Important principles of pasture management demonstrated within the Cicerone Project's grazed farmlet experiment: some personal reflections

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Abstract
The Cicerone Project conducted a grazed farmlet experiment at a moderate scale (53 ha per farmlet) from July 2000 to December 2006 on the Northern Tablelands of NSW to investigate the influence of increased pasture inputs and intensive rotational grazing compared to a typical management system with moderate inputs and a flexible rotational grazing regime. This paper is a personal reflection on the evidence gathered about pastures and their effects on animal and farmlet performance over the experimental period.

The most influential management factor which affected farmlet productivity was the sowing of pastures while increasing soil phosphorus and sulfur levels. This allowed the maintenance of higher levels of sown perennial grasses and a significant increase in legume content which together, lifted stocking rate by more than 40%. Although intensive rotational grazing resulted in significant improvements in the control of intestinal worms in sheep and maintained sown perennial grasses quite well, it showed an increase in warm season grasses and had similar low levels of legume and stocking rate compared to the typical farmlet.

Some of the important principles discussed include: how to maintain adequate desirable species, the importance of pasture renovation and soil fertility, the need for perennial pastures to persist over decades, the critical levels of green herbage necessary for both animals and pastures, allowing grazing animals sufficient choice in their diet and the need for better management at the individual paddock level.

Key Words
Perennial pastures, selective grazing, green herbage mass, stocking rate, soil fertility, grazing management.

Introduction

Whilst much has been learned about pasture management in the high rainfall zone of Australia over recent decades, the practice of managing pastures still suffers from the fact that the grazing animal gets more attention than the pasture. As the animal is the direct source of livestock products and therefore income, it is logical that the focus be on the animals and their health. However, it is acknowledged by scientists and livestock producers alike that the dominant driver of animal growth is the amount and quality of feed they are able to consume, especially when grazing pastures. Thus, it makes good sense to reflect on how we can improve pasture management and, where possible, to highlight some key principles to guide that management.

A grazed farmlet experiment was conducted by the Cicerone Project on the Northern Tablelands of NSW from July 2000 to December 2006 to investigate how different management systems compare in their profitability and sustainability. Many of the results referred to here come from a series of 24 papers which are to be published late in 2012 as a Special Issue of the journal Animal Production Science (volume 52). As it is not feasible to summarise all of the results in this short conference paper, an attempt will be made to discuss some important principles of pasture management that were reinforced by the experiment. Nevertheless, it is anticipated that key results will be displayed during the Conference.

The Cicerone farmlet experiment

The decision to conduct a grazed farmlet trial of different management approaches arose from a survey of Northern Tablelands graziers by Kaine *et al.* (2012) who found that their most important problems were: (a) the difficulty of maintaining a sufficient, high quality feed supply that can maintain breeding ewes in 3 score condition, especially through pregnancy and dry seasons, without the need for excessive amounts of expensive supplementary feed and (b) the management of intestinal worm parasites in sheep.

The trial set out to compare three different management systems of interest to Cicerone members on three farmlets, each of 53 ha. The three systems were: a typical system (farmlet B) with a moderate level of soil fertility with 8 paddocks which were grazed using a flexible rotational system based on the assessment of pastures and livestock, similar to the ProGraze approach (Bell and Allan 2000); a higher input system (farmlet A) with a high rate of pasture renovation and higher soil fertility but with the same number of paddocks and grazing management as farmlet B; and a third farmlet (C) with the same soil fertility as farmlet B but intensive rotational grazing over its 37 paddocks. Stocking rate was treated as an emergent property of each system. As noted by Morley and Spedding (1968), if stocking rates are allowed to vary in experiments, it is necessary to take a 'whole farm' approach when evaluating such systems.

Discussion of results in relation to some principles of pasture management

Maintaining an adequate proportion of desirable species in a pasture. The changes in botanical composition among the farmlets have been described in detail by Shakhane *et al.* (2012b). As the level of sown perennial grasses (SPG) rose on farmlet A compared to the typical farmlet (B), the proportion of warm season grasses (WSG) declined; over time, these changes were driven mostly by increased soil P and pasture renovation. In contrast, whilst farmlet C (intensive rotational grazing) retained most of its SPG, it showed a similar increase in WSG compared to that on farmlet B. Farmlet C also demonstrated much improved intestinal worm control (Colvin *et al.* 2008). The higher soil P levels on farmlet A also increased the level of cool season species, legumes and herbs on that farmlet. By the end of the trial, pastures on the typical farmlet (B) had become degraded, with an increased number of thistles and evidence of more 'patch' grazing where sheep heavily grazed parts of paddocks and left other parts virtually untouched (Shakhane *et al.* 2012b). Also, low levels of legume on farmlets B and C meant that both had low nitrogen inputs, thus limiting the protein content of pastures with consequences for the production of the protein products such as meat and wool. In spite of these findings, farmlet B showed the best cash flow results, as it spent less on capital and maintenance. But the question remains, what would have happened over a longer period of time and some above-average rainfall years? This question is addressed below under 'optimising profitability'.

Farmlet productivity was enhanced by pasture renovation and soil fertility. Pasture renovation, combined with increases in soil fertility, were confirmed as having a substantial positive effect on animal production per head and per hectare (Hinch *et al.* 2012) and hence farmlet productivity. Of course, this higher productivity came at a cost of pasture renovation as well as increased levels of fertiliser (Scott *et al.* 2012b). In contrast, intensive rotational grazing did not lift overall productivity compared to typical management.

Need to maintain perennial pastures for decades. The detailed economic and modelling analyses conducted as part of the trial demonstrated clearly that the renovated pastures need to be maintained for many years (Behrendt *et al.* 2012a). Using data from the farmlet experiment, the modelling showed that a rate of pasture renovation of 4% produced optimal economic outcomes over the long-term (Behrendt *et al.* 2006). This means that, if renovation investments are to be optimised, pastures need to be maintained for some 25 years! The evidence suggests that this can be best achieved by ensuring a strong legume presence (which is aided by adequate soil fertility), combined with persistent perennial grasses, by careful grazing management and by adjusting the stocking rate to avoid over-exploitation of the pasture (Sanford *et al.* 2003).

Assessing pasture growth and utilisation is difficult. The trial showed how difficult it is to accurately measure pasture growth (Shakhane *et al.* 2012a), especially in the below-average rainfall years which were experienced (Behrendt *et al.* 2012b). When pasture growth is slow, it is even more challenging for a grazier to be able to know the current pasture growth rate or accurately measure the level of pasture utilisation. Thus, it is important that graziers have a high level of competency in estimating herbage mass levels using visual techniques such as those practised in ProGraze courses. The satellite images which were used to assess the potential pasture growth rate over the entire area of the farmlets (Donald *et al.* 2012) found significant differences in potential pasture growth between farmlets. This technology has great promise as a means of cost-effectively providing evidence of green herbage mass and growth rate in a practical and timely fashion, thus greatly improving a grazier's capacity to more proactively adjust stocking rate.

Achieving a balance between animal and pasture needs is difficult. Matching the conflicting needs of pastures and animals is known to be challenging (Chapman *et al.* 2007). In this whole-farmlet experiment, even with considerable resources, it was difficult to have timely measurements of all of the essential information about pasture supply and animal demand across all paddocks and all grazing mobs (Shakhane *et al.* 2012c). Again, it is even more difficult in commercial grazing enterprises where much less information is available. Further development of regular remote sensing and automated livestock weighing may allow more timely assessments of the balance between the pasture supply and livestock demand to facilitate improved management of paddocks and mobs leading to more profitable grazing enterprises.

Maintaining critical levels of green herbage is essential for a number of reasons. The issue of how much green herbage to maintain on the farmlets was an area of considerable controversy between the researchers and the producer members of the Cicerone Board. Whilst most of the producers wanted to increase stock numbers whenever green feed was obvious, the researchers wanted to accumulate green herbage to 1000 kg DM/ha before increasing stock numbers. The end result was that, too often, the levels of green herbage mass on the farmlets reached levels below 500 kg DM/ha (Shakhane *et al.* 2012a). The published literature reports a number of critical levels of green herbage which are important not only for the animal but also for the pasture. For example, reproductive ewes require 1000 to 1500 kg DM/ha of green herbage from late pregnancy to lactation. Secondly, the amount of green herbage and its height has consequences for intestinal parasite management. Thirdly, if one desires pastures to grow near to their potential growth rate for any given level of light, temperature, soil moisture and soil nutrients, it is crucial that there be enough functional green leaf to photosynthesise adequately; this can be between 1500 and 2500 kg DM/ha (Bluett *et al.* 1998). Finally, it is essential that pasture plants are not grazed too frequently or harshly if they are to persist, especially when plants are regrowing following grazing during dry spring periods (Boschma and Scott 2000).

Winter production demands temperate species and adequate soil nitrogen. Animal nutrition during winter, which usually involves the increasing demands of pregnancy, relies on an adequate supply of green leaf, either from current growth or from autumn-saved pasture. In either case, temperate species are needed for this purpose as warm season grasses become frosted and do not grow during winter conditions (Cook *et al.* 1978). These species were most apparent on farmlet A which benefited from more pasture renovation and higher soil fertility, leading to higher levels of legume which in turn resulted in higher soil nitrogen (Guppy *et al.* 2012) which again, in turn, enhances pasture growth under cold conditions.

For high animal production, the animal must be offered dietary choice. High rates of animal production depend on high levels of pasture herbage mass and quality. Under conditions of relatively low stocking densities (on farmlets A and B), animals were better able to choose their diet than when very high stock densities were used (as on farmlet C) (Hinch *et al.* 2012). When there was high quality pasture across entire paddocks, as on farmlet A, animals grazed those paddocks relatively evenly. However, on farmlet B, the lower quality pasture led to more uneven grazing with substantial proportions of paddocks rarely grazed. In the case of farmlet C, with its high stock densities, animals competed intensely and thereby selected a lower quality diet; the result was even utilisation of the paddock but low per head production. With intensive rotational grazing, the options for increasing dietary choice are to either reduce the stocking rate or shorten the graze period by creating more paddocks.

The paddock is the unit of management. As shown convincingly by this trial, it is the paddock which is the crucial unit of management – for soil fertility, pasture species and animal management. If graziers find that their pasture resources are holding back their farm's production, then the key is to manage these resources, one paddock at a time. As part of this management, it is vital that regular soil testing be carried out on each paddock to allow any fertility constraints to be overcome as cost effectively as possible (Guppy *et al.* 2012).

Optimising profitability, cash-flow and net worth required modelling to estimate returns over the long-term. Although farmlet A had the highest gross margins, its cash flow was inferior to farmlets B and C (Scott *et al.* 2012b) due to the rapid development of pastures and soil fertility. In terms of cash flow, farmlet C was intermediate between farmlet B (highest) and farmlet A (lowest). These results were affected by the drier than normal conditions during the trial and the artificially high rate of pasture renovation on farmlet A. Modelling of farm financial performance using longer term climatic records, with farmlet data scaled up to a commercial farm scale, revealed that the farmlet A strategy had the potential to be more profitable over the long-term than farmlet B, but with a higher level of risk (Scott *et al.* 2012a).

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