INTENSIVE ROTATIONAL GRAZING REDUCES NEMATODE FAECAL EGG COUNTS IN SHEEP ON THE CICERONE PROJECT

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SUMMARY
The Cicerone Project consists of 3 farmlets each with management systems contrasting in inputs (levels of fertilisers and pastures) and grazing management. Farmlet A has high input, high stocking rate, with flexible grazing using the Prograze principles. Farmlet B has moderate input, moderate stocking rate with the same grazing management as Farmlet A. Farmlet C has moderate inputs and aims at high stocking density using intensive rotational grazing. This paper presents the results of analysis of nematode faecal egg counts (FEC) taken from ewes, hoggets and lambs for flock monitoring purposes over the last 4 years. There were significant ($P<0.05$) interactions between the effects of farmlet and date of sampling for all classes of stock with effects of farmlet dependent on date of sampling. In the early part of the monitoring period, there were no consistent effects of farmlet on FEC, but as grazing and pasture management began to take effect, FEC values for Farmlet C were consistently lower than for the other 2 farmlets. This is reflected in the FECs of lambs and hoggets in early 2003 where counts for Farmlets A and B were high, while Farmlet C FECs stayed very low (lambs: 2270, 1067, 85; hoggets: 670, 439, 115 eggs per gram, for Farmlets A, B and C, respectively). Farmlet A and B animals also had 2 more drenches than Farmlet C animals, yet Farmlet C sheep had consistently lower counts during 2003. The results suggest superior worm control on Farmlet C associated with high intensity, short duration grazing.

Keywords: worm burden, grazing management, intensive rotational grazing

INTRODUCTION
Gastrointestinal nematode infection is a substantial source of economic loss to the Australian sheep industry with an estimated cost of $220 million per annum (McLeod 1995). Over the last century, rotational grazing and set stocking have been discussed in detail in relation to control of gastrointestinal nematode infection (Morgan 1933; Gordon 1948; Gibson 1973; Barger 1997). These papers suggest that rotational grazing in temperate regions provides no better control of gastrointestinal nematode infection than set stocking. Studies, however, in a tropical environment by Banks *et al.* (1990) on *Haemonchus contortus* in Fiji showed that larvae in these regions do not survive in detectable numbers on pasture for more than 5-13 weeks. Similar short survival periods for larvae of cattle nematodes in tropical North Queensland were reported by Fabiyi *et al.* (1988). These studies led to experimentation with rotational grazing of goats in Fiji that proved to be effective in reducing worm burdens and to be especially effective against *Haemonchus contortus* (Barger 1994). Many of the early studies on rotational grazing in temperate regions (Roe *et al.* 1959; Gibson 1965) were based on short rotations of around 4 weeks. Donald (1967) states that there is no sound evidence that pastures should be spelled for periods shorter than 2 months. In a study by Southcott *et al.* (1976), pastures were found to be potentially infective up to 12 months after sheep where removed. This persistence of larvae on pasture is of great importance when considering rotation periods for grazing systems in temperate environments.

The Cicerone Project provided a unique opportunity to compare typical Northern Tablelands grazing practices, with different levels of inputs, with an intensive rotational grazing system involving extended rest periods. The main aim of research carried out on the Cicerone Project is to provide extension material to aid in decision making on farm. This paper reviews the parasitology data from the last 4 years of the Cicerone Project to test the general hypothesis that faecal egg count (FEC) would be significantly influenced by the management systems compared on the Cicerone farmlets. The data presented in the paper are from routine monitoring of FEC, rather than from critical experimentation, which data should provide insights into the effects of levels of inputs and grazing management that can form the basis of detailed critical experimentation in the future.

MATERIALS AND METHODS

The Cicerone farmlets

The Cicerone Project farm is located at Chiswick CSIRO, 18 km south of Armidale NSW (30°52'S, 151°67'E). The Farm was divided into 3 farmlets of 50 ha each in 2000 (Gaden *et al.* 2004). Cattle were run as well as superfine Merino ewes in a flexible 15:85 ratio on the basis of dse. Stocking rates on the farmlets have been similar since measurements started in 2000 (approx. 7-9 dse/ha) up until 2003.

Farmlet A - high input, high stocking rate. Farmlet A consists of 8 paddocks, and flexible grazing is achieved using Prograze principles where stock movement is based on estimated pasture availability. With high inputs, the initial aim in 2000 was to achieve a minimum average of 15 dse/ha within 5 years. The stocking rate for Farmlet A was increased in early 2003 to 16 dse/ha from 7-9 DSE/ha. Nutritional supplementation was fed to all Farmlet A ewes and lambs during the drought period to reach desired target weights. The sowing of pasture is aimed at having 100% of pastures sown to deep-rooted grasses and persistent legumes. During recent years, a high percentage of Farmlet A has been re-sown, reducing options for stock movements. The target soil phosphorus and sulphur levels of Farmlet A are 60 and 10 ppm, respectively.

Farmlet B - medium input, moderate stocking rate. Farmlet B also consists of 8 paddocks, and employs grazing management similar to that used on Farmlet A. This farmlet aims to carry 7.5 dse/ha. In recent years, no sowing of pastures has taken place. The target soil phosphorus and sulphur levels for Farmlet B are 20 and 6.5 ppm, respectively. Farmlet B ewes and lambs received periodic supplementary feed in the form of lupins during the drought.

Farmlet C-medium input, high stocking rate. Farmlet C is an intensive rotational grazing system based on high utilisation, with high stocking density followed by long rest periods. The original 16 paddocks were further divided into 32 paddocks to ensure appropriate grazing pressure, pasture utilisation and rest periods. Grazing periods were 3 days on average, with the average rest period being 108 days. No recent sowings of pasture have taken place on Farmlet C, but clover is at times broadcast with fertiliser applications. The targets for soil phosphorus and sulphur levels on Farmlet C are the same as Farmlet B. Farmlet C ewes and lambs were also fed lupins during 2002/2003.

Measurements

Faecal egg counts (FEC, eggs/g/faeces) were determined using the modified McMaster technique (MAFF 1986) at the Elders Ltd Check-Up laboratory, and from July 2002 at Veterinary Health Research, Armidale. Not all farmlets, or all classes, were sampled at each sampling period as this was dependent on the date of the last drench.

Anthelmintic treatment

Drenching was carried out on the basis of routine FEC monitoring although some treatments were given without a FEC monitor. All sheep on the Cicerone farmlets were given a quarantine drench prior to moving to the CSIRO shed for shearing. The numbers of drenches given for each farmlet are given in Table 1.

Table 1. Number of drenches given to each class on the Cicerone farmlets, Aug 2000 – June 2003.

Class	Farmlet A	Farmlet B	Farmlet C
Ewes	12	13	12
Hoggets	13	10	7
Lambs	11	11	9
TOTAL	**36**	**34**	**28**

Analyses

The FEC data were not normally distributed so were cube-root transformed (CubFEC) to normalise the data prior to analysis. Data selected for analysis included only those for which 1 or more classes of sheep (ewes, hoggets or lambs) were sampled in the same week on all 3 farmlets. CubFEC was subjected to analysis of variance (AOV) within sheep class. The effects tested in the AOV model were farmlet (A, B, C), date of sampling, and the interaction between farmlet and date of sampling. Where significant main effects occurred, means were separated using Duncan's New Multiple Range test. Significant interactions between the 2 main effects were investigated by AOV for the effect of farmlet within sampling periods. A significance level of P<0.05 is used throughout, and means were back-transformed for presentation (with or without s.e.).

RESULTS

Faecal egg counts

There were highly significant interactions between the effects of farmlet and date of sampling for all 3 classes of stock, indicating that there were significant differences between farmlets, but that these were dependant upon date of sampling (Figure 1). The effect of farmlet was greatest for lambs, with lambs on Farmlet C having lower mean FEC over all sampling periods than those on Farmlets A or B (33, 99 and 144, respectively).

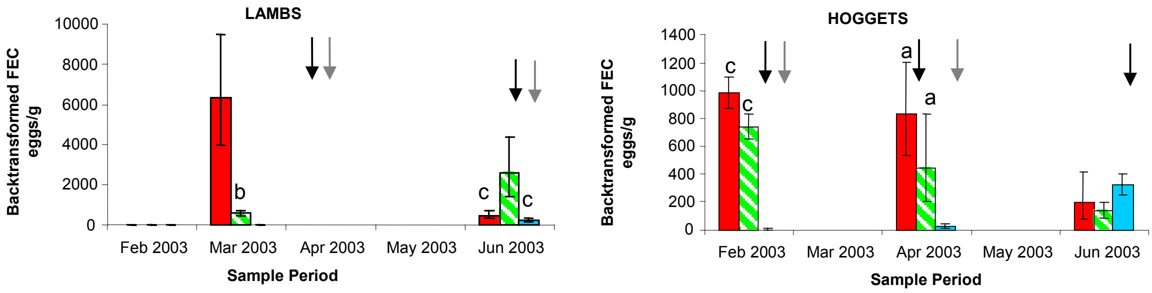

Figure 1. Mean (± s.e.) faecal egg count (FEC, back-transformed means) for lamb and hogget classes of sheep on Cicerone farmlets during early 2003(■ Farmlet A ▨ Farmlet B ■ Farmlet C). Point at which drench was given: ↓ Farmlet A ↓ Farmlet B. (Columns within the same sampling period with different letters are significantly different (P<0.05)).

Larval Cultures

The larval culture results for Farmlets A and B for February, March and April of 2003 in both lambs and hoggets showed that the infection was almost purely *Haemonchus contortus*. Farmlet C hoggets had 20% and 60% *H.contortus* larvae in February and April 2003, respectively. Zero larvae were recovered for Farmlet C lambs in March 2003 with 93% *H.contortus* larvae recovered in June 2003.

DISCUSSION

The general hypothesis that FEC would be significantly influenced by grazing and pasture management is supported by this study. The most marked and consistent effect of farmlet is seen in the latter part of the monitoring period in lambs and hoggets. All 2002 drop lambs were treated with anthelmintic in December 2002. Lambs on Farmlets A and B then had 2 more drenches in April and June 2003 when their FECs increased dramatically with simultaneous persistent rains. In contrast, Farmlet C lambs had zero FEC in late March 2003, and low nematode FCEs in June 2003, 214 days after their only anthelmintic treatment. The hoggets followed a similar trend to the lambs with all farmlets having a drench in October 2002. The FECs remained low until February 2003, when Farmlets A and B had high FECs whilst Farmlet C FEC remained very low. Farmlet A and B hoggets received a drench in February and, when retested in April, again showed significantly higher FECs than Farmlet C. The shorter grazing periods on Farmlet C probably meant that sheep were removed before nematode eggs develop into infective larvae on many occasions (Gibson and Everett 1976). An increase in larval mortality may also occur with greater exposure to temperature and moisture fluctuations in the shorter pasture. The long rest periods of Farmlet C probably resulted in the death of most of the infective larvae (Donald 1967), thereby contributing to low larval availability and reduced infection rates. The high level of *Haemonchus contortus* infection in Farmlet A and B lambs and hoggets in early 2003, and the low to moderate levels of *H. contortus* in Farmlet C, suggest that the intensive rotational grazing system is especially effective against *Haemonchus* infections. This observation is significant as Closantal resistance has been noted on Cicerone, and is an increasingly common occurrence in the New England area (Love *et al.* 1998).

Improved protein nutrition has been shown to reduce worm burdens in sheep (Steel 2003). This phenomenon, however, does not seem to be a likely explanation for the lower FEC observed in Farmlet C lambs and hoggets. Farmlet C has a moderate input of fertiliser and no recently sown pastures, whereas Farmlet A has high inputs of fertiliser, which increased the digestibility of the pasture on this farmlet (L. Shakhane, *pers. comm.*).

Prior to 2003, there was no consistent pattern of farmlet effect on FEC, with all farmlets being lower or higher at different times. There was a long term trend, however, for FEC to increase over time. This can be attributed to the fact that the site for the farmlets was clean when the sheep arrived, as sheep had not grazed these pastures for many months. Thus, FEC rose slowly as the infectivity of the pastures increased. As FEC increased on the Cicerone farmlets, so to did the need to drench, with divergence in drenching patterns between farms beginning in November 2001. The fact that FECs stayed low on the farmlets until 2003 can also be attributed to drought conditions prevailing during 2002 and early 2003. The rainfall received in the New England region in late February and March 2003 is reflected in the FECs for the lambs and hoggets, which peaked at this time. This rise in FEC of lambs and hoggets on Farmlet A also coincided with a doubling of stocking rate on this farmlet in early 2003 from around 8 dse to 16 dse.

These early results, whilst they show superiority of worm control on Farmlet C, need to be interpreted in the light of contrasting data on animal liveweight change and wool growth, both of which tend to be higher on Farmlets A and B (Gaden *et al.* 2004). Ultimately, the Cicerone Project aims to determine the whole-farm consequences of these different management strategies so that graziers will better understand some of the complex interactions that occur when both the pasture feedbase and grazing management are altered. These integrative analyses will be the subject of future work which will determine how best to integrate parasite management strategies for the control of economically important nematodes into whole farm practices.

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REFERENCES

BARGER, I.A. (1994). *Vet. Parasit.* **53**, 109-116.
BARGER, I.A. (1997). *Vet. Parasit.* **72**, 493-506.
BANKS, D.J.D., SINGH, R., BARGER, I.A., PRATAP, B. and LE JAMBRE, L.F. (1990). *Int. J. Parasit.* **20**, 155.
DONALD, A.D. (1967). *Aust. Vet. J.* **43**, 122-128.
FABIYI, J.P., COPEMAN, D.B. and HUTCHINSON, G.W. (1988). *Aust. Vet. J.* **65**, 229-231.
GADEN, C.A., HALL, E.M., SCOTT, J.M. and HOAD, J, (2004). *Anim. Prod. Aust.* **25**, (This Proceedings).
GIBSON, T.E. (1965). *Vet. Rec.* **77**, 1034.
GIBSON, T.E. (1973). *Vet. Rec.* **92**, 469-473.
GIBSON, T.E. and EVERETT, G. (1976). *Brit. Vet. J.* **132**, 50-59.
GORDON, H. MCL. (1948). *Aust. Vet. J.* **26**, 17-45.
LOVE, S.C.J., LLOYD, J.B. and DAVIS, E.O. (1998). *In* 'Proceedings of the Australian Sheep Veterinary Society.' (Ed. T.J. Watts.) p. 42. (Australian Sheep Veterinary Society: Indooroopilly, Qld.)
MAFF (1986). 'Manual of Veterinary Parasitological Laboratory Techniques.' (3rd Ed.) (Her Majesty's Stationary Office: London.)
MCLEOD, R.S. (1995). *Int. J. Parasit.* **25,** 1363-1367.
MORGAN, D.O. (1933). *J. Helminth.* **11**, 169-180.
ROE, R., SOUTHCOTT, W.H. and TURNER, H.N. (1959). *Aust. J. Agric. Res.* **10**, 530.
SOUTHCOTT, W.H., MAJOR G.W. and BARGER, I.A. (1976). *Aust. J. Agric. Res.* **27**, 277-286.
STEEL, J.W. (2003). *Aust. J. Exp. Agric.* **43**, 1469-1476.

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