Genetic parameters and trends in a selection experiment for increased clean fleece weight involving South African Merinos. *Australian Journal of Experimental Agriculture* 38, 427-432.

Matebesi, P.A., Cloete, S.W.P. & Van Wyk, J.B., 2007. Genetic parameters for subjectively assessed wool traits and objectively measured wool traits and live weight in Tygerhoek Merino flock. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 17, 332-335.

Matebesi, P.A., Cloete, S.W.P. & Van Wyk, J.B., 2009. Genetic parameter estimation of 16-month live weight and objectively measured wool traits in the Tygerhoek Merino flock. *South African Journal of Animal Science* 39, 73-82.

Matebesi, P.A., Van Wyk, J.B. & Cloete, S.W.P., 2009. Genetic parameters for subjectively assessed wool and conformation traits in the Tygerhoek Merino flock. *South African Journal of Animal Science* 39, 176-187.

Matebesi, P.A., Van Wyk, J.B. & Cloete, S.W.P., 2009. Relationships of subjectively assessed wool and conformation traits with objectively measured wool and live weight traits in the Tygerhoek Merino flock. *South African Journal of Animal Science* 39, 188-196.

Naidoo, P., Cloete, S.W.P. & Olivier, J.J., 2004. Heritability estimates and correlations between subjectively assessed and objectively measured fleece traits in Merino sheep. *South African Journal of Animal Science* 34 (Supplement 2), 38-40.

Schoeman, S.J., Cloete, S.W.P. & Olivier, J.J., 2010. Returns on investment in sheep and goat breeding in South Africa. *Livestock Science* 130, 70-82.

Snyman, M.A., Cloete, S.W.P. & Olivier, J.J., 1998. Genetic and phenotypic correlations of total weight of lamb weaned with body weight, clean fleece weight and mean fibre diameter in three South African Merino flocks. *Livestock Production Science* 55, 157-163.

11. The effect of selection of Dormer sheep on direct breeding values for growth and carcass quality on traits of economic importance

(Final Project Report Summary 2012/2013)

Project Leader: Prof SWP Cloete

Separate analyses were conducted on a commercial stud with scanning records, and the Elsenburg Dormer flock. The first analyses included either yearling conformation or weaning weight analyzed together with yearling weight and scanning traits (fat depth and eye muscle depth). Heritability estimates for weight traits reached a level of double the corresponding standard error, but not for conformation or scanning traits. Genetic correlations among all traits were positive and mostly >0.50 . However, genetic correlations involving scanning fat depth and conformation in combination with yearling weight and eye muscle depth had high standard errors. It should also be considered that positive genetic correlations with fat depth are not necessarily good, as consumers prefer leaner meat. In the Elsenburg flock, heritability estimates were as expected for birth weight and post weaning weight, but not for weaning weight. Further studies are indicated to obtain more accurate genetic parameters for scanning traits in South African sheep.

References for further information on this project:

Van Wyk, J.B., Fair, M.D. & Cloete, S.W.P., 2006. Case Study: The effect of inbreeding on the production and reproduction traits in the Elsenburg Dormer sheep stud. *Livestock Science* 120, 218-224.

Cloete, S.W.P. & Olivier, J.J., 2009. Genetic and environmental effects affecting live weight, conformation and scanned carcass traits in a Dormer stud. *Programme and Summaries booklet, 43rd Congress of the South African Society for Animal Science*, 28–30 July 2009, Alpine Heath Conference Village, KwaZulu-Natal, p. 18.

Kruger, A.C.M. & Cloete, S.W.P., 2012. Production differences between Dormer and South African Mutton Merino sheep. Short paper, *Proceedings of the 30th Congress of the South African Society for Agricultural Technologists*, 18–20 September 2012, KwaZulu-Natal.

12. The quantification of the South African ovine genetic resource

Project Leaders: Prof SWP Cloete and Dr JJE Cloete

This study evaluated the differences in the bone-fat-muscle yield of Namaqua Afrikaner, Dorper and SA Mutton Merino (SAMM) ram lambs. The animals were reared under Mediterranean conditions at the Norrier Experimental farm. The breeds constituted an indigenous, hardy and late-maturing, fat-tail breed (Namaqua Afrikaner), an early-maturing commercial meat breed (Dorper) and a late-maturing commercial dual-purpose breed (SAMM). Ram lambs from each breed were slaughtered between 30 and 50 days post weaning. The carcasses were separated into commercial cuts (leg, loin, rib and shoulder) and deboned. Meat and fat were separated and weighed to calculate the bone-fat-muscle yield per cut. Least-square means (LSM) were computed with slaughter age as co-variate.

On analysis of the entire carcass, no differences ($P>0.05$) were found for percentage bone and fat between the Namaqua Afrikaner, Dorper and SA Mutton Merino (SAMM) breeds. No differences in the percentage bone, fat or muscle were found between the Dorper and SAMM in any of the commercial cuts. In comparison with the Dorper, the Namaqua Afrikaner had a higher % of bone in the leg, loin and rib cuts. However, the % of bone in the leg and loin cuts did not differ between the SAMM and Namaqua Afrikaner breeds. Only the % of bone in the rib cut of the Namaqua Afrikaner was higher than that of the SAMM. No differences in the shoulder cut were observed between breeds. With the exception of the shoulder, the Namaqua Afrikaner had a lower % of meat than the Dorper or SAMM. Although the rib of the Namaqua Afrikaner had a lower % of meat than that of the Dorper, it did not differ from the SAMM rib. The % of meat in the leg of the Namaqua Afrikaner was lower than in the SAMM, but did not differ from the Dorper leg. The percentage fat in the commercial cuts did not differ between breeds, except for the loin where that of the Namaqua Afrikaner was lower than that of the Dorper. The lower meat yield, particularly in the more expensive loin and leg cuts weighs against the indigenous Namaqua Afrikaner breed, when compared to the commercial breeds.

The response of 305 approximately 4-month-old Namaqua Afrikaner, Dorper and South African Mutton Merino lambs to a human being was studied in an arena test. A total number of 305 animals born in 2010 and 2011 and raised under extensive veldt conditions were assessed in a modified arena test. From the test results it was possible to calculate the following parameters to describe the behaviour of the sheep: (i) The mean distance from the human operator. (ii) The time a lamb spent in a specific zone (one the closest to the human and three the furthest from the human operator). (iii) The total number of boundaries

crossed, giving an indication of the total distance travelled by an individual. Other data recorded were the number of bleats and the number of times an animal urinated or defecated.

No conclusive breed differences were found for any of the traits describing the behaviour of the lambs in the latter breeds, except for the number of bleats. Namaqua Afrikaner lambs bleated more in a three minute testing period than Dorpers and SAMM lambs. There were also no significant gender and birth type differences for any of the behaviour traits. Based on the breed difference in number of bleats it could be argued that the Namaqua Afrikaners were more anxious under test conditions. It is known from casual observations that Namaqua Afrikaners have strong flocking instincts and that being separated from their flock would create stress. Further research is necessary to see if this slight indication of anxiety would be related to other traits such as lamb survival or product quality.

The effect of pure breeding relative to terminal crossbreeding on offspring live weights and survival was studied in the two major South African wool breeds, namely the Merino and the Dohne Merino. The study was conducted on 1189 lambs on the Langgewens experimental farm in the Swartland as the progeny of Merino and Dohne Merino mated to rams of their own breed or to Dorper and Suffolk rams as terminal sires. The data were analysed by least squares procedures and the analyses included the fixed effects of dam breed (Merino or Dohne), breeding regime (pure or terminal cross), year (2007 to 2011), sex (ram or ewe), age of dam (2 to 7+ years) and birth type (singles or pooled multiples). Year, sex, age of dam and birth type effects were consistent with expectations and will not be reported, unless interacting with dam breed or breeding regime.

Dam breed affected birth weight, lambs borne by Dohne ewes being 11% heavier than those borne by Merinos. Birth weight was independent of breeding regime (5.16 ± 0.10 kg for crossbreeding vs 5.05 ± 0.09 kg for pure breeding). Lamb survival was affected by an interaction of dam breed x birth type. Single-born lambs born by Dohne ewes had a better proportional survival than multiples (0.118 ± 0.024 vs 0.192 ± 0.025), while no difference was found for lambs born by Merino ewes (respectively 0.237 ± 0.032 vs 0.208 ± 0.022). No conclusive advantage for crossbred lambs relative to purebred lambs could be demonstrated (respectively 0.175 ± 0.019 vs 0.194 ± 0.019). Weaning weight was affected by both dam breed and breeding regime. Progeny of Dohne ewes were 13% heavier than those of Merino ewes (35.0 ± 0.4 vs 31.0 ± 0.04 kg) and crossbred progeny were 14% heavier than their purebred contemporaries (35.1 ± 0.4 vs 30.9 ± 0.05 kg). Research on the possible advantages of crossbreeding for commercial production in the South African sheep industry is thus continuing at Langgewens.

References for further information on this project:

Burger, A., Hoffman, L.C., Cloete, J.J.E., Muller, M. & Cloete, S.W.P., 2012. Carcass composition of Namaqua Afrikaner, Dorper and SA Mutton Merino ram lambs. *Proceedings of the 45th South African Society of Animal Science Congress*, 9–12 July 2012, East London, p. 18.

Cloete, J.J.E., Cloete, S.W.P., Scholtz, A.J. & Hoffman, L.C., 2012. Behaviour of Namaqua Afrikaner, Dorper and South African Mutton Merino lambs in response to humans. *Proceedings of the 45th South African Society of Animal Science Congress*, 9–12 July 2012, East London, p. 25.

Cloete, J.J.E., Cloete, S.W.P. & Hoffman, L.C., 2011. Slaughter and carcass characteristics of lambs from Merino and Dohne Merino ewes in pure or crossbreeding systems with Dormer or Suffolk rams. *Book of Abstracts, 44th Congress of the South African Society for Animal Science*, 11-14 July 2011, Stellenbosch, p. 50.

Cloete, J.J.E., Cloete, S.W.P. & Scholtz, A.J., 2011. Tick burdens of breeding ewes grazing natural pastures. *Book of Abstracts, 44th Congress of the South African Society for Animal Science*, 11-14 July 2011, Stellenbosch, p. 80.

Cloete, S.W.P., Cloete, J.J.E. & Hoffman, L.C., 2012. Live weight and survival of lambs from Merino and Dohne Merino ewes subjected to pure and terminal crossbreeding. *Proceedings of the 45th South African Society of Animal Science Congress*, 9–12 July 2012, East London, p. 26.

Scholtz, A.J., Cloete, S.W.P. & Cloete, J.J.E., 2011. Preliminary results on the tick burdens of South African breeding ewes on natural pastures. *Proceedings of the 3rd International Conference on Sustainable Animal Agriculture for Developing Countries*, 26-29 July 2011, Nakhon Ratchasima, Thailand, Volume II: Abstracts, p. 90.

13. The propagation of Merino lines divergently selected for reproduction by multiple ovulation and embryo transfer (MOET)

Project Leaders: Prof SWP Cloete and Mrs ACM Kruger

Expressed relative to ewes flushed, there were no line differences in the number of *Corpora lutea* observed, the number of transferable embryos, the number of lambs born or the number of lambs weaned ($P>0.25$) from 2009 to 2012. The total number of embryo lambs that were born was 65 in 2009, 61 in 2010, 86 in 2011 and 36 in 2012, thus numbering 248 lambs in total. These relatively small numbers make statistical comparison difficult. Absolute means for birth weight were comparable between lines. H line lambs reared by the recipient ewes were consistently heavier at weaning, with a suggested better lamb survival in the early years (respectively 81 vs 49% in 2009 and 86 vs 67% in 2010). However, the survival of 7 L line lambs born in 2012 was 100% compared to a survival of 93% in 28 H line lambs.

The only ewes born from embryo transfer that lambed so far were those born in 2009 and 2010 and lambing in 2011 and 2012. There were 27 records of H line ewes and 19 records of L line ewes that could be assessed so far. In these ewes, averages were 0.89 lambs born per ewe mated in H line ewes and 0.95 for L line ewes. Corresponding means for lambs weaned per ewe mated were respectively 0.59 and 0.68. The progeny of these ewes weighed 24.5 kg in the H line and 18.8 kg in the L line at weaning. This resulted in total weight weaned per ewe mated being 14.5 kg of lamb/ewe in the H line and 12.8 kg of lamb/ewe in the L line.

These results suggest that, contrary to expectations, the H line MOET ewes were similar to L line contemporaries for reproduction. More data over a longer period is needed to confirm or refute this suggestion.

References for further information on this project:

Kruger, A.C.M., Cloete, S.W.P. & Cloete, J.J.E., 2010. The relative performance of dams from lines divergently selected for reproduction in a multiple and embryo transfer (MOET) program. *Proceedings of the Conference of the South African Association for Agricultural Technologists*, p. 22.

14. Formulation of breeding and management strategies to monitor and subsequently improve low production performance of small-scale sheep farmers in the Western Cape region.

Project Leaders: Prof SWP Cloete and Ms Annelin Davids

Collaboration has been established with two small-scale farmers in Beaufort-West and a total of 350 ewes have been ear tagged and recorded. Midrib wool samples were collected from Merino sheep in Beaufort West and were sent to the Wool Testing Bureau in Port Elizabeth for analyses of fibre diameter, strength, length and % yield. Surveys were conducted in Beaufort West (Karoo) and at Ebenhaeser. Blood samples have also been collected from the Nortier Research farm, which will serve as a control for the study. The experimental resources at the research farm are seen to be more representative in terms of breed composition to those perceived to be kept by small-scale sheep farmers than at other research farms. These blood samples will be genotyped in December 2013/January 2014. Phenotypic data that was available for the Nortier Experimental Farm of the three pure breeds (Namaqua Afrikaner, Dorper and South African Mutton Merino (SAMM)) that was accumulated from 2007 until 2012 was analysed for fixed effects, breed, age and year. A preliminary fixed effects model was run, using generalized linear models (GLM) procedure in SAS, (2013). Fixed effects fitted were breed, dam age (2-6+ years), year (2007-2012), sex (male and female) and birth status (single, multiples). All the traits were significantly influenced by all fixed effects tested. The Interaction effect for breed x year was also fitted. Significant breed x year interactions were observed for birth weight and weaning weight. Namaqua Afrikaner lambs were lighter than Dorper and SAMM lambs at birth (respectively 3.6 kg vs 4.2 and 4.1 kg) and at weaning (respectively 23.3 kg vs 29.7 and 27.0 kg). The effect of breed on pre-weaning survival was significant, with Namaqua Afrikaner lambs more likely to survive than SAMM lambs (respective proportions of lambs survived per lamb born 0.87 and 0.68). Breed differences for birth weight and weaning weight were expected, since the SAMM and Dorper were selected for growth during breed formation. The improved pre-weaning survival of the unimproved Namaqua Afrikaner lambs relative to SAMM lambs may suggest better adaptation of this breed to extensive pasture conditions.

Reference for further information on this project:

Davids, A.H., Cloete, S.W.P., Olivier, J.J., Grobler, H.J.F. & Dzama, K., 2012. Preliminary study to investigate reproduction of breeding ewes of communal flocks in the Western Cape. *Proceedings of the 45th South African Society of Animal Science Congress*, 9–12 July 2012, East London, p. 131.

15. Enhancing the breed analysis of the Dohne Merino by looking at heterogeneous variances and phantom groups

Project Leaders: Prof SWP Cloete and Ms W Jordaan

Genetic (co)variances for body weight, clean fleece weight and fibre diameter were estimated for the South African Dohne Merino using data transformed as proportions of contemporary group means. The data analyzed included live weight, clean fleece weight and fibre diameter records for 282 513 animals, evaluated between 1992 and 2011. There were 5 698 sires, 105 886 dams and 6 291 contemporary groups in the data. A three-trait animal model was fitted, where the random variables were the direct additive genetic effects, as well as the sire-flock-season (SFS) interaction, while the fixed effects included contemporary groups (FYSSM) (6 291 classes), birth status (single, twins or triplets), age of dam (1 to 3 years), which was plotted as a linear regression as well as age at performance measurement, which was fitted as a polynomial.

The direct heritability estimates (SE) for body weight, clean fleece weight and fibre diameter were 0.265 (0.005), 0.210 (0.004) and 0.437 (0.005), respectively. Genetic correlations for body weight with clean fleece weight and fibre diameter were 0.035 (0.015) and 0.139 (0.011), respectively, while the genetic correlation between clean fleece weight and fibre diameter was 0.169 (0.012). Body weight had phenotypic correlations of 0.327 (0.002) and 0.150 (0.002), respectively, with clean fleece weight and fibre diameter, which had a phenotypic correlation of 0.190 (0.002) with clean fleece weight. The moderate to high heritability estimates suggests that there is substantial genetic variation, which may result in genetic improvement if selection is applied on these traits. Genetic correlations were generally low, suggesting that progress in all these traits was possible in a scientific selection program. Genetic trends derived during the study supported the contention that genetic progress in all traits was attainable in a well-constructed breeding programme.

Transformation of the data to percentages of contemporary groups resulted in adjustments to breeding values. The breeding values for sires originating from flocks maintained in limiting environments (Low group; 180 sires) were adjusted upwards, while those of sires originating from a non-limiting production environment (High group; 146 sires) were adjusted downwards. These effects were markedly obvious for the quantitative traits (body weight and clean fleece weight), but to a much lesser extent for fibre diameter. This transformation resulted in the genetic trends for the Low groups being adjusted to be comparable to those in the High group for live weight and fibre diameter. It was concluded that sire breeding values derived from transformed data would be

more robust across the typical diverse environments supporting local Dohne Merino production.

The genetic value of animals entering the recorded population from a commercial base (F4 animals) was below the fully recorded part of the population. The inclusion of phantom parent groups in the genetic analysis rendered genetic trends in F4 animals comparable to that of the pedigreed portion of animals in the analyses. It was concluded that animals from a commercial base (which are alleged to have advantages in terms of fitness and robustness) were more likely to perform satisfactorily for selection with the inclusion of phantom groups than without it.

It was recommended that data in the national Dohne Merino analysis be transformed proportion of contemporary group means to account for heterogeneous contemporary group variances. Phantom parent groups should also be applied to the analysis to increase the probability of those animals entering the breeding flock from a commercial base being selected.

Reference for further information on this project:

Jordaan, W., 2013. Enhancing the breed analysis of the Dohne Merino by accounting for heterogeneous variances and phantom parents. M.Sc. (Agric.) Thesis, University of Stellenbosch.

16. Identification of SNPs associated with robustness and greater reproductive success in the South African Merino sheep using SNP chip technology

Project Leaders: Prof SWP Cloete and Ms L Sandenbergh

The results of the first round of genotyping were received during February 2012. The data were filtered in order to ensure the quality of all the scores and the integrity of the DNA samples. A total of 23 781 of the potential 54 241 markers passed the quality control and 91 animals out of the 132 individual samples that were submitted also passed the quality control measures. In comparison with other studies the number of markers and samples passing quality control were relatively low. We have ascribed this to the manner in which the original samples were stored and have improved the sample storage.

Partitioning of the genotype data for the High (H) and Low (L) lines was carried out and this data were used in downstream analysis. Factorial component analysis indicated the two lines to be genetically discrete with two distinct clusters visible for all chromosomes. The two lines are therefore phenotypically and genetically distinct as a result of divergent selection. Differences in marker allele frequencies between the two lines were demonstrated using two Fst outlier methods. A Bayesian and frequentist methods were used to ensure unbiased results. A total of 48 markers were identified by both approaches and these markers were further investigated. Most of these markers were found to be near or within known ovine genes. One of the markers was in close proximity to the corticotrophin releasing hormone gene, a gene involved in the stress response. Previous studies have indicated stress response hormones to be implicated in differences between the two lines. A difference in stress coping ability could therefore potentially be responsible for the difference in lamb rearing ability within these two lines.

References for further information on this project:

Sandenbergh, L. & Cloete, S., 2012. Genomics technology to add value to industry. *Red Meat/Roivleis* 3(1: March 2012), 58-61.

Sandenbergh, L., Roodt-Wilding, R., Van der Merwe, A.E., Cloete, S.W.P., 2013. Analysis of a South African Merino flock divergently selected for reproductive potential. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 20, 98-101.

17. The relationship between sperm phenotype and genotype, and the correlation with fertilizing ability of sperm obtained from genetically diverse Merino rams

Project Leaders: Prof SWP Cloete and Ms NH Boshoff

All samples were successfully collected from the rams (from both the ejaculated samples and those aspirated from the cauda epididymis). Samples were subjected to macroscopic evaluation (volume, colour and macroscopic motility) and microscopic evaluation (with the Sperm class analyzer (SCA®)). All motility samples were evaluated at a frame rate of 100 frames/second using SCA®.

After initial concentration was determined, dilutions were prepared with a cryopreservative (obtained from Ramsem®, Bloemfontein) into three specific concentrations. These concentrations were at 100-, 150-, and 200 million sperm/mL. After dilutions were made, sperm were subjected to three specific equilibration periods (after 1, 2, or 3 hours) at 4°C. After each of the equilibration periods, straws (0.25mL) were filled and sealed with PVC powder for cryopreservation. A standard cryopreservation protocol was followed to cryopreserve the straws in liquid nitrogen at -196 °C.

Seminal plasma (SP) was collected from extra ejaculations from the trained rams. This was done by using a temperature controlled centrifuge and spinning the sample at 2000g at 4°C for 15 minutes. The supernatant was then collected and stored at -20°C for further use. SP was added to epididymal samples pre-equilibration and post thaw to see the possible effect of SP addition to the morphometric parameters of sperm. Straws were cryopreserved for each of the SP treatments, thawed at a later occasion and analyzed to see whether the addition of seminal plasma had an effect on the membrane stability. There is a lot of controversy in literature about the effect of SP on the stability of the acrosomal membrane of the sperm.

Two different motility determining techniques were also compared, namely the flush technique (developed by Prof G. van der Horst at the University of the Western Cape) and the more standard swim-up technique.

Microscopic slides were made from all samples pre cryopreservation ('neat' and the different "concentration x equilibration" treatments) and post thaw. Seminal plasma effect slides were also made, prior to addition, after equilibration addition and post thaw addition. All slides were then stained using SpermBlue stain and fixative, mounted using DPX mounting medium and analyzed using the morphology and morphometric package of the SCA (Microptic, S.L, Barcelona) provided by the University of the Western Cape.

Mating ability of the rams between High line (HL) and Low line (LL) were also recorded during observation sessions, where each ram was placed with 6-8 ewes for a 20 minute session, during which the time till first mount, number of mounts, time till first serve, and number of services were recorded.

Statistical analysis was done using SAS Enterprise Guide 5.1. Mating ability of the rams are analyzed using descriptive stats. The motility parameters and the possible effect of seminal plasma will be analyzed using the generalized linear model (GLM), by way of least square means (LSM) and adjusted for multiple comparisons with the Bonferroni t-test. The morphology parameters will be analyzed with a two-way ANOVA, and also ANCOVA, with the initial sperm concentrations as the co-variant.

Results were obtained for the motility parameters of both ejaculate and epididymal fresh samples. For ejaculated samples, the results indicated that there were no significant differences between the HL and LL for concentration, macroscopic motility, and volume. Nor were any significant differences found when comparing HL and LL for the motility parameters VCL, VSL, STR, LIN, ALH, BCF, VAP and WOB.

The mating ability tests showed that the HL rams ejaculated more frequently within the 20 minute session than that of the LL rams. Further analysis will follow, which will include a bigger sample size.

When the swim-up technique and the flush technique were compared, the flush technique compared favourably. These results indicate that the flush technique can replace the swim-up technique, which will yield the same (or more accurate) results in a much shorter time than that of the swim-up technique. It is of great importance to shorten the duration of the motility determining test, as this will then reduce the amount of time from collection to cryopreservation, which in turn will increase the survival and viability of the sperm post-thaw.

References for further information on this project:

Lambrechts, H., Boshoff, N.H., Van der Horst, G., Maree, L. & Cloete, S.W.P., 2012. The use of SCA technology in the quantitative analysis of sperm samples obtained from Merino rams divergently selected for reproduction. *Proceedings of the 45th South African Society of Animal Science Congress*, 9–12 July 2012, East London, p. 148.

18. Investigation into the relationship between milk production of grazing ewes and maternal breeding values for early growth traits in three South African sheep flocks

Project Leaders: Dr MA Snyman and Prof SWP Cloete

The project started on 01 June 2012 and data for only a single year (2012) is available. Lactation records of 113 H line ewes and 28 L line ewes were available at approximately 21 days of lactation. Means for the H and L lines were respectively 155 and 144 ml for milk yield over 3 hours, 7.37 and 7.56 for butterfat %, 4.25 and 4.27 for protein %, 5.13 and 4.98 for lactose % and 851 and 797 for somatic cell count. Lactation records of 100 H line ewes and 22 L line ewes were available after approximately 84 days of lactation. Means for the H and L lines were respectively 102 and 85 ml for milk yield over 3 hours, 8.80 and 9.33 for butterfat %, 5.35 and 5.35 for protein %, 4.79 and 4.77 for lactose % and 905 and 1745 for somatic cell count. Previous studies have shown the H line to have a slightly higher milk production than the L line, with little evidence of differences in the % traits.

References for further information on this project:

Cloete, S.W.P., Snyman, M.A. & Scholtz, A.J., 2011. Genetic and environmental parameters of milk production and milk composition in South African Merinos. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 19, 419-422.

Snyman, M.A. & Cloete, S.W.P., 2008. Lactation curves of wool sheep under different grazing conditions. *Grootfontein Agric.* 8(1), 22-32.

19. Selection strategy to control breech strike in South African Merinos using indicator traits

Project Leaders: Prof SWP Cloete and Dr AJ Scholtz

Breech strike has a serious impact on animal health and welfare under pastoral conditions. The long term goal has to be the permanent reduction of susceptibility in sheep through genetic selection. Response to selection is the highest if a trait is directly selected for. However to identify resistant sheep, the sheep must first be challenged (animal welfare implications). Direct selection is often not efficient due to the sporadic nature of breech strike. Alternatively, characteristics that make sheep susceptible to breech strike can be identified (indicator traits) and can be selected for or against. Identified traits that predispose sheep to become susceptible to breech strike are:

- number of caudal folds in the breech area,
- the clean area around the anus and vagina,
- resistance to gastro-intestinal nematodes,
- susceptibility to diarrhoea (dags) and
- to a lesser extent fleece rot, dermatophilosis, high suint (specific for wool = combination of dried salts from perspiration + greasiness in fleece), wool colour, fleece moisture and smell/odour.

The objective of this project is:

To determine heritability and correlation estimates for some of the identified breech strike indicator traits under South African conditions. To use estimates from the current year and the following 5 years so that we can breed Merinos that are more resistant to breech strike.

This project has recently been re-registered, and no new results are available as of yet.

References for further information on this project:

Scholtz, A.J., Cloete, S.W.P., Van Wyk, J.B., Misztal, I. & Van der Linde, T.C. de K., 2009. Preliminary genetic (co) variances between wrinkle score and breech strike in Merino sheep, using a threshold-linear model. Book of Abstracts of the 60th Annual Meeting of the European Association for Animal Production. *Book of Abstracts* No. 15, 263, 24–27 August. (Barcelona: Spain). (Poster presentation).

Scholtz, A.J., Cloete, S.W.P., Van Wyk, J.B., Misztal, I., du Toit, E. & Van der Linde, T.C. de K., 2010a. Genetic (co)variances between wrinkle score and absence of breech strike in mulesed and unmulesed Merino sheep, using a threshold model. *Animal Production Science* 50, 203–209.

Scholtz, A.J., Cloete, S.W.P., Van Wyk, J.B., Kruger, A.C.M. & Van der Linde, T.C. de K., 2010b. The influence of divergent selection for reproduction on the occurrence of breech strike in mature Merino ewes. *Animal Production Science* 50, 210-218.

Scholtz, A.J., Cloete, S.W.P., Cloete, J.J.E., Kruger, A.C.M. & Van der Linde, T.C. de K., 2012. Divergent selection for reproduction affects dag score, breech wrinkle score and crutching time in Merinos. *South African Journal of Animal Science* 42, 274–279.

Scholtz, A.J., 2010. Components of an integrated pest management (IPM) program for the control of the sheep blowfly *Lucilia cuprina* under South African conditions. Ph.D. (Agric.) Thesis, University of the Free State, South Africa.

Scholtz, A.J., 2011. The use of selective breeding to control breech strike in sheep. *Graan SA/Grain SA*, Volume 13(3), 50-51, 53, March 2011.

Scholtz, A.J. & Cloete, S.W.P., 2011. Breech strike resistance as a correlated response to selection for reproduction. *SA Graan/Grain April* 2011: 66–67.

Scholtz, A.J., 2011. Blowfly strikes in South Africa. *Farming SA*, March 2011, pp. 10-11. (A.J. Scholtz Interviewed by Arnold Kirkby – Edited by A.J. Scholtz).

Scholtz, A.J., 2011. Brommeraanvalle op skape. RSG Landbou Vrydag 11 Maart 2011. (Radio talk). (*In Afrikaans*).

Scholtz, A.J., 2011. Seleksie van 2 Merinolynne op Elsenburg. 1 April 2011. RSG – Radio Elsenburg. (Radio talk). (*In Afrikaans*).

Scholtz, A.J., Cloete, S.W.P., Cloete, J.J.E., Kruger, A.C.M. & Van Wyk, J.B. & Van der Linde, T.C. de K., 2011. Breech and crutch cover scores of Merino ewes divergently selected for their ability to rear multiple offspring – preliminary results. *South African Society for Animal Science (SASAS) 44th Congress*, Stellenbosch University, Stellenbosch, 11–14 July. *Book of Abstracts* p. 20.

Scholtz, A.J., Cloete, S.W.P., Cloete, J.J.E., Kruger, A.C.M. & Van Wyk, J.B. & Van der Linde, T.C. de K., 2011. Genetic parameters for breech strike indicator traits and yearling production traits in Merinos. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* 19, 175–178. Perth, Australia, 18–21 July 2011.

Scholtz, A.J., 2011 Weerstandbiedendheid in broekaanvalle as 'n gekorreleerde respons op seleksie vir reproduksie. (*In Afrikaans*).

Scholtz, A.J., 2011. Breech strike resistance as a correlated response to selection for reproduction. (News snippet).

Scholtz, A.J., Cloete, S.W.P. & Van Wyk, J.B., 2012. Genetic parameters for breech strike, body strike and breech strike indicator traits in sheep. *Book of Abstracts of the 4th International Conference on Quantitative Genetics: Understanding Variation in Complex Traits*, Edinburgh, 17–22 June 2012. (Poster presentation).

Scholtz, A.J., Cloete, S.W.P. & Van Wyk, J.B., 2012. Genetic analysis of breech strike and breech strike indicator traits in sheep. *South African Society for Animal Science (SASAS) 45th Congress*, East London International Convention Centre, East London, Eastern Cape, 9–12 July. *Book of Abstracts* p. 94.

20. Assessment of steroid hormone profiles during the peripartum period of Merino lambs divergently selected for multiple rearing ability

Project Leaders: Prof SWP Cloete and Dr D Hough

The blood sampling and data collection has been successfully achieved for two lambing seasons. The steroid hormone profiling for the first lambing season has been achieved (results below), however, the steroid profiles for the second lambing season remain to be analysed (samples and data collected in March 2013).

Preliminary results of H- and L-line embryos (from 2009–2011 progeny), which were randomly implanted in recipient ewes in a multiple ovulation and embryo transfer (MOET) programme, indicated that H-line lambs are born approximately 1 day earlier than L-line lambs. Gestation lengths could be estimated within 4 hours of accuracy, due to control exerted through intra-uterine artificial insemination for MOET. This indicates that the higher hypothalamic-pituitary-adrenal axis responsiveness in adult H-line sheep may translate to higher continual activation of the foetal hypothalamic-pituitary-adrenal axis of the H-line lambs, which results in the earlier foetal maturation and onset of parturition than the L-line. A previous study by Cloete *et al.* (2004) also found that H-line ewes gave birth 2.6 days earlier than L-line ewes under natural reproductive conditions, whereas H-line ewes also experienced shorter births (Cloete *et al.*, 1998). These collective results suggest that both maternal and neonatal hypothalamic-pituitary-adrenal axis function may influence the gestation length and duration of parturition.

Results:

Predominant steroids

The predominant steroids detected in the peripartum blood plasma samples were: cortisol, cortisone, progesterone, corticosterone and DHEA-S. The minor steroids that were detected, but at too low concentrations to accurately draw conclusions from, were: β -estradiol, estrone, 11-dehydrocorticosterone, androstenedione and testosterone (present in some of the samples).

Profiles of predominant steroids

Cortisol

Cortisol concentrations are significantly different across the time of sampling, whereas it is not significantly different among selection line. The number of L-line lambs from only one lambing season is too low to use in statistical analysis. There is a clear increase in cortisol concentrations of the lamb on the day of parturition (5-fold) and remain high for approximately 2 days post parturition,

before declining. The concentration of cortisol in the lambs is much higher compared to the ewes. These results clearly indicate that the main source of cortisol (responsible for initiating cascade of events than induces the onset of labour) is from the lamb, and not the ewe.

Cortisone

Cortisone is the inactive 11-oxo derivative of cortisol and its interconversion to and from cortisol is mediated by 11 β -hydroxysteroid dehydrogenase (11 β HSD types 1 and 2). The expression of the two 11 β HSD isoforms during pregnancy (in the placenta and foetal pituitary) plays an important role in regulating the amount of active glucocorticoids. The same trend as for cortisol concentrations is seen with cortisone concentrations and DHEA-S.

Corticosterone

Corticosterone concentrations were very low and seemed to increase 4 days after parturition. With more sampling, the trend may become clearer and it may become possible to elucidate its purpose.

Progesterone

As expected, the progesterone levels decreased rapidly prior to parturition. Progesterone is produced primarily in the ewe, and may not be relevant when comparing the adrenal function of H- and L-line lambs.

Minor steroids

These steroids were detected at low concentrations, close to their limits of quantification and therefore not suitable for comparative analyses. Derivatization of these compounds is suggested if estrone and estradiol (maternal origin) need to be measured. The other steroids are simply produced at too low concentrations to allow for detection with the quantification method, unless the sample volume is increased significantly. It is possible that sheep produce estrone-sulfate instead of estrone. We currently do not have any steroid standards available for estrone-sulfate and therefore we do not have the means to detect it at this stage.

Conclusion

The sampling method is adequate to study the production of steroid hormones that relate to foetal hypothalamic-pituitary-adrenal axis function during the peripartum period. The quantification method can be improved, by derivatization or significantly increasing the sample volume to be analyzed (e.g. 1mL plasma instead of 500 μ L). Further research is required to establish the function of each steroid hormone produced in sheep during the peripartum period.

This method of sampling is adequate for comparison of the hypothalamic-pituitary-adrenal axis function of H- and L-line sheep and analyses of the second lambing season's samples will increase the accuracy and trends for the steroid

hormone profiles. These profiles could then be related to the phenotypic traits observed for the lambs during the peripartum period (e.g. progression to first standing/suckling and birth weight).

References for further information on this project:

Hough, D., Cloete, S.W.P., Storbeck, K., Swart, A.C. & Swart, P., 2013. Cortisol production in sheep is influenced by the functional expression of two cytochrome P450 17-alpha-hydroxylase/17,20-lyase (CYP17) isoforms. *Journal of Animal Science* 91, 1193-1206.

Hough, D., Swart, P. & Cloete, S.W.P., 2013. Exploration of the Hypothalamic-Pituitary-Adrenal Axis to improve animal welfare by means of genetic selection: Lessons from the South African Merino. *Animal* 3, 442-474.

Contribution to "RSG Landbou" radio programme, split into two sessions on 18 May 2012 (www.elsenburg.com/radio/2012/r120518.html) and 1 June 2012 (www.elsenburg.com/radio/2012/r120601.html).

Paper published in the Wool Farmer magazine, September 2012 issue, p. 3 (www.nwga.co.za/woolfarmer).

Paper published in the Stud Breeder magazine, Issue 32, October-December 2012, p. 33 (www.veeplaas.co.za).

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