Sharing dairy industry research for all grassland farmers

Dawn Dalley
Dexcel, Palmerston North, New Zealand
(formerly with Department of Primary Industries, Ellinbank, VIC 3821)
dawn.dalley@dexcel.co.nz

Opportunities exist for extensive grazing industries to benefit from research conducted in the dairy industry. While at first glance you may question the relevance of such research to these industries, an important factor to remember is that they all rely heavily on grazed pasture. Grazed pasture is considered the cheapest feed available to dairy farmers. Therefore, in their pursuit of improved efficiency, dairy farmers are leading the field in understanding pasture management and the limitations of pasture. This paper describes several recent projects that have investigated the impact of grazing management, fertiliser application, stocking rate, and pasture allocation on the intake by cattle of dry matter and nutrients from pastures.

Dry matter intake from pasture

There are two theories associated with the control of pasture intake by grazing animals. The first is that grazing behaviour is the most important factor influencing pasture intake (Forbes, 1995). The amount of time spent grazing is dependent on the quantity and quality of pasture on offer and on the physiological state of the animal. Animals rarely graze for more than 12 out of every 24 hours (Krysl and Hess, 1993), so slow rates of eating caused by sparse pastures will result in low intakes.

In the second theory, rumen fill and rate of digestion are the key factors controlling intake. Gibson (1984) reported that infrequent feeding lowers the efficiency with which an animal can digest food and utilise the nutrients by approximately 16%.

Recent research in the dairy program has investigated the effect of pasture allowance and frequency of feeding on pasture intake.

Increased pasture allowance

Ulyatt and Waghorn (1993) and Muller (1993) emphasised that limitations to cow productivity in pasture-based dairy systems often arise from a low voluntary intake of pasture. The effect of increasing pasture allowance on voluntary dry matter intake was investigated in a series of experiments at Ellinbank and Kyabram, Victoria (Dalley *et al.*, 1999; Wales *et al.*, 1998, 1999).

In the Ellinbank study, DM intake began to plateau at allowances of between 60 and 70 kg DM/cow/day on rainfed perennial pastures (Figure 1). Experiments conducted at Kyabram (Wales *et al.*, 1998, 1999) reported a linear relationship between pasture allowance and intake, over a pasture allowance range of 20 to 70 kg DM/cow/day, on irrigated perennial pastures. Intake increased by 0.14 kg DM/kg DM increase in pasture allowance at Ellinbank and 0.18 kg DM/kg DM increase in pasture allowance at Kyabram. At the very high allowances, less then 30% of the pasture on offer was utilised, the consequence of which is difficulty maintaining pasture quality. Decisions on pasture allocation therefore become a compromise between achieving acceptable pasture intakes and maintaining pasture quality.

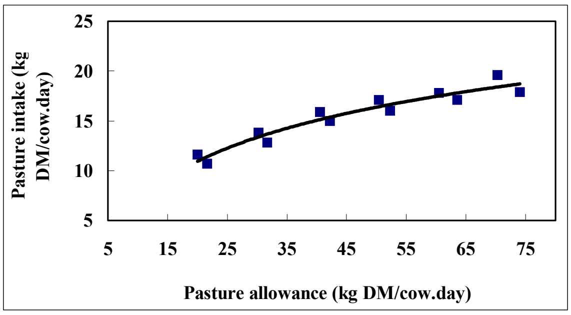

Figure 1. Relationship between pasture allowance and estimated dry matter intake of cows grazing rainfed perennial pastures in spring.

Increased frequency of feeding

Two experiments were conducted at Ellinbank to investigate the effects of increased frequency of feeding on dry matter intake, grazing behaviour, and milk production of dairy cows (Dalley *et al.*, 2001). Lactating dairy cows were offered fresh pasture either once or six times per day. Pasture intake was estimated daily throughout the study. Despite the adoption of extreme grazing management procedures, we were unable to increase pasture intake or milk production in early lactation. The results suggest that there is little opportunity for farmers to increase pasture intake by increasing the frequency of pasture allocation. Therefore, the extra time and effort required to fence paddocks and move animals with more frequent feeding cannot be justified.

Key Message:
•Increasing daily pasture allowance appears to be the most effective means of increasing pasture intake.

Nutrient intake from pasture

With an understanding of the nutrients obtained from grazed pastures, farmers should be able to better utilise supplements, as well as improve pasture utilisation and profitability. While specifically describing the nutritive characteristics of supplements is relatively easy to accomplish (either through testing of supplements for nutrient content or, alternatively, feeding products that a feed company can accurately describe), precise and timely descriptions of the nutrient content of pastures in grazing systems is more difficult to achieve.

A number of projects in the dairy program have provided information on the nutrients provided by pasture at different times of the year and under different management systems.

Perennial Pasture Database

A database commissioned by the Department of Primary Industries has been developed to assist Victorian dairy farmers and their advisers to estimate the nutritive characteristics (energy, protein, fibre) of pastures. The inputs required are simple, on-farm, observable attributes of pasture. The database contains information from over 8,000 pasture samples collected statewide using standard methods. These data could also be of value to the sheep and beef industries of Victoria and New South Wales.

The user is asked to select information on the region, from a range of drop-down menus, including where the farm is located and month of year. The search can be further refined by specifying the pre-grazing pasture mass (t DM/ha) and/or by specifying dominant pasture species, i.e., clover, ryegrass, paspalum.

The database proceeds to collate all pasture samples matching the inputs specified by the user and displays a summary of these on an output screen. The output screen gives average values for metabolisable energy, crude protein, and fibre, as well as standard deviations, ranges, and the number of matching samples found during the search.

The Perennial Pasture Database for the Northern Irrigation region and for southwest Victoria can be accessed through the Target 10 website (www.target10.com). From the home page, select Resources, and then Online Consultant. Click on the Pasture Management heading, and then select Nutritional Value. This will bring up the Perennial Pasture Database.

The database provides a basis for farmers and other end users to more accurately predict the nutritive value of pastures and, therefore, is an effective tool to assist in matching nutrients from pastures and supplements. Values generated from the database can be used in nutritional packages to assess whether the diet is appropriate for a desired level of production.

ABC farmlets

The ABC farmlet demonstration was conducted at Ellinbank from 1992 to 1998 and provided an opportunity to determine the variation in nutrient intake from pasture under three farm management systems. Farm A was stocked at 1.4 cows per hectare, received 300 kg/ha of 2-in-1 superphosphate per annum as a single application, and the cows were rotationally grazed through 11 paddocks. Farm B was stocked at 2.5 cows per hectare, received 450 kg/ha of 2-in-1 superphosphate per annum in two applications plus strategic nitrogen (N), crops were grown as part of a pasture renovation program, and grazing of the cows was optimised through rotational grazing of 22 paddocks. Farm C was stocked at 4.7 cows per hectare and received 700 kg/ha of 2-in-1 superphosphate in three applications plus strategic N. Use of crops and grazing management was the same as the B farmlet.

The metabolisable energy (ME) concentration of the pasture ranged from 8.0 to 12.5 MJ/kg DM (Figure 2). Low ME concentrations during late spring and summer were the major limitation to production on pasture-only diets. The decline in ME concentration following spring was affected by farm management practices, with the greatest decline seen when fertiliser input and stocking rate were low (A Farm).

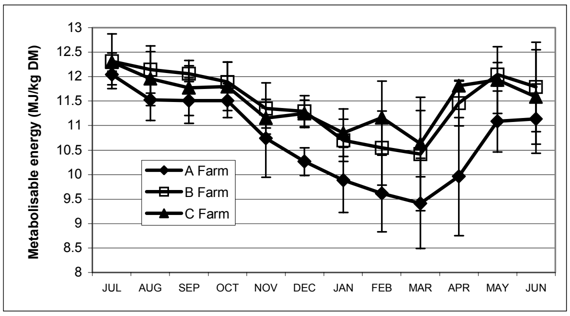

Figure 2. Seasonal variation in pasture metabolisable energy concentration under three farm management systems.

Crude protein concentrations ranged from 10% to 33% DM (Figure 3). Application of N fertiliser increased crude protein concentrations during summer but only to between 14% and 16%. Pasture protein concentrations often exceed protein requirements during spring.

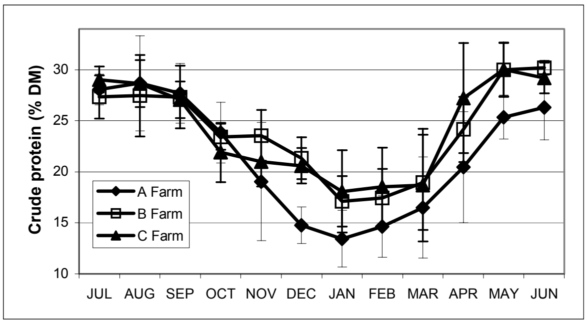

Figure 3. Seasonal variation in pasture crude protein concentration under three farm management systems.

Neutral detergent fibre (NDF) concentrations ranged from 38% to 78% DM (Figure 4). NDF is unlikely to be deficient on pasture-only diets, and high concentrations may restrict intake in summer due to limitations on rumen fill and the slower rates of digestion of poorer-quality feed.

Pasture potassium (K) concentrations ranged from 1% to 4.9% DM (Figure 5). High pasture K levels during winter and spring will decrease magnesium absorption and increase the risk of grass tetany. Pasture K levels increase as the input of potash increases. Split applications or late-spring applications of K fertilisers are recommended to reduce the incidence of grass tetany.

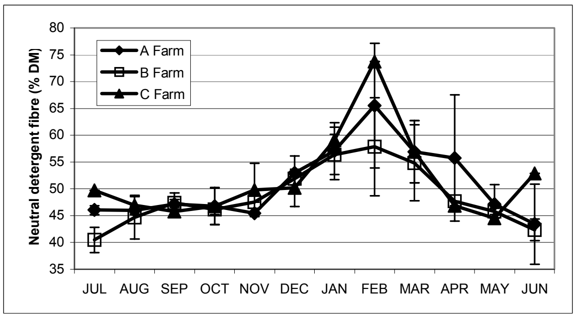

Figure 4. Seasonal variation in pasture neutral detergent fibre concentration under three farm management systems.

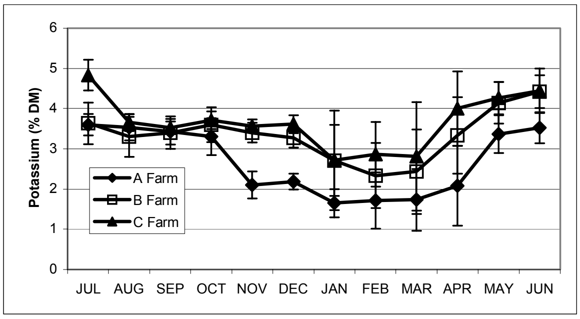

Figure 5. Seasonal variation in pasture potassium concentration under three farm management systems.

Key Messages:

- **Grazing management affects the quality of pasture consumed by grazing animals. The energy concentration of pasture can be improved through rotational grazing with pre- and post-grazing herbage mass targets and strategic use of hard grazing, topping, or pasture conservation.**
- **Crude protein, phosphorus, potassium, and sulphur concentrations can be increased by the use of nitrogen fertilisers, superphosphate, and potash.**
- **Whether a nutrient is deficient will depend on the class of stock being run, i.e., dairy, beef, or sheep, and their physiological state, i.e., growing, lactating, or pregnant.**

Phosphorus for Dairy Farms

The Phosphorus for Dairy Farms project was conducted at Ellinbank from 1995 to 2001. The project had a number of objectives relating to phosphorus (P) fertiliser rates and stocking rate, and the design is outlined in Figure 6. At the commencement of the project, the site had an average Olsen P of 13.2 ppm. At the completion of the project, the Olsen P concentrations were 8 ppm on the 0 kg P/ha treatments, 15 ppm on the 35 kg P/ha treatments, 26 ppm on the 70 kg P/ha treatments, and 46 ppm on the 140 kg P/ha treatments.

The dietary components for each herd varied considerably from month to month depending on pasture growth rates. From October to December, pasture comprised the largest proportion of the diet of all the herds. When water stress slowed growth rates during summer, hay, silage, and barley were used to meet the feed shortage.

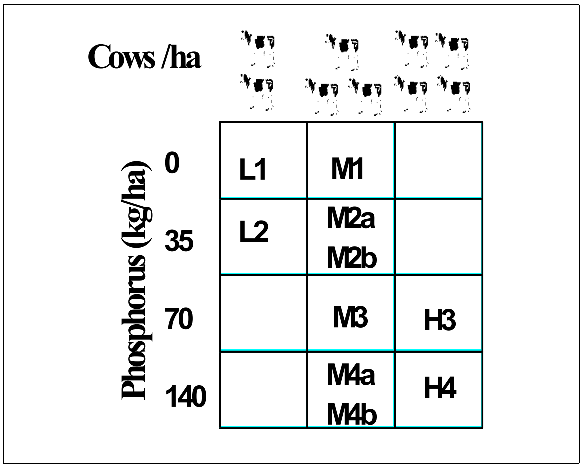

Figure 6. Design of the Ellinbank Phosphorus for Dairy Farms project.

There was very little difference in the ME concentration of the pasture consumed by the cows on the different farmlets (Figure 7). At first glance, this seems surprising. We might have expected that cows on the low P, low stocking rate treatments may have consumed pasture of poorer quality. However, because of the grazing management regimes employed in the project, pasture quality was maintained on all the farmlets with the major differences being season variation in quality.

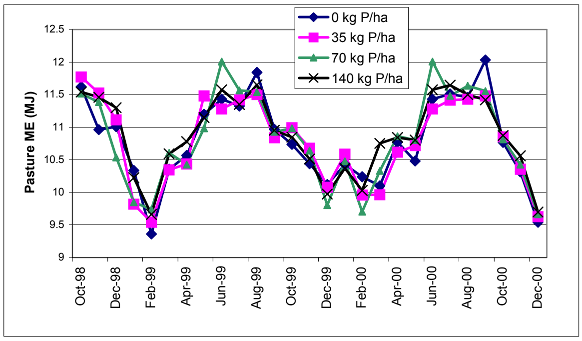

Figure 7. Effect of phosphorus fertiliser rate on the metabolisable energy concentration of the pasture consumed.

There were only small differences in crude protein concentrations between the farmlets. However, crude protein concentrations were low (13% to 14%) for all farmlets during the summer. P fertiliser and stocking rate had no significant effect on calcium (Ca), magnesium (Mg), sulphur (S), or copper (Cu). The intake of Ca and Mg during winter/spring on all the farmlets was marginal relative to requirements. As a prevention against grass tetany, all cows received Mg supplementation from calving until after mating. To minimise the incidence of milk fever, additional Ca was supplemented for the first 4 days of milking after calving while the cows were in the colostrum herd.

As expected, the major difference in nutrient intake between the farmlets occurred with phosphorus, and this was primarily driven by differences in pasture P content and the proportion of pasture in the diet. For example, during spring, P intake on the 140 kg P/ha treatment was double that of the 0 P/ha treatment (Figure 8).

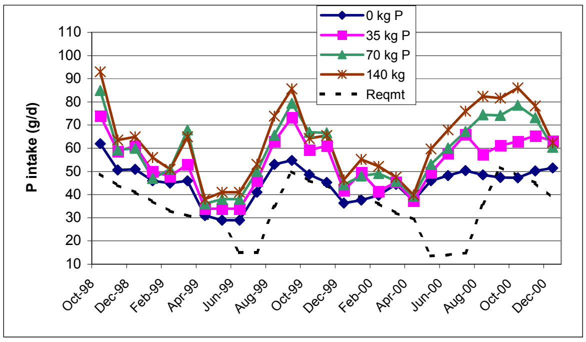

Figure 8. Effect of phosphorus fertiliser rate on phosphorus intake.

As a consequence, the calcium:phosphorus ratio of the diet during this period fell below the recommended range of between 1:1 and 2:1 for a number of the herds. This has implications for calcium metabolism and bone structure and density. The question is 'Are these high P diets creating cows with osteoporosis?' At the other extreme, P intake on the 0 P treatment during the summer often failed to meet animal requirements. The low P intake on poorly fertilised soils has implications in the rearing of replacement dairy stock and in the beef and sheep industries. Imbalances in these minerals could be compromising production in some situations.

Key Messages:

- **High-quality pastures can be grown on areas of low Olsen P provided good grazing management practices are adopted.**
- **The crude protein concentration of rainfed pastures declines to very low levels during summer.**
- **Extremes in phosphorus fertiliser applications may be predisposing our grazing livestock to mineral imbalances. On soils of very low Olsen P (less than 8), low phosphorus intakes may be affecting the growth of young animals. In contrast, at high Olsen P levels, an imbalance in the Ca:P ratio may be affecting bone density in older, high-producing animals.**

Conclusion

Grazed pasture forms the basis of the dairy, beef, and sheep industries in southern Australia and provides a competitive advantage for these production systems. Increased understanding of the limitations to grazed pasture will allow farmers to fine tune their operations and strategically use supplements to balance nutrient intake and animal requirements.

References

Dalley, D. E., Roche, J. R., Grainger, C., and Moate, P. J. 1999. Dry matter intake, nutrient selection and milk production of dairy cows grazing rainfed perennial pastures at different herbage allowances in spring. *Australian Journal of Experimental Agriculture* 39:923–931.

Dalley, D. E., Roche, J. R., Moate, P. J. and Grainger, C. 2001. More frequent allocation of herbage does not improve the milk production of dairy cows in early lactation. *Australian Journal of Experimental Agriculture* 41:593–599.

Forbes, J. M. 1995. The intake of fresh and conserved grass. In *Voluntary food intake and diet selection in farm animals*, ed. J. M. Forbes, 354–383. Wallingford Oxon, UK.

Gibson, J. P. 1984. The effects of frequency of feeding on milk production of dairy cattle: an analysis of published results. *Animal Production* 38:181–189.

Krysl, L. J., and Hess, B. W. 1993. Influence of supplementation on behaviour of grazing cattle. *Journal of Animal Science* 71:2546–2555.

Muller, L. D. 1993. Limitations of pasture for high production by dairy cows - A US perspective. In *Improving the quality and intake of pasture based diets for lactating dairy cows*, ed. N. J. Edwards and W. J. Parker, 11–32. Palmerston North, New Zealand: Department of Agriculture and Horticulture Systems Management, Massey University.

Ulyatt, M. J., and Waghorn, G. C. 1993. Limitations to high levels of dairy production from New Zealand pastures. In *Improving the quality and intake of pasture based diets for lactating dairy cows*, ed. N. J. Edwards and W. J. Parker, 11–32. Palmerston North, New Zealand: Department of Agriculture and Horticulture Systems Management, Massey University.

Wales, W. J., Doyle, P. T., and Dellow, D. W. 1998. Dry matter intake and nutrient selection by lactating cows grazing irrigated pastures at different pasture allowances in summer and autumn. *Australian Journal of Experimental Agriculture* 38 (5): 451–60.

Wales, W. J., Doyle, P. T., Stockdale, C. R., and Dellow, D. W. 1999. Effects of variation in herbage mass, allowance and level of supplement on nutrient intake and milk production of dairy cows in spring and summer. *Australian Journal of Experimental Agriculture* 39:119–130.