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Short-term grazing of lucerne and chicory increases ovulation rate in synchronised Merino ewes

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ABSTRACT

This study evaluated the ability of short-term grazing of live = green pasture to increase ovulation rate during late summer when annual pasture is generally dead and of low quality. Ovulation rates, measured by the number of corpora lutea, were compared between 4 nutritional treatments: senesced phalaris (*Phalaris aquatica*), phalaris plus 500 g lupin grain per day, lucerne (*Medicago sativa*) or chicory (*Chicorum intybus*) pastures. The study used 100 Merino ewes per treatment, divided between 2 replicates. The experiment was repeated in 3 years; February 2006, and January 2007 and 2008. Oestrus was synchronised and the ewes grazed the pastures for 9 days prior to ovulation at times corresponding to days 8–17 of the cycle in 2006, and days 6–14 in 2007 and 2008. The proportion of ewes producing multiple ovulations was higher ($P < 0.05$) in the lucerne and chicory (0.36, 0.38) than the phalaris (0.27), and intermediate in the lupin (0.33) treatment. Regression analysis showed that the proportion of ewes with multiple ovulations increased with the quantity of live herbage ($P < 0.04$). Responses were achieved even at low levels of live herbage with 90% of the maximum proportion of multiples occurring at 350 kg DM/ha. It is concluded that providing short-term grazing of live chicory or lucerne to ewes can increase ovulation rates relative to ewes grazing senesced phalaris and to levels similar to those achieved by lupin grain supplementation.

1. Introduction

Increasing ewe reproductive capacity provides potential for increasing profitability in sheep meat production systems (Warn et al., 2006). This increase in reproductive rate needs to be achieved cost effectively and in a way that satisfies an increasing consumer demand for a "clean, green and ethical" product (Martin et al., 2004). Using nutrition to manipulate ovulation rate provides a useful strategy that may be inexpensive and avoids the use of chemicals and hormones.

Increased nutrition or flushing prior to mating has long been known to increase ovulation rates or the number of lambs born. This operates through either or both a 'dynamic' effect – a rising plane of nutrition and gaining weight at and for some weeks prior to mating (Gunn et al., 1984), or a 'static' effect – that of the resultant higher liveweight or condition at the time of mating (Coop, 1962; Edey, 1968). An 'acute' effect of nutrition has also been shown, whereby 'short-term' or 'spike' feeding with lupin grain for 4–6 days increases ovulation rates without affecting liveweight or body condition (Knight et al., 1975; Smith and Stewart, 1990). This short-term feeding targets a critical period in the luteal phase of the oestrous cycle around

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days 10–14 of the oestrous cycle (Stewart and Oldham, 1986), or during the period 6 days before luteolysis (Nottle et al., 1990). The benefit of this strategy is that limited feed resources can be used more efficiently than if a longer feeding period is required.

It is clear that the ovulatory response to short-term feeding with lupins is generally repeatable (Scaramuzzi et al., 2006) although responses are variable, and can provide increases in ovulation rate of up to 60% (Stewart and Oldham, 1986; Teleni et al., 1989; Nottle et al., 1990, 1997; Wilkins, 1997). Lupin grain has been the most common feed supplement used in previous studies, but is expensive and not readily available in all localities. However, the use of supplements is an additional cost which may be unnecessary if similar responses could be obtained using existing pasture resources. Since research has provided increasing evidence that the effect of short-term feeding on ovulation rate is driven by dietary energy (e.g. Teleni et al., 1989; Vinoles et al., 2005), other feed alternatives that provide similar nutrition, but are less risky to metabolic health and are more cost effective than lupin supplementation, become possible. Indeed, the value of short-term grazing (up to 18 days) of high quality leguminous pastures such as the perennial shrub tagasaste (*Chamaecytisus palmensis*) (Wilkins, 1997) and *Lotus* spp. (Ramirez-Restrepo et al., 2005; Vinoles et al., 2009) have already been shown to have positive effects on prolificacy. If similar responses to those obtained with lupin grain could be achieved with commonly grown summer-active pasture species, short-term grazing to increase ovulation rates in summer/autumn joined ewes could be adopted by a substantial number of sheep producers.

Lucerne (*Medicago sativa*) and chicory (*Chicorum intybus*) are perennial pastures that provide good quality nutrition during the summer and autumn (Holst et al., 1998) when traditional annual pastures senesce and become low in nutritive value (Thomas et al., 2010). Phalaris (*Phalaris aquatic*) is widely sown as pasture in the higher rainfall temperate regions of Australia, but it is summer-dormant and less able to provide quality summer feed for finishing lambs and improved ewe nutrition at joining. Lucerne is suited to medium and high rainfall areas and in addition to extending the supply of quality pasture, can be sown as a pasture phase in crop rotations to provide a disease break and fix nitrogen. Chicory is more tolerant of acid soils than lucerne, thereby providing an alternative where lucerne cannot be grown (Upjohn et al., 2005). Lucerne and chicory are also desirable because, as perennials, they show potential to reduce ground water recharge and thus contribute to the control of dryland salinity (Dear and Ewing, 2008). Although these improved pastures have proven effective in producing high growth rates in lambs over the summer period (Holst et al., 1998) in central N.S.W., the potential of these forages to increase ovulation rate in a fashion similar to supplementation with of lupin grain and the leguminous species reported by others, is not known.

The field study described in this paper was conducted over 3 years. It aimed to investigate the effects of short-term grazing of lucerne and chicory on ovulation rate in Merino ewes compared to the existing perennial pasture, phalaris with and without short-term lupin grain supplementation.

2. Materials and methods

This experiment was conducted with the approval of the Charles Sturt University Animal Ethics committee. The experiment was conducted on a property south-east of Wagga Wagga NSW (latitude 147.5; longitude −35.2). The climate is typical Mediterranean with hot dry summers and moderately cold winters. Rainfall is an average 600 mm per annum falling evenly throughout the year, although summer rainfall is typically less reliable.

2.1. Animals and experimental procedures

A schematic representation of the experimental design is presented in Fig. 1. The experimental design comprised 4 nutritional treatments (senesced phalaris pasture, senesced phalaris pasture plus 500 g/ewe/day lupin grain (*Lupinus angustifolius*), chicory and lucerne), in a randomised block design with 2 replicates of each treatment combination. The experiment was repeated in each of 3 years (2006, 2007 and 2008). In each year, 400 medium to large-framed 5-year-old Merino ewes of CentrePlus bloodline (a dual-purpose bloodline selected for both meat and wool characteristics) were stratified and randomly allocated to treatment groups ($n = 100$) according to body condition (scale 0 (emaciated) to 5 (obese) (Jefferies, 1961)) and liveweight. In 2007 and 2008, when some older ewes were replaced with younger ewes, animals were also allocated according to age group.

Ewes were weighed and condition scored (without fasting) at the beginning and end of the nutritional treatment periods. Oestrous cycles were synchronised using an intravaginal CIDR® (Controlled Internal Release Device; 0.3 g progesterone, EZI-breed® NZ) inserted for 11–13 days. In 2006, CIDRs were inserted on day −11 and removed on day 0. It was expected that the mean time of ovulation would occur approximately 3 days after CIDRs were removed. That is, the mean time of onset of oestrus in the flock would occur around 36 h after CIDR removal (Kohno et al., 2005) and ovulation would occur approximately 24 h after that. All treatment groups grazed senesced pastures off plots until day −6 when they were introduced to pasture plots and remained there until day 3. Lupin grain was fed daily to the relevant group while grazing the phalaris pasture. After 2006, the protocol was modified to remove the possibility that high levels of feeding, late in the luteal phase of the oestrous cycle, may inhibit ovulatory response (Stewart and Oldham, 1986). Therefore, in 2007 and 2008, CIDRs were inserted at day −13 and removed on day 0. In these years, due to drought conditions, the ewes were supplementary fed a maintenance ration (SCA, 1990) of wheat grain until day −8 when they were placed on the pasture plots and were removed from plots at the end of the CIDR treatment. In all years, the ewes grazed plots for a period of 9 days, corresponding to days 8–17 (2006) or days 6–14 (2007 and 2008) of the 17-day oestrous cycle. On removal from pasture treatment plots, ewes were returned as one flock to annual pasture or low quality hay until the day