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Comparison of strategies to provide lambing paddocks of low gastro-intestinal nematode infectivity in a summer rainfall region of Australia

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ABSTRACT

A replicated field experiment using nine 2 ha paddocks was designed to compare the efficacy of 3 management strategies to prepare spring lambing paddocks of low gastro-intestinal nematode (GIN) infectivity. The management treatments were designed to provide the same overall stocking rate over the lambing paddock preparation period (Phase 1, 16 January–9 June, 2006). The first treatment involved two 21-day periods of intensive grazing with drenched wethers in Jan–Feb, and in late March (Smartgraze summer rainfall, SGSR). The second treatment was industry standard practice of continuous grazing of adult sheep over the entire preparation period (continuous sheep, CS) and the third treatment was industry best practice of continuous grazing of adult cattle (continuous cattle, CC). Phase 2 of the experiment (14 August–12 December, 2006) tested the efficacy of the paddock preparation treatments. Single-bearing ewes ($n = 10$ per paddock) were introduced on 14 August following an effective short acting anthelmintic treatment. Lambing commenced 2 weeks later on the 25th of August with lamb marking at 7 weeks and weaning at 15 weeks when the experiment was terminated. Tracer sheep ($n = 2$) were run in each of the paddocks for 2 weeks at the start of Phase 1, and at the start and conclusion of Phase 2 to assess pasture GIN contamination.

Total worm counts in tracers were reduced by 97.7% (SGSR), 96.9% (CC) and 88.5% (CS) between the start of the experiment and the introduction of lambing ewes. Between the start of the experiment and weaning, total reductions were 87.9% (SGSR), 85.6% (CC) and 26% (CS). Worm egg counts of ewes and lambs grazing SGSR or CC paddocks were significantly lower than those grazing CS paddocks. As a consequence ewes grazing CS paddocks required anthelmintic treatment at both marking and weaning and their lambs at weaning, whereas no anthelmintic treatments were required for ewes or lambs on SGSR paddocks. Ewes and lambs grazing paddocks prepared with SGSR and CC were significantly heavier at weaning than those grazing paddocks prepared with CS, despite requiring fewer anthelmintic treatments.

This experiment demonstrates that an understanding of regional GIN epidemiology can be employed to prepare pastures of very low infectivity in sheep only systems (SGSR) providing parasitological and production benefits equivalent to those obtained by grazing non-host species, in this case mature cattle (CC). Implications of these strategies for the development of anthelmintic resistance are discussed.

1. Introduction

In the New England region of New South Wales, the most prevalent gastro-intestinal nematode (GIN) para-

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sites; *Haemonchus contortus*, *Trichostrongylus colubriformis* and *Teladorsagia circumcincta* (Anderson et al., 1978), constitute a major constraint to sheep health, welfare, production and consequent enterprise profitability. The regional trend towards summer rainfall favours the development of *H. contortus* in particular, which associated with the greater fecundity and pathogenicity of this species (Gordon, 1948; Soulsby, 1965), makes it the primary focus of GIN control. For many years, GIN control in the New England region has been synonymous with the highly successful "WormKill" program (Dash, 1986), which mandated epidemiologically based anthelmintic treatments at a whole farm level. However, the development of widespread closantel resistance in *H. contortus* (Lloyd et al., 1998) has led to a marked decline in its efficacy and usage. This presents both an opportunity and a challenge to identify new integrated parasite management (IPM) approaches to help fill this void.

Southcott et al. (1976) observed that peak levels of infective larvae (L3) in the New England region typically occur on pasture during spring and autumn, and that sufficient autumn-developing L3 are able to over-winter and perpetuate the epidemiological cycle by infecting sheep in spring. The timing of the spring peak coincides with the presence of peri-parturient ewes and lambs, in which poor expression of immunity towards GIN parasites permits greater establishment, survival and fecundity of parasitic GIN stages (Connan, 1967; Gibson and Parfitt, 1972). This in turn enables rapid reinfection following anthelmintic treatment with significant consequences for the productivity (Darvill et al., 1978; Waller et al., 1987b) and welfare (Barger and Southcott, 1978; Watts et al., 1978) of these classes of sheep. Moreover, peri-parturient ewes and lambs have been identified as a significant source of subsequent pasture contamination (Barger, 1996a). This suggests that a targeted approach aimed at providing low infectivity ('clean') paddocks for spring lambing may provide production and welfare benefits as part of an IPM program.

Importantly, methods for the preparation of spring lambing paddocks should aim to limit pasture contamination with L3 in the previous autumn. The key processes involved in reducing L3 pasture contamination are the death rate of L3 and the ingestion, and hence removal, of L3 by an alternate host in which the GIN will not effectively establish. Death of L3 typically occurs to a constant proportion of the existing population (Michel, 1969; Barger et al., 1972; Leathwick et al., 1992) – with the proportion regulated primarily by temperature and moisture – and in the absence of susceptible stock will lead to pasture L3 numbers declining in an exponential manner with time. Grazing management alone and with strategic integration of anthelmintic treatment are two approaches that have been demonstrated to effectively regulate these key processes for improved worm control.

A number of grazing management approaches have been observed to limit pasture contamination for sheep, including alternate grazing with cattle (Southcott and Barger, 1975; Donald et al., 1987), prior grazing with less susceptible classes of sheep such as non-lactating ewes and mature wethers (Anderson et al., 1987) and use of intensive rotational grazing systems which prevent infection from the current grazing period, and increase the time between grazing events sufficiently to allow significant mortality of L3 (Colvin et al., 2008). However, practical application of these approaches may be limited by the availability of cattle and the capital and management requirements of intensive rotational grazing systems. Even the effective use of less susceptible classes of sheep is highly dependent upon seasonal conditions (Waller et al., 1993). Under conditions when unfavourable seasonal conditions cannot be guaranteed, integration of grazing management with summer anthelmintic treatments has been demonstrated in the winter rainfall regions of southern Australia to provide clean pastures for young sheep in the following winter (Niven et al., 2002). This method, subsequently called "Smart Grazing" by the authors, uses two periods of short-term (1 month) intensive grazing by recently drenched sheep over late spring and summer to reduce pasture herbage and promote L3 death rate to produce pastures of comparatively low infectivity the following winter and spring for use by weaners.

The aim of this experiment was to determine if the principles of "Smart Grazing" could be adapted to the summer rainfall dominant New England region to provide clean paddocks for spring lambing. The parasitological and productive effectiveness of this approach was evaluated against the standard practice of prior grazing with less susceptible classes of sheep and the proven effective method of alternate grazing with mature cattle.

2. Materials and methods

2.1. Experimental site and design

The experiment was conducted from November 2005 until January 2007 at a rural property of the University of New England (latitude: 30°28′S, longitude: 151°38′E, altitude 1006 m), in the New England region of New South Wales, Australia. The climate is cool temperate, and the long-term average for annual precipitation is 788 mm, the majority (*circa*. 35%) of which falls in summer. Pasture on the experimental site (47 ha) was a mixture of native and introduced species.

The experiment was split into two phases. Phase 1 (16 January–9 June of 2006, Experiment days −210 to −65) comprised the application of the experimental treatments and Phase 2 (14 August–12 December 2006, Experiment days 0–120) comprised assessment of the treatment effects. The experiment used a completely randomised block design with 3 paddock preparation treatments, each with 3 replicates blocked by topography and vegetation. Three blocks of 6.0 ha each were selected and broadly categorised as creek flats, grassed slopes and wooded hills. Each block was subdivided into 3 treatment paddocks of 2.0 ha each to provide 9 experimental paddocks in total. Prior to the start of the experiment, Merino ewe hoggets ($n = 20$ per paddock) harbouring naturally acquired GIN infections of *H. contortus*, *Trichostrongylus* spp., *T. circumcincta* and *Nematodirus* spp. were rotated among paddocks from November 1, 2005 until