Sheep reproduction RD&A alert

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

The annual call for MLA's Producer Demonstration Site (PDS) program will open on **3 April 2023**. The PDS program gives livestock producers an opportunity to discover and implement new management practices that could improve business profitability, productivity and sustainability. The PDS program underpins MLA's RD&A programs by supporting groups of producers to demonstrate, adapt and validate the triple bottom line benefits of integrating new management practices, research and development outputs, and associated skills within the context of their own commercial production systems. The [Terms of Reference for the 2023/24 PDS open call](#) is available now!

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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.

Feature project update

Predictors of artificial insemination success & semen standards

Artificial insemination (AI) of sheep is a vital reproductive technology that underpins rates of genetic gain for seedstock producers and by extension the broader sheep industry. In recent years there have been anecdotal reports of variable fertility following AI as well as possible waning adoption rates in some parts of the country.

Aim
To collect and analyse large scale fertility data within the Australian sheep industry to identify trends in the success of artificial breeding programs and establish the capability to predict the success of AI programs and recommend new semen standards for sheep AI.

Progress
Data has been collected from AMSEA sire evaluation sites and ram breeders across most Australian states and ewe types. Data is being collected on ewe factors at the time of AI including age of the ewe, sire joined semen used (pellet or straw), time of AI in relation to CIDR pull, PMSG dose, time of insemination, uterine tone and intra-abdominal fat score. A sample of the semen used is analysed for motility, morphology, concentration, DNA integrity, viability, membrane fluidity and acrosome integrity.

At the beginning of 2023, the project's database comprised 32,000 ewes and 420 sires which is the largest Australian dataset of sheep AI information.

If you are running an AI program this year with more than 500 ewes and two sires and would like to be involved in this project, please contact Dr Jess Rickard (jessica.rickard@sydney.edu.au).

Scientific papers

Induction of ovulation using repeated doses of sulpiride, a dopamine antagonist, in ewe lambs

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Abstract

This study aimed to test the hypothesis that sulpiride can increase the concentration of circulating gonadotropin that can promote puberty in pre-pubertal ewe lambs. Here, 12 1–3-year-old Merino rams and 60 7–9-month-old Merino sheep were included in the study. The sheep were randomly divided into sulpiride (n = 30) and control (n = 30) groups. The sulpiride group was subcutaneously injected with 0.6 mg/kg sulpiride twice daily (morning and evening) for 9 days. During these 9 days, blood samples were taken from the sheep before drug administration and at 4 h after every drug administration. The number of ovulating animals in the sulpiride group was significantly higher than that in the control group (90% vs. 32%). No oestrous signs were observed in either group during ram release. Further, there were no differences in the levels of mean follicle-stimulating hormone in the two groups based on treatment (p = .2), time (p = .3) or treatment-by-time interaction (p = .3). After sulpiride administration, the luteinizing hormone (LH) levels of the sulpiride group rapidly increased and remained stable for a long time, whereas physiological LH fluctuations in the control group remained unchanged. Within-group changes in terms of LH concentrations were significant for both groups (p < .001), whereas LH pulse frequency was significantly different between the sulpiride group (p = .03). Therefore, it is concluded that sulpiride can be used as a non-steroidal alternative to stimulate pre-pubertal ewe lambs and sheep during anoestrus.

Melatonin improves post-thaw sperm quality after mild testicular heat stress in rams

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Abstract

The objective was to determine effects of slow-release melatonin on post-thaw sperm quality in rams exposed to mild testicular heat stress (HS; scrotal neck insulation). Twelve yearling Dorset rams were randomly and equally allocated to receive either 36 mg melatonin in 1 ml corn oil or 1 ml corn oil injected subcutaneously (SQ); 15 day later, all rams had HS for 96 h (start of HS = start of Week 0). Semen was collected before HS and once weekly from Weeks 1 to 7, extended in Steridyl CSS One Step, held at 5°C for ~3 h, loaded into 0.5 ml straws, held 5 cm above liquid nitrogen for 10 min and then plunged. Computer assisted semen analysis (CASA) was conducted on frozen–thawed sperm. There were group and week effects for total and progressive motility (p < .001), plus group and week effects and group*week interactions (p < .001) for post-thaw total abnormalities, acrosome integrity, post-thaw sperm DNA fragmentation index (DFI) and high mitochondrial membrane potential (HMMP). Post-thaw sperm total and progressive motility, acrosome integrity and HMMP were higher (p < .05) in melatonin versus control groups from Weeks 1 to 7, and the melatonin group reached baseline level (pre-heat stress) at Week 7 (75.79 ± 0.96, 65.48 ± 1.51, 75.00 ± 0.89 and 67.00 ± 1.06, respectively; mean ± SEM). Conversely, post-thaw sperm total abnormalities and DFI were lower (p < .05) in melatonin versus control, and both reached baseline at Week 7 in the melatonin group (26.00 ± 0.57 and 5.66 ± 0.17, respectively). Coiled tails, distal midpiece reflexes, distal cytoplasmic droplets, ruffled acrosomes, bowed midpieces, pyriform heads and knobbed acrosomes were

the most common abnormalities in both groups, with lower percentages in melatonin-treated rams. Results supported our hypothesis that HS reduces post-thaw sperm quality, and that melatonin lessens those reductions, manifested by significantly better total and progressive motility, acrosome integrity and HMMP, and fewer sperm total abnormalities and DFI.

Potential role of biologgers to automate detection of lame ewes and lambs

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Abstract

Lameness is an important health, welfare and economic problem in sheep flocks and early treatment is key to controlling lameness. Biologging technology provides high-resolution, continuous data that offers a novel opportunity to detect lameness either directly or by identifying behavioural changes; either option would facilitate more rapid treatment of lame sheep than visual observation. Here, the role of biologging data to identify lame sheep through behavioural changes within and between sheep is investigated. Accelerometers and proximity sensors were fitted to a flock of 50 Poll Dorset ewes rearing 32 single and 36 twin lambs, in Devon, UK in October 2019. Accelerometers were used to identify standing time and classify behaviour into four states for ewes (inactive, ruminating, grazing, walking) and three for lambs (inactive, sucking, moving). Principal components analysis reduced these behaviours to two components, 'feeding' and 'inactive' for ewes, and 'inactive' and 'feeding' for lambs. A visual locomotion score of each sheep was used each day to assess lameness. Complete records from sensors and locomotion observations were obtained for 513 days of ewe-activity and 720 days of lamb-activity (40 ewes, 26 single-raised and 28 twin-raised lambs). Linear mixed effects models were used to assess the effect of lameness adjusted for covariates age, litter size, social behaviour, environment and climate on standing time and the principal components. Lame ewes stood less, spent less time grazing and were more inactive than non-lame ewes. Lame lambs also stood less and were more inactive than non-lame lambs. Lambs with severely lame dams were also more inactive than those with non-lame dams. In conclusion, it is possible to identify behavioural differences between lame and non-lame ewes and lambs which could help enable automated early warning of lameness and consequently early treatment of lameness, and improved sheep welfare.

On-station comparative analysis of reproductive and survival performance between Red Maasai, Dorper, and Merino sheep breeds

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Highlights

- Indigenous Red Maasai sheep breed is adapted to the extensive production system.
- Red Maasai breed is haphazardly cross-bred with Dorper and Merino.
- Red Maasai's weaning rate is higher than the Dorper and Merino breeds.
- Red Maasai is less vulnerable to major mortality courses than imported breeds.
- Red Maasai's breed in-situ conservation should be promoted by within-breed selection.

Abstract

The reproductive performance of ewes and the survivability of lambs to weaning have a critical economic impact on sheep farming worldwide. Further, knowledge of major mortality causes allows an opportunity for

improved flock management to evade financial losses. The maximum likelihood estimates for generalised linear mixed models and chi-square test methods were used to examine 971 mating records, 839 and 763 lambs born and weaned (singles or twins) from the Naivasha Sheep and Goats station in Kenya for the years 2011 to 2020 consisting of Dorper, Red Maasai (RedM), and Merino breeds. The RedM ($P < 0.05$) outperformed Dorper and Merino in weaning rate, whereas reproductive performance between the three breeds was not significantly different ($P > 0.05$) in litter size and multiple lambings per ewe lambing. On the one hand, Dorper significantly ($P < 0.05$) outperformed the other two breeds only in weaning weight per lamb born. In addition, among all the major causes of death, pneumonia appeared to be the one to which Dorper breeds were most susceptible (chi-square test, $P < 0.05$). According to the findings of this study, neither the Dorper nor the Merino sheep breeds were reproductively superior to the RedM in an extensive semi-arid production environment. In addition, Dorper's susceptibility to the leading causes of mortality, particularly pneumonia and sheep pox, were relatively high compared to other breeds and could be a precursor to massive economic losses for Dorper sheep producers. In contrast to the indigenous RedM breed, imported sheep breeds appeared to be more susceptible to major mortality-related under an extensive production system. Therefore, regardless of weaning weight, RedM breed production appears to be a more viable investment for small-scale farmers, particularly in semi-arid regions.

Improvement of the seminal characteristics in rams using agri-food by-products rich in phytomelatonin

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Simple Summary

One of the limiting factors in sheep husbandry is reproductive seasonality, which is regulated by nocturnal melatonin secretion. Subcutaneous implants of this hormone have been used to modulate this seasonality. Nowadays, consumers are increasingly concerned about organic, hormone-free production. In order to adapt sheep production to these new demands, it would be of interest to replace synthetic melatonin with phytomelatonin, which is present in plants and can be included in sheep diet. In addition, if phytomelatonin comes from by-products from the food industry, a further step would be taken towards the objectives of the circular economy. Thus, the main objective of this work was to evaluate the effect of phytomelatonin-rich diets on ram sperm quality and seminal plasma composition. With this work, we found that a phytomelatonin-rich diet, including a mix of grape pulp, and pomegranate and tomato pomaces, can increase melatonin levels in seminal plasma, improve sperm viability and morphology, and protect sperm cells against oxidative damage.

Abstract

The aim of this study was to evaluate the effect of a phytomelatonin-rich diet, including by-products from the food industry, on ram sperm quality and seminal plasma composition. Melatonin content in several by-products before and after in vitro ruminal and abomasal digestion was determined by HPLC-ESI-MS/MS. Finally, 20% of a mix of grape pulp with pomegranate and tomato pomaces was included in the rams' diet, constituting the phytomelatonin-rich diet. Feeding the rams with this diet resulted in an increase in seminal plasma melatonin levels compared with the control group (commercial diet) in the third month of the study. In addition, percentages higher than those in the control group of morphologically normal viable spermatozoa with a low content of reactive oxygen species were observed from the second month onwards. However, the antioxidant effect does not seem to be exerted through the modulation of the antioxidant

enzymes since the analysis of the activities of catalase, glutathione reductase and glutathione peroxidase in seminal plasma revealed no significant differences between the two experimental groups. In conclusion, this study reveals, for the first time, that a phytomelatonin-rich diet can improve seminal characteristics in rams.

Assessment of changes in udder half defects over time in non-dairy ewes

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Simple Summary

Two studies were undertaken to assess the changes in palpable udder half defect (hard, lump, or normal) over time and the prediction of future occurrence in a non-dairy breed (Romney) of ewes. In the first study, a standardized udder scoring method was applied at pre-mating, pre-lambing, docking, and weaning. The second study assessed the udder half defect changes in the first six weeks of lactation. The results show that a higher occurrence of diffusely hard udder halves were observed at either pre-mating or docking, while a higher occurrence of udder half lumps were observed at docking and weaning. Udder halves detected with a diffuse hardness or lumps of various sizes at pre-mating were more likely to have a palpable udder half defect (either hard or lump) at pre-mating, docking, or weaning, within the same year, or at pre-mating in the following year. Udder half defect status was highly variable in early lactation; however, overall, the number of defective udder halves decreased with lactation. Thus, these findings show that the risk of future occurrence of a defect was higher in udder halves previously identified with either hard or lump and, therefore, ewes with diffusely hard udder halves or udder half lumps should be culled and not retained for breeding.

Abstract

A total of 1039 non-dairy breed (Romney) ewes were enrolled in two studies to assess the changes in udder half defect status (hard, lump, or normal) over time and to predict the risk of future udder half defect occurrence. In the first study (study A), udder halves of 991 ewes were assessed utilizing a standardized udder palpation method and scored four times a year, for two successive years (pre-mating, pre-lambing, docking, and weaning). The second study (study B) assessed the udder halves at pre-mating, and at six weekly intervals in the first six weeks of lactation in 46 ewes that had defective and normal udder halves. Udder half defect change over time was visualized via lasagna plots, and multinomial logistic regression was used to predict the risk or probability of udder half defect occurrence. In the first study, the highest occurrence of udder halves categorised as hard was observed at either pre-mating or docking. Udder halves categorised as lump had their highest occurrence at either docking or weaning. Udder halves detected with a defect (hard or lump) at pre-mating were more likely (RRR: 6.8 to 1444) to be defective (hard or lump) at future examinations (pre-lambing, docking, or weaning) within the same year or pre-mating the following year, compared to udder halves categorised as normal. In the second study, the change of udder half defect type over the first six weeks of lactation was variable. However, it was observed that the udder half defects, particularly udder halves categorised as hard, decreased during lactation. Failure to express milk in udder halves in early lactation was associated with a higher occurrence and persistency of udder half defects. In conclusion, the occurrence of diffuse hardness or lumps in an udder half changed over time, and the risk of future occurrence of a defect was higher in udder halves previously categorised as either hard or lump. Hence, it is recommended that farmers identify and cull ewes with udder halves categorised as hard and lump.

Fetal growth and osteogenesis dynamics during early development in the Ovines

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Simple Summary

Our study represents an innovative attempt to describe fetal skeleton development during the first part of gestation in sheep using ultrasonography associated with a differential staining technique that allows the observation of the first ossification processes. The timing of ossification and the growth rate of skeletal components are very important to assess normal prenatal growth. This knowledge may be useful for gestational management and early diagnosis of skeletal diseases, especially in the early period of pregnancy when bone growth is very fast in the ovine species.

Abstract

Increased knowledge of the developmental processes during gestation could provide valuable information on potential alterations in embryonic/fetal development. We examined the development of ovine conceptus between the 20th and 70th day of gestation with three convergent analyses: (1) uterus ultrasound examination and measurement (eco) of crown–rump length (CRL) and biparietal diameter (BPD) of the conceptus; (2) direct measurement (vivo) of CRL and BPD of the conceptus outside the uterus (3) osteo–cartilage dynamics during development by differential staining. No significant differences were observed between eco and vivo measurements for CRL and BPD in all examined concepti. CRL and BPD, instead, showed a significant positive linear correlation with gestational age. The study of osteogenesis dynamics has demonstrated a completely cartilaginous ovine fetus at up to 35 days of gestation. The ossification begins in the skull (40th day) and is almost complete between the 65th and the 70th of pregnancy. Our study highlighted that CRL and BPD are accurate parameters for gestational age estimation in the first part of sheep pregnancy and provides an overview of osteochondral temporal dynamics. Furthermore, tibia ossification is a valid parameter to estimate fetal age by ultrasound.

Comparison of three maternal composite sheep breeds managed under pasture lambing and purebred or terminal mating systems: ewe body weight, reproductive efficiency, and longevity

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Abstract

Extensive sheep systems have lower inputs (e.g., feed, labor, infrastructure) but, generally, lower outputs per ewe than intensively managed flocks. Average ewe prolificacy is low (< 1.1 lambs per ewe) across the United States and traditional expectation is that costs required to support larger litters will not be recovered due to greater lamb mortality. The Composite-IV (C-IV) is a 50% Romanov, 25% Katahdin, and 25% White Dorper hair sheep developed and selected for enhanced reproductive efficiency at the U.S. Meat Animal Research Center. Objectives of the current study were to compare productivity of C-IV ewes (N = 404) to Katahdin (N = 342) and Polypay (N = 390), two popular maternal composite breeds, in a lower-input system. Experimental ewes were exposed to either rams of their own breed or Texel rams for the first time at 7 mo of age and remained in the same mating system for up to 4 yr. Ewes lambed on pasture from May to June and were expected to rear their lambs in the absence of supplemental feed and with minimal intervention. The ewe age × breed interaction effect impacted all annually recorded traits (P < 0.01) including number and total weight of lamb marketed at 25 wk per ewe exposed to mating (LS25 and LW25, respectively). Within all ages,

LS25 of C-IV was greater (1.2 to 1.63 lambs; P < 0.01) than Katahdin (0.71 to 1.17 lambs) and Polypay (0.68 to 1.26 lambs) which were similar. At 1, 2, and 3-yr of age, C-IV ewes had, on average, 12 to 17 kg greater LW25 (P ≤ 0.01) than other breeds. Polypay LW25 was similar to Katahdin at 1 yr of age, but 8 to 13 kg greater (P < 0.01) at older ages. At 4 yr of age, LW25 was similar for C-IV and Polypay (63 and 62 kg, respectively). Overall, Texel mating improved LW25 by 3 kg compared to purebred mating (P < 0.01). Twin litters were most common within mature ewes (> 1 yr) of all breeds (52% to 65%); however, the proportion of triplet litters was numerically greater for C-IV (13%) than Katahdin (1%) or Polypay (4%). The frequency of mature ewes that gave birth to and reared twins (75% to 82%) was high for all breeds. Most triplet-bearing mature C-IV ewes reared twins (43%) though many reared triplets (39%). Ewe reproductive efficiency can be enhanced in lower-input systems by utilizing additive breed effects and heterosis in a complimentary crossbreeding program. More research is needed to identify indicator traits associated with lamb survival and to derive appropriate levels of prolificacy to fit specific management constraints.

The effect of weaning age on animal performance in lambs exposed to naturally acquired nematode infections

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Highlights

- Activity patterns were associated with gastrointestinal nematode infection levels.
- At early weaning, body weight gain was reduced in GIN-challenged lambs.
- Late weaning increased the exposure to Haemonchus.

Abstract

The effects of mixed gastrointestinal nematode (GIN) infections on animal growth and post-weaning activity patterns were investigated in grazing intact ram lambs when naturally exposed to two different infection levels and weaned at different ages. Ewes and their twin-born lambs were turned-out to graze in two permanent pasture enclosures naturally contaminated with GIN the previous year. Ewes and lambs in the low parasite exposure group (LP) were drenched before turn-out and at weaning, respectively, with 0.2 mg ivermectin per kg body weight, whereas those in the high parasite exposure group (HP) were left untreated. Two weaning ages were applied, early weaning (EW) (10 weeks) and late weaning (LW) (14 weeks), respectively. The lambs were then allocated to one out of four groups based on parasite exposure level and weaning age (EW-HP, n = 12; LW-HP, n = 11; EW-LP, n = 13; LW-LP, n = 13). Body weight gain (BWG) and faecal egg counts (FEC) were monitored, in all groups, from the day of early weaning and every four weeks, for 10 weeks. In addition, nematode composition was determined using droplet digital PCR. Activity patterns measured as Motion Index (MI; the absolute value of the 3D acceleration) and lying time were monitored continuously from the day of weaning until four weeks post-weaning using IceQube® sensors. Statistical analyses were performed in RStudio, using mixed models with repeated measures. BWG was 11% lower in EW-HP compared with EW-LP (P = 0.0079) and 12% lower compared with LW-HP (P = 0.018), respectively. In contrast, no difference in BWG was observed between LW-HP and LW-LP (P = 0.97). The average EPG was higher in EW-HP compared with EW-LP (P < 0.001), as well as in EW-HP compared with LW-HP (P = 0.021), and LW-HP compared with LW-LP (P = 0.0022). The molecular investigation showed that animals in LW-HP had a higher proportion of Haemonchus contortus compared with EW-HP. MI was 19% lower in EW-HP compared with EW-LP (P = 0.0004). Daily lying time was 15% shorter in EW-HP compared with EW-LP (P = 0.0070). In contrast, no difference in MI (P = 0.13) and lying time (P = 0.99) between LW-HP and LW-LP was observed. The results suggest that a delayed weaning age may reduce the adverse effects of GIN infection

on BWG. Contrarily, an earlier weaning age may reduce the risk of H. contortus infection in lambs. Moreover, the results demonstrates a potential use of automated behaviour recordings as a diagnostic tool for the detection of nematode infections in sheep.

Bigger lambs or more lambs: The conundrum for New Zealand lamb producers.

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Abstract

New Zealand sheep producers generate most of their income from sheep sales, particularly lamb sales. To increase revenue from lamb sales producers have two choices, increase the number of lambs weaned or increase the weight of lambs produced and sold. Lifting the number of lambs sold requires an increase in lambs born per ewe, however this comes at a cost as these lambs are typically smaller and may not reach optimal slaughter weight within the desired timeframe. Alternatively, increasing the weight of lambs, while maintaining total feed supply constant, means that the number of breeding ewes carried on the farm may have to be reduced. This study utilises an existing bioeconomic model to examine the impact on farm productivity and profitability of increasing lambing percentage from an average of 133.5% to 140, 150 or 160%, or increasing lamb weaning weight from 30 kg and 25 kg for singles and twins respectively, by 10, 20 or 30%, or alternatively a mix of the two, i.e., 140% lambing rate and weaning weights of 33 and 27.5 kg for singles and twins, respectively. The results show that lifting lamb weaning weight, by 10, 20 or 30%, increases enterprise cash operating surplus (COS) from $291/ha to $342, $392, or $444/ha, respectively, which is more than the increases in COS from lifting lambing percentage by 10, 20 or 30%, which increased COS to $313, $345, or $368/ha, respectively. The alternative of lifting lambing percentage by 10% and lamb weaning weight to 33 kg and 27.5kg, increased COS by $74/ha. Overall, increasing pre-weaning lamb growth was more profitable than increasing lambing percentage. Therefore, if a producer has a lambing percentage of 140% or above their focus should be on improving pre-weaning lamb growth rates rather than lifting lambing percentage.

Ovarian follicle dynamics in ewes treated with intra-vaginal progesterone pessaries. 2. Factors affecting timing of estrus and reproductive outcomes following artificial insemination

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Abstract

This study extends observations on the effects of intra-vaginal progesterone treatment on the relationships between the time of luteolysis, emergence of the ovulatory follicle, timing of estrus and ewe fertility. Observations were made in progesterone - treated ewes in autumn, the spring equinox and late spring (Experiment 1, Data set 1) and in progesterone – treated ewes and naturally cycling ewes in autumn and the spring equinox (Experiment 1, Data set 2). In Data set 1, the day of emergence of both the first and second ovulatory follicle was positively related to the day luteal regression within each season. In turn, the day of emergence influenced the timing of estrus by means of a season by day of luteal regression interaction ($P < 0.001$) indicating that the relationship was positive in autumn and the spring equinox but negative in late spring. In autumn, older ovulatory follicles were associated with an earlier onset of estrus compared with

younger ovulatory follicles. In late spring, this relationship was reversed and was influenced by whether or not ewes were cycling at the time of pessary insertion. In Data set 2, the relationship between the day of follicle emergence and luteal regression was influenced by a treatment by day of regression interaction indicating the relationship was positive in treated ewes and negative in naturally cycling ewes. Timing of estrus was positively related ($P < 0.001$) to both the day of luteal regression and the day of follicle emergence ($P < 0.05$), with both relationships being stronger in naturally cycling ewes than in treated ewes. In Experiment 2, pregnancy rate following artificial insemination in autumn was highest (90.2%) when luteolysis occurred during Days 7–9 of the pessary period compared with Days 1–6 (77.8%, $P = 0.16$), 10 to 12 (68.8%, $P < 0.05$) or Days ≥13 (71.2%, $P < 0.05$). Timing of estrus was not affected. The mean diameter of ovulatory follicles that emerged during Days 7–9 was larger on Day 12 (5.8 ± 0.13 mm) compared with other periods (range 4.7 ± 0.05 to 5.6 ± 0.14 mm). This study provides two potential strategies to improve the success of AI programs. Firstly, appropriately timed treatment with PGF2α to control the time of emergence of ovulatory follicles and, secondly, earlier treatment with eCG to improve the development of ovulatory follicles that emerge late in the pessary period. Each is likely to be influenced by season and the cyclical status of the ewe.

Upcoming events

Date	Event	Location
3 April 2023	RamSelect and Merino Flock Profiling Workshop Moses & Son	Wagga Wagga, NSW
4 April 2023	RamSelect and Merino Flock Profiling Workshop Moses & Son	Grenfell, NSW
5 April 2023	RamSelect and Merino Flock Profiling Workshop Moses & Son	Condobolin, NSW
5 April 2023	T90 New South Wales Field Day Towards 90	Yeoval, NSW
19 April 2023	Production in the Rangelands Riverina Local Land Services	Hay, NSW