DURATION-CONTROLLED GRAZING OF DAIRY COWS: IMPACTS ON PASTURE PRODUCTION AND LOSSES OF NUTRIENTS AND FAECAL MICROBES TO WATER

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Abstract

Mitigation strategies for improved environmental sustainability of the New Zealand dairy industry need to focus on reducing the transport of nitrogen (N) from urine patches and phosphorus (P) and faecal microbes from dung patches to waterways. One strategy is Duration-controlled grazing (*DC* grazing), a system based upon shorter grazing periods on pasture (4 hours) and removing cows to a stand-off facility for rumination and excretion. The stored effluent is applied to pasture as a slurry at an appropriate time when nutrients are required and soil conditions are suitable.

A three year field study was established in the Manawatu to compare key features of *DC* grazing with a standard grazed (*SG*) system. This thesis explores the impact of a *DC* grazing system on the losses of N, P, potassium (K) and faecal microbes to water through drainage and surface runoff. It also investigates the effects of such a system on pasture production and intakes of pasture by cows.

Pasture accumulation was the same for both treatments in the first year, but there was a 20% and 9% decline on the *DC* treatment in the subsequent two years. This was due to the way that slurry applications were managed. A large amount of slurry (212 kg N/ha) was applied in the first year, and no slurry was applied in the second year. In the third year slurry was applied four times at a total rate of 115 kg N/ha. The study indicates more frequent application of all nutrients captured in the effluent from standing cows off is required to maintain pasture production.

Compared to the *SG* plots, the reductions in N losses from *DC* grazed plots were large, with an average 52% reduction in NO_3^- and 42% reduction in total N leached. Reducing urine deposition during autumn grazings appeared to have the largest impact on reducing NO_3^- leaching. Runoff losses of N were small and similar between treatments. The losses of P were small through both surface runoff and drainage. There was a large variation in runoff volume, which resulted in highly variable P runoff loads across plots and between treatments. The average 32% reduction in total P load from *DC* grazed plots was not significantly different from *SG* plots. Useful predictors of P load lost from all plots were runoff depth and the time cows spent grazing. Faecal microbe losses were also similar between treatments, with the useful predictors of faecal microbe concentration across all plots being the number of days since grazing and the climate after grazing.

The amount of K applied in slurry and urine had a large influence on both soil and herbage K. It was determined that in a *DC* grazing situation, the K-rich liquid component must be included in the applied slurry to maintain soil K levels.

The OVERSEER® nutrient budgeting software was able to simulate nutrient cycling in the *DC* grazing system reasonably well. The total N loss from the system was predicted accurately, although the relative proportion of N in drainage and runoff was not.

Several opportunities for further work arise from this research. While *DC* grazing is a tool that could be implemented to significantly reduce N leaching losses, the management of collected excreta needs to be further developed to ensure pasture production gains are realised, or at least maintained. The combined effects of reducing treading damage and *DC* grazing should be investigated. Finally, a comprehensive economic analysis of standing cows off should be undertaken.

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