Drivers of pasture growth in perennial ryegrass pastures in northern New Zealand dairy pastures.

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Introduction

The critical importance of pasture production to New Zealand's economic performance has been widely recognised. However, a number of critical issues have been identified that limit dairy industry growth, including sub-optimal pasture condition and poor pasture persistence. Dairy farm systems in the Waikato and Bay of Plenty provinces in the upper North Island of New Zealand are predominantly pasture-based, with a temperate climate and they represent around 30% of New Zealand's total number of dairy farms (LIC and DairyNZ, 2012). This project was established to quantify pasture performance and identify factors that drive that performance. We established a network of on-farm trials where case studies of pasture renewal practices and outcomes were developed. Ten farms in each province were monitored for three consecutive years – four paddocks from each province are considered here.

Methods

Farm/paddock selection

All paddocks were renewed at the beginning of the trial using a variety of methods and range of ryegrass/endophyte combinations (Table 1).

Measurements

Net herbage accumulation (NHA) and composition were measured by harvesting the accumulated forage regrowth at intervals of 3-8 weeks, depending on time of year, for three years post establishment. The pasture was harvested at the three leaf stage and was cut to a height of around 3 cm (approximately 1500 kg DM/ha). NHA was then aggregated into seasonal totals: 'summer' (Sept-Feb) and 'winter' (Mar-Aug). Samples were dissected into sown grass, other grasses, clover and weed fractions and dried. Growth rates for each fraction were then calculated. Soil samples were collected annually from each paddock; 40-50 cores (2cm diameter x 7.5cm depth) from each paddock were sampled from a diagonal transect line and analysed for soil phosphorus (Olsen P). Daily, seasonal and annual weather records were sourced from NIWA (Virtual Climate Weather Station Data; Tait *et al.* 2006) for the duration of the trial period (2009-2012). Data were analysed using correlations and regressions to determine the effect of break crop length, rainfall and soil fertility on total and seasonal pasture production.

Results

Pasture production/composition

Total annual pasture NHA varied from 12.7 t/ha/yr to 23.6 t/ha/yr (Table 2). 'Summer' NHA varied from 8.6 t DM/ha to 15.0 t DM/ha (Table 2). A high proportion of the total production (50-89%) was from ryegrass on all farms and across all seasons (Fig. 1).

Soil fertility varied widely, from 26 to 160 ppm Olsen P and annual average rainfall ranged from 1150 to 2070 mm over the three years of the trial.

Paddock effects

Break crop. Paddocks that spent time in a break crop tended to have a reduced proportion of other grasses and broad-leaved weeds, although this was not statistically significant (P>0.05). Time spent in a break crop did increase the clover proportion of the sward from 3 to 13% (R^2=0.59, P<0.05). There were no statistically significant effects on NHA or composition from cultivation.

Soil fertility. Total annual pasture NHA was positively related to soil P (R^2=0.62, P<0.05).

Table 1. Paddock renewal information from the two paddocks from the Waikato (WAI) and the two paddocks from the Bay of Plenty (BOP) regions of New Zealand

Paddock	Renewal Plan/Break crop	Cultivation	Cultivar	Endophyte
WAI A	Grass - grass	No till	Bealey/Arrow	NEA 2/AR 1
WAI B	Grass - grass	No till	Arrow	AR1
WAI C	Grass - triticale - grass	Full cultivation	Alto/Arrow	AR 1
WAI D	Grass - maize - ARG$^+$ - chicory - grass	Full cultivation	Alto	AR 37
BOP A	Grass - grass	No till	Bealey	NEA 2
BOP B	Grass - maize x8* - grass	Full cultivation	Bealey	NEA 2
BOP C	Grass - maize - grass	No till	Extreme	AR 37
BOP D	Grass - maize - grass	Full cultivation	Bealey	NEA 2

* eight consecutive maize crops; $^+$Annual ryegrass

Table 2. Mean (of 4 years) net herbage accumulation (NHA) on four farms from the Waikato (WAI) and Bay of Plenty (BOP) regions of New Zealand

Farm	Average 'summer'* NHA (t DM/ha)	Average 'winter'+ NHA (t DM/ha)	Average annual NHA (t DM/ha)	Olsen P (ppm)	Rainfall annual average /mm
WAI A	15.0	8.6	23.6	143	1470
WAI B	14.5	8.5	23.1	160	1470
WAI C	8.6	4.1	12.7	26	1590
WAI D	11.3	4.5	18.1	35	1170
BOP A	12.3	6.9	19.2	111	2050
BOP B	13.2	7.5	20.7	47	2050
BOP C	12.4	6.9	19.3	51	2020
BOP D	11.8	5.8	17.6	35	1960

*'summer' = September-February inclusive; + 'winter' = March-August inclusive

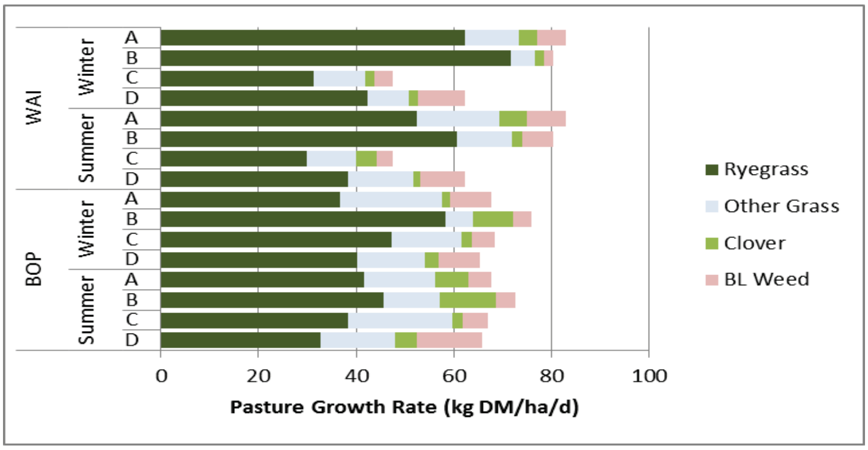

Figure 1. Average pasture growth rate and composition of eight renewed paddocks from the Waikato (WAI) and Bay of Plenty (BOP) regions of New Zealand, over four years aggregated into two seasons: 'summer' (September-February) and 'winter' (March-August). BL = broad-leaf weed.

Rainfall & soil moisture. Total annual rainfall and seasonal rainfall (summer/winter) had no significant effect on pasture production or composition (P>0.05). Average annual rainfall was 1530 mm/yr in Waikato and 2030 mm/yr in the Bay of Plenty.

Conclusion

Time spent in break crops had beneficial effects on pasture composition, increasing the clover content of the new pasture. This result was demonstrated for at least four years and is consistent with the findings of Gerard *et al.* (2009). Olsen P was an important driver of pasture production with higher NHA at higher soil P concentrations. However, there were too few data points to reliably identify the optimum soil P concentration (see Mackay *et al.* 2010).

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