

OCTOBER 2024

Sheep reproduction RD&A alert

This sheep reproduction RD&A alert is an initiative of the Sheep Reproduction Strategic Partnership (SRSP).

The [Productivity & Profitability series](#) presents new and topical information to help southern producers increase the success of their businesses. The webinars and podcasts feature a diverse line up of expert speakers delivering information to aid on-farm decision making.



PRODUCTIVITY & PROFITABILITY

series

The October webinar features Deb Scammell (Talking Livestock) who discussed mineral supplementation for beef and sheep and focussed on the available options for mineral supplements and how to best assess their cost-effectiveness. You can access the webinar recordings and associated podcasts from the [Productivity & Profitability series](#) webpage.

The SRSP aims to help sheep producers to profitability and sustainably increase lamb production through increasing lamb survival and weaning rates and will coordinate a national approach to improving sheep reproductive performance.

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Feature project update

Expressing ewe lamb joining targets as a proportion of adult weight

Background

The recently completed More Lambs from Ewe Lambs (MLEL) project showed that the attention to detail when mating ewe lambs must improve for the production, profit and welfare outcomes from ewe lambs to be improved simultaneously. A key finding from MLEL was minimum joining weights of 45kg are required, along with at least 15kg of total pregnancy weight gain, so that a pregnant ewe lamb weighs at least 60kg at the point of lambing. This ensures the ewe lamb is adequately grown to bear a lamb of sufficient birth weight to survive and subsequently produces enough colostrum and milk to grow her progeny to improve marking percentages from joining ewe lambs.

Aim

To quantify the standard references weight (SRW, adult weight at condition score 3.0, free from fleece and conceptus) of the flocks that participated in the MLEL project.

Project Objectives

- Gather accurate standard reference weights from at least 20 producer sites involved in the MLEL project.
- Determine the impact of pregnancy and lactation as a ewe lamb on adult weight.
- Determine the robustness of expressing joining, pregnancy scanning and lambing weight targets as a proportion of adult weight.

- Model growth profile across the Maternal, Merino and Shedding genotypes and expressing weight targets as a proportion of adult weight.

Current progress

This project has recently been contracted. If you would like more information about getting involved in the project, please contact Jason Trompf (Jason@jtagrisource.com.au).

Review papers

Small ruminant parturition detection based on inertial sensors—A review

Pedro Gonçalves, Maria R. Marques, Shelemia Nyamuryekung'e and Grete H. M. Jorgensen
animals, Volume 14, Issue 19 October 2024 **OPEN ACCESS**

DOI <https://doi.org/10.3390/ani14192885>

Simple Summary

Animal births, much like human births, can encounter complications that threaten the well-being of both the mother and the offspring. While monitoring the birth process is essential for ensuring proper care, human supervision can be costly. Commercial systems do exist for large animals, but there are currently no comparable solutions for small ruminants, despite various research efforts. This study explores the application of inertial sensors to detect parturition in small ruminants. This study also highlights which factors most significantly influence the outcomes of each investigation and summarizes the main results regarding birth detection. The review shows that different approaches focus on recognizing particular animal behaviors and designing detection algorithms. Although none of the studies presented a completely reliable detection method, most produced encouraging results, indicating noticeable behavioral changes in the hours preceding birth.

Abstract

The birth process in animals, much like in humans, can encounter complications that pose significant risks to both offspring and mothers. Monitoring these events can provide essential nursing support, but human monitoring is expensive. Although there are commercial monitoring systems for large ruminants, there are no effective solutions for small ruminants, despite various attempts documented in the literature. Inertial sensors are very convenient given their low cost, low impact on animal life, and their flexibility for monitoring animal behavior. This study offers a systematic review of the literature on detecting parturition in small ruminants using inertial sensors. The review analyzed the specifics of published research, including data management and monitoring processes, behaviors indicative of parturition, processing techniques, detection algorithms, and the main results achieved in each study. The results indicated that some methods for detecting birth concentrate on classifying unique animal behaviors, employing diverse processing techniques, and developing detection algorithms. Furthermore, this study emphasized that employing techniques that include analyzing animal activity peaks, specifically recurrent lying down and getting up occurrences, could result in improved detection precision. Although none of the studies provided a completely valid detection algorithm, most results were promising, showing significant behavioral changes in the hours preceding delivery.

Determinants of ram sexual behavior and its impact on sheep breeding

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Animal Reproduction Science, Volume 270, November 2024

DOI <https://doi.org/10.1016/j.anireprosci.2024.107599>

Highlights

- Sexual behavior is complex.
- Requires sensory recognition and processing, and integration of ram cohorts.
- Social dominance is a main determinant of the breeding individual effectiveness.
- Female mate choice is also a determinant of the distribution of matings.
- Sexual interest and behavior are determinants of reproductive efficiency.

Abstract

In sheep, anatomical characteristics of the cervix and animal value limit application of reproductive technologies; therefore, most breeding is natural service. Rams are selected based on desired physical traits and semen capacity, but their contribution to flock genetics is constrained by expression of sexual behavior. In 1964, it was first reported that approximately one-third of rams expressed limited sexual interest toward ewes in estrus. Therefore, if rams were evaluated for expression of sexual behavior, it is estimated that as many rams would be culled for the lack of behavior as are currently culled for semen quality or physical deficiencies. Sexual behavior is complex, requiring sensory recognition and processing, integration of ram cohorts and social dominance, female mate choice, and a physical response. This review of the literature aims to provide insights into factors influencing expression of ram sexual behavior.

Quality assurance applied to semen analysis

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DOI <https://doi.org/10.1016/j.anireprosci.2024.107615>

Highlights

- Semen analysis is integral to production of semen products used for livestock artificial insemination.
- Large intra- and inter-laboratory variation in semen analysis results have been reported.
- Quality Assurance (QA) procedures are recommended to control results obtained during semen analysis.
- Reference, standard technical specifications for sperm concentration, motility and morphology analysis are provided.

Abstract

Artificial insemination is an important biotechnology employed in livestock production. Production of semen products requires analysis of sperm concentration, motility and morphology. Although adequate analytical procedures are essential to ensure product quality, several multicenter studies have reported large variations in semen analysis results within and across laboratories. Differences in equipment and methodology, inconsistent training and performance testing, and lack of quality assurance programs are likely responsible for these observations. The somewhat pervasive perception that semen analysis is a trivial task must be challenged as it jeopardizes efficient semen production and germplasm utilization. This manuscript reviews the Quality Assurance (QA) procedures recommended to control results obtained during semen analysis. Reference, standard technical specifications for basic semen analysis are also described.

Scientific papers

Effect of within-litter competition on lamb survivability

Carrie S Wilson, J Bret B Taylor and Natalie Cherry

Journal of Animal Science, Volume 102, issue Supplement_3, September 2024 **OPEN ACCESS**

DOI <https://doi.org/10.1093/jas/skae234.462>

Abstract

The objective of this study was to evaluate the influence of lamb and littermate competition on lamb survivability to weaning. Litter sex composition and litter birth weight variation were the primary considerations for influencing competition. Records from maternal dual-purpose (Polypay, Rambouillet, and Targhee) and terminal breeds [Suffolk and Paternal Composite (PC; 3/8 Columbia, 3/8 Suffolk, 1/4 Texel)] were used, with 18,654 single and 56,324 twin records from all breeds and 11,082 triplet records from the 3 maternal breeds. Records were reported from 1980 to 2023, except for the PC, which began inter se mating in 2009. Lamb survivability to 90 d was analyzed using a Bayesian logistic regression model with the logit link function. Lamb survivability was assumed binomially distributed and influenced by age of dam, birth year, lamb sex, and sex of littermates as fixed effects. The relationship among littermates was also accounted for. Least squares means were transformed from the log odds scale to the probability scale. Birth weight was assumed normally distributed and influenced by the same fixed effects as lamb survival and was analyzed using a linear mixed model. Lamb survivability was also analyzed using the same model described above but including mean litter weight and individual birth weight deviation as linear covariates. Accounting for mean litter birth weight and individual birth weight deviation removed the birth weight differences between the sexes, leaving only true sex differences between lambs for survivability. For single births, females tended to have greater survivability than males when adjusted for birth weight for all breeds but was only significant ($P < 0.05$) for Rambouillet and Targhee. For maternal breeds, females in twin litters had significantly greater survivability ($P < 0.05$) than their male counterparts when adjusted for birth weight; differences in terminal breeds were not significant (Table 1). Males in twin litters had heavier birth weights than females ($P < 0.05$) for all breeds. Triplet born females for all litter-sex combinations had significantly higher survival than males ($P < 0.05$) for Polypay when adjusted for birth weight. Females in female-female-male (FFM) litters had 76.4% survival versus 58.9% for males while females in female-male-male (FMM) litters had 75.9% versus 66.7% for males. When lamb survivability was adjusted for birth weight, Rambouillet females in FFM litters had 72.2% survival compared with 59.9% for males ($P < 0.05$) and females in FMM litters had 73.0% survival compared with 63.8% for males. Similar significant differences were observed for FFM and FMM Targhee litters. This study suggests lamb performance is influenced by its littermate(s). Changes in postnatal management of mixed-sex litters may benefit overall lamb survival.

Artificially reared ewes cannot be distinguished from natural reared ewes based on observed maternal behavior or lamb weaning weights

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Journal of Animal Science, Volume 102 September 2024

DOI <https://doi.org/10.1093/jas/skae283>

Abstract

Artificially rearing lambs is an important component of United States sheep production as some flocks select for increasing litter size to boost productivity. However, there is a conception among shepherds that artificially reared ewe lambs will ultimately result in poor mothers since they were not naturally raised. The objective of this study was to determine if differences in maternal behavior could be detected between ewes raised artificially and those raised naturally and if dam rearing type had an impact on lamb growth performance. Forty-eight ewes were enrolled comprised of 4 equal sized groups: artificially reared primiparous, naturally reared primiparous, artificially reared multi-parous, and naturally reared multi-parous. Ewes were observed using remote cameras to record maternal behaviors toward the lambs during and

shortly after parturition. Behavior of 29 ewes during the first hour after parturition was analyzed. Independent multivariable regression models were evaluated for: proportion of time spent grooming, proportion of time spent helping the lambs nurse, number of helpful bouts, and the number of negative bouts. No statistically significant difference ($P < 0.05$) was detected between artificially reared and naturally reared ewes for the proportion of time spent grooming and the proportion of time spent helping the lambs nurse. Historical flock data were utilized to evaluate lamb growth between artificially and naturally reared ewes. No detrimental associations between artificially reared ewes and lamb weaning weights were observed. This study shows that artificially reared ewes are no different in terms of mothering behaviors and may be used as potential replacement candidates.

Feeding twin-bearing Merino ewes above the metabolisable energy requirements for maintenance during late gestation increases the duration of parturition of the first-born lamb

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Animal Production Science, Volume 64, Issue 15 **OPEN ACCESS**

DOI <https://doi.org/10.1071/AN24158>

Abstract

Context: In Australia, approximately 53% of lamb deaths are caused by dystocia. One of the main welfare concerns in the sheep industry is under- and overfeeding ewes, which may be contributing to cases of dystocia.

Aims: This pilot study aimed to investigate how increasing energy intake affects the duration of parturition and predictors of lamb survival.

Methods: On Day 100 of gestation (dG), 20 twin-bearing and 10 singleton Merino ewes were selected and allocated to three treatment groups; (1) singleton ewes fed at 1.0× maintenance levels ($n = 10$); (2) twin-bearing ewes fed at 1.0× maintenance levels ($n = 10$) or (3) twin-bearing ewes fed at 1.25× maintenance ($n = 10$). Ewes were housed indoors in individual pens. Urine and blood were sampled from ewes on dG 130, 140, then daily from dG 145 through to parturition, and blood was sampled at the onset of parturition and 30 min post-partum. Urine was analysed for pH and blood was analysed for metabolic parameters, mineral concentration and acid–base balance. Predictors of lamb survival from birth to 24 h consisted of weight, rectal temperature, blood glucose and lactate, and body morphology.

Key results: Serum calcium in late gestation and blood base excess pre-parturition were higher in Singletons 1M compared with Twins 1M ($P < 0.05$). The Twins 1.25M group took longer to give birth to the first-born lamb (104.4 ± 21.1 min) compared with the Twins 1M group (44.1 ± 6.6 min; $P = 0.015$). There were no differences in the predictors of lamb survival measures between the twin-bearing groups ($P > 0.05$).

Conclusions: Ewes from the Twins 1.25M group took significantly longer to give birth to the first-born lamb. There were no other significant findings between the twin-bearing groups, including lamb liveweight, however, lambs born to ewes from the Twins 1.25 group were numerically heavier, which may explain the increase in parturition length.

Implications: Feeding ewes above maintenance did not provide any production benefits to metabolic health or any other physiological parameters. Producers should avoid overfeeding ewes during late gestation.

Evaluation of the protective efficacy of different doses of a *Chlamydia abortus* subcellular vaccine in a pregnant sheep challenge model for ovine enzootic abortion

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Animals Volume 14, Issue 20 October 2024 **OPEN ACCESS**

DOI <https://doi.org/10.3390/ani14203004>

Simple Summary

The bacterial pathogen *Chlamydia abortus* is an important infectious cause of lamb death worldwide, causing abortion in the last few weeks of pregnancy. Existing live vaccines to protect sheep from abortion are effective but have been shown to cause infection and disease in some animals. We have recently developed a new, safer prototype subcellular vaccine comprising inactivated components of the pathogen that prevent abortions occurring in sheep and cannot itself cause disease. Initial testing of this new vaccine involved administration in two shots. In this latest investigation, we have reduced this to one single vaccination that contains less antigen without affecting its effectiveness. This low-antigen single-shot delivery reduces the costs associated with manufacturing the vaccine, increasing its viability as a new commercial product.

Abstract

Chlamydia abortus causes the disease ovine enzootic abortion, which is one of the most infectious causes of foetal death in small ruminants worldwide. While the disease can be controlled using live and inactivated commercial vaccines, there is scope for improvements in safety for both sheep and human handlers of the vaccines. We have previously reported the development of a new prototype vaccine based on a detergent-extracted outer membrane protein preparation of *C. abortus* that was determined to be more efficacious and safer than the commercial vaccines when administered in two inoculations three weeks apart. In this new study, we have developed this vaccine further by comparing its efficacy when delivered in one or two ($1 \times 20 \mu\text{g}$ and $2 \times 10 \mu\text{g}$) doses, as well as also comparing the effect of reducing the antigen content of the vaccine by 50% ($2 \times 5 \mu\text{g}$ and $1 \times 10 \mu\text{g}$). All vaccine formulations performed well in comparison to the unvaccinated challenge control group, with no significant differences observed between vaccine groups, demonstrating that the vaccine can be administered as a single inoculation and at a lower dose without compromising efficacy. Future studies should focus on further defining the optimal antigen dose to increase the commercial viability of the vaccine.

Combining two injectable progesterone formulas for estrous synchronization in ewes

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Animal Reproduction, Volume 21, Issue 4 **OPEN ACCESS**

DOI <http://dx.doi.org/10.1590/1984-3143-AR2024-0073>

Abstract

The study aimed to evaluate the effectiveness of combining two injectable progesterone (iP4) formulas for estrous synchronization in ewes and to compare it with traditional intravaginal progesterone devices. Additionally, the study assessed whether the inclusion of GnRH enhances the reproductive outcomes of the iP4 treatment. Two experiments were conducted. In the first experiment, 20 Santa Inês ewes were divided into two groups: one group received intravaginal progesterone devices, and the other received combined long-acting and short-acting iP4. In the second experiment, 30 Corriedale ewes were divided into two groups:

one received the combined iP4 with GnRH, and the other without GnRH. Estrous, ovulation, follicular populations, and progesterone concentrations were monitored. The combined iP4 treatment induced an artificial luteal phase and produced reproductive responses similar to those obtained with intravaginal devices. In the first experiment, the iP4 treatment tended to result in more synchronized ovulation compared to the control ($P=0.095$). In the second experiment, adding GnRH enhanced the quality of the corpus luteum, as indicated by increased diameter and vascularization on Day 23 ($P=0.047$ and $P=0.02$, respectively). The combined administration of long-acting and short-acting iP4 effectively synchronized estrous in ewes and showed similar efficacy to traditional intravaginal devices. The inclusion of GnRH improved luteal quality, suggesting potential benefits for reproductive management in ewes. Further studies are needed to evaluate the fertility outcomes of these protocols under field conditions.

Behavioral responses during and after a postpartum human-animal interaction in rangeland breeding ewes

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Applied Animal Behaviour Science Volume 280 November 2024

DOI <https://doi.org/10.1016/j.applanim.2024.106405>

Highlights

- Pacing and investigating the human could reflect a temperament trait within ewes, during lamb handling.
- Behavioural responses during initial lamb collection is related to lamb outcome and worth future investigation.
- Occurrence of pawing behaviour is consistent among ewes and may be related to maternal investment during ewe-lamb interactions.

Abstract

Lamb welfare, performance and survival on rangeland is partially determined by the quality of maternal care received (i.e., high durations of sniffing/grooming, allowing udder access, and staying close to the lamb). Previous studies have explored maternal behavior scores (MBSs), as a tool to select ewes based on their proximity to the lamb and the shepherd, finding variable evidence towards sensitivity and robustness in scores in ability to gauge lamb outcome (birth weight and weaning weight), survival, and maternal care throughout the lambing season. Though this scoring system is convenient, there may be another behavioral attribute related to fear of human or relationship to the human handler may be elicited during lamb collection and processing. This longitudinal study investigated the presence of a trait in response to the human handler employing a Lamb Handling (during processing) and a Lamb Tie Down (after processing) test with $N=42$ total ewes and $n=26$ ewes consistently present across both years of the study. The current study also set out to investigate the relationship between proximity to the shepherd and lamb outcome. Attempts to perform principal component analysis revealed that variables from the Lamb Handling and Lamb Tie down test were not suitable for factor analysis. In the Lamb Handling test, proportion of 'pacing' was a nearly significant, negative predictor ($P=0.07$) term in the binary 'investigating human' model, improved model fit and explained more variance compared to the null model [(cumulative weight: 90 vs 10 %); ($R^2_{adjusted}$: 30.8 vs 15.2 %; deviance= 31 vs 18.5 %)]. A random term for individual also improved fit in this model, indicating a potential behavioral trait driven by the ewe related to fear or perception of the human. The occurrence of grazing (0 or 1) was a nearly significant, positive predictor ($P=0.06$), improved model fit and explained more variance in the 'investigating human' model compared to the null model [(cumulative weight: 76 vs 24 %); ($R^2_{adjusted}$: 21 vs 15.2 %; deviance= 26.8 vs 18.5 %)]. Individual did not improve model fit in the relationship between 'investigation human' and 'grazing'. Weaning weights were a nearly significant positive predictor in

the model for 'close proximity' at lamb collection ($P=0.07$) and a significant positive predictor for 'close proximity' during processing ($P<0.001$), however, did not improve model fit over the null. Birth weights improved model fit for behaviours including 'sniffing/grooming' and 'pawing' in the Lamb Tie Down test and these behaviours may have been moderated by maternal investment in heavier lambs. Behavioural responses, expanding beyond proximity measures, can be useful for gauging maternal attachment and investment in the lamb during and after processing. Fear or perception of humans should also be considered as contributors to the response to the shepherd during human-animal interactions in the lambing season.

The effect of flunixin meglumine on the premature regression of corpus luteum, recovery rate, and embryo production in superovulated Dorper ewes

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Animal Reproduction Science, Volume 270, November 2024

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Highlights

- Premature regression of corpus luteum (PRCL) can be prevented in superovulated ewes.
- Ewes treated with 2.2 mg/kg of flunixin meglumine for 3 days did not show PRCL.
- Ewes treated with flunixin meglumine presented a greater number of normal corpus luteum, viable embryos, and recovery rate.

Abstract

This study evaluated the use of flunixin meglumine to prevent the occurrence of premature corpus luteum (CL) regression in superovulated ewes, improving embryo recovery and viability. Ewes ($n=23$) submitted to conventional superovulatory protocol and laparoscopic artificial insemination were treated with 2.2 mg/kg/day of flunixin meglumine (FLU, $n=12$) or 1.5 mL saline solution (CONT, $n=11$) on Days 2, 3, and 4 (Day 0 = 48 h after device removal). Serum progesterone (P4) concentrations were measured (Day 1–6). Ultrasound (US, Days 3 and 6) and laparoscopic evaluation (Day 6) were performed to identify luteinized structures. In the US, laparoscopy, and P4 assessments, the percentage of ewes with premature CL regression differed ($P<0.05$) between CONT (54.5; 63.6; and 54.5 %) and FLU (0.0; 0.0; and 0.0 %), respectively. The US exams revealed the effect ($P<0.05$) of treatment on the number of regressing CL between CONT (1.4 ± 0.6) and FLU (0.0 ± 0.0). Greater ($P<0.05$) number of normal CLs (10.5 ± 1.8 vs. 4.4 ± 1.5), ova/embryos (9.1 ± 2.1 vs. 3.7 ± 1.3), viable embryos (5.1 ± 1.1 vs. 2.6 ± 1.2), and recovery rate (79.5 ± 9.6 vs. 41.3 ± 15.0 %) were observed in FLU compared to CONT, respectively. The embryo viability rate did not differ ($P>0.05$) between FLU (60.7 ± 10.5 %) and CONT (45.5 ± 16.1 %). In conclusion, the flunixin meglumine protocol was able to prevent the occurrence of premature CL regression in superovulated ewes, increasing the recovery rate and embryo production.

Perspectives for reproduction and production in grazing sheep and cattle in Australasia: The next 20 years

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Theriogenology, Volume 230, December 2024 **OPEN ACCESS**

DOI <https://doi.org/10.1016/j.theriogenology.2024.09.017>

Highlights

- The context for management of reproduction is large flocks or herds grazing over large areas.
- Nutrition-reproduction is key – feed supply is variable, becoming more so with climate change.
- Extreme weather events caused by climate change might directly affect reproduction.
- Reproduction is an industry focus, but transdisciplinary problem-solving will be needed.
- Intensive ART not likely for genetic strategies so lateral thinking is needed.

Abstract

We offer a perspective on the major challenges that are confronting the management of reproduction in sheep and cattle in Australia and New Zealand, over the next two decades. An important context is the dominance of grazing systems in which large flocks or herds are managed over large areas where it is challenging to manage reproduction with precision. Consequently, the variable forage supply usually dominates reproductive outcomes, a problem that will be exacerbated by global heating. Thus, in extensive grazing systems, there is a great need for technological solutions to improve the management of nutrition. Global heating will also exert direct effects on reproductive function. Therefore, for the foreseeable future, reproduction will remain a focus for industry. In addition, as the industries develop, we foresee continued societal pressure to reduce medication, mitigate environmental damage, and improve animal well-being.

Management solutions for extensive grazing systems must involve minimal interventions with the animals and be applicable to diverse genotypes and environments. Clearly, genetics and breeding will be at the heart of solutions and elegant strategies will be needed that focus on developing animals that are robust, if perhaps a little less productive. A high rate of genetic gain is the main reason for pursuing reproductive technologies, but highly advanced reproductive technology is not likely to be the best fit in extensive management systems. Even for AI, the simplest technology, uptake is limited and lateral thinking is needed to find ways to improve the rates of genetic gain.

We conclude that there are many opportunities for improving reproductive performance in sheep and cattle in Australia and New Zealand. As we gain deeper understanding of the processes involved, we should be able to make progress in fertility and fecundity, embryo survival, and postnatal survival. Improvements in reproductive performance will increase productivity, and should also be associated with significantly improved animal well-being and a reduction in methane emissions intensity. To capture these benefits, the development of new management options will require lateral thinking about reproductive technology for extensive grazing systems, and a transdisciplinary approach that brings together the systems biology of grazing animals with an understanding of the barriers to adoption by farmers.

Upcoming events

Date	Event	Location
8 November 2024	Grazing Management Research Update NSW Local Lands Services	Orange, NSW
11 November 2024	Managing sheep and cattle mortality NSW Local Lands Services	Oberon, NSW
12 November 2024	Managing sheep and cattle mortality NSW Local Lands Services	Mudgee, NSW
12 November 2024	Spring quality pasture webinar NSW Local Lands Services	Webinar
21 November 2024	Summer sheep nutrition – in all conditions! AWI Extension NSW	Webinar