

Influence of total soil nitrogen levels on dry matter production responses to nitrogen fertilisation of dairy pastures in New Zealand

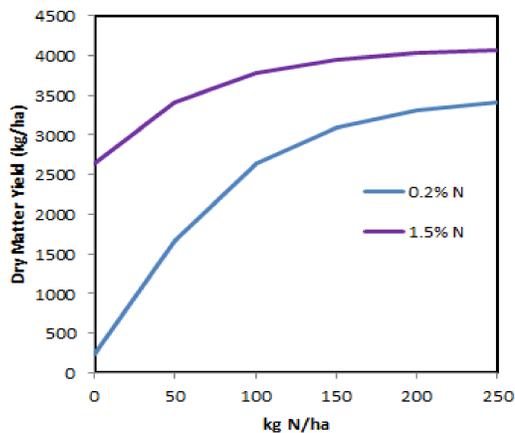


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INTRODUCTION

- Dairy farmers tend to apply N fertiliser uniformly on their farms regardless of differences in inherent soil N fertility of their paddocks. This approach can be wasteful of N fertiliser and can contribute to N pollution of the environment. We assess if a simple total soil N test can potentially be useful in farms where there are substantial differences in total soil N between/among paddocks whereby paddocks with high total N will receive little or no N fertiliser while those with low total N will receive more N fertiliser thereby improving pasture N use efficiency.



Hypothesis: Dairy pasture soils with low total N are more responsive to N fertiliser application than soils with high total N.

METHODS

- In winter 2013, on 28 farms, topsoil (0-7.5 cm) samples were taken and analysed for total soil N. On farms where there was a total N difference between paddocks of at least 0.3 percentage points, four paddocks, two with low total soil N and two with high total soil N were selected for spring 2013 and autumn 2014 field trials (see below). In autumn 2014, two of the sites at Taihape became unsuitable for further measurements and were abandoned. Several missing observations occurred in the Central Hawke's Bay 2 site in one of the low N paddocks in autumn and were not included in the analysis.

Total soil N levels (0-7.5 cm) at the individual trial sites.

Farm Location	NZ Soil Classification (Order Level)	Total Soil N (%)			
		Low		High	
Whangarei, North Island	Brown	0.40	0.55	0.75	0.85
Te Awamutu, North Island	Allophanic	0.54	0.58	0.96	1.32
Central Hawke's Bay 1, North Island	Pallic	0.43	0.44	0.68	0.82
Central Hawke's Bay 2, North Island	Brown/Recent	0.32	0.34	0.91	0.96
Taihape, North Island	Allophanic	0.52	0.52	0.90	1.04
Culverden, South Island	Pallic	0.25	0.37	0.44	0.57
Te Anau, South Island	Allophanic	0.39	0.40	0.75	0.82

- In spring 2013 and autumn 2014, five rates of N (25, 50, 75, 100, 200 kg/ha) were applied. Two monthly cuts were obtained in each season and DM yields at each season's first and second cuts were combined. Data for Central Hawke's Bay 1 and 2 were combined into one graph (Figures 1 and 2).

RESULTS

Spring 2013 summary (See Figure 1 for details)

Farm Location	Hypothesis supported?	
	Yes	No
Whangarei, North Island		*
Te Awamutu, North Island	*	
Central Hawke's Bay 1 & 2, North Island		*
Taihape, North Island		*
Culverden, South Island	* (until 75 kg N/ha)	
Te Anau, South Island		*

Autumn 2014 summary (See Figure 2 for details)

Farm Location	Hypothesis supported?	
	Yes	No
Whangarei, North Island	* (until 75 kg N/ha)	
Te Awamutu, North Island	*	
Central Hawke's Bay 1 & 2, North Island	*	
Taihape, North Island		*
Culverden, South Island	* (partially)	
Te Anau, South Island	*	

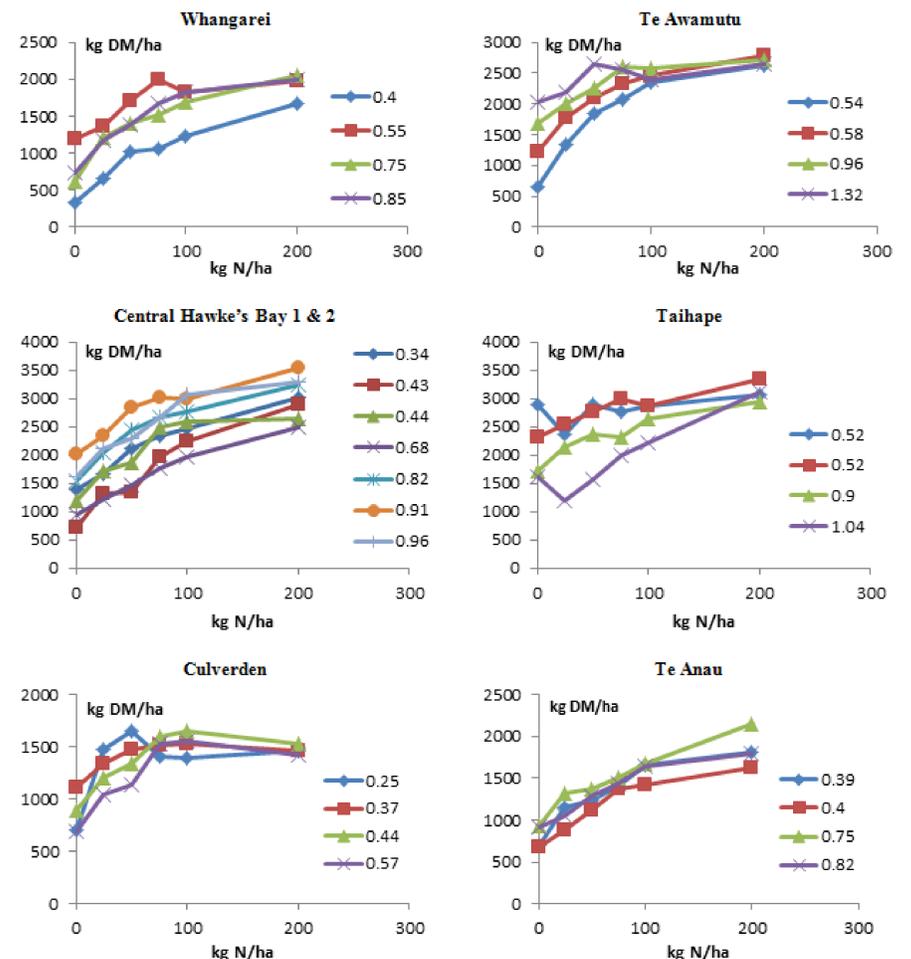


Figure 1. Pasture DM yield responses to N fertilisation under low and high total soil N levels, Spring 2013 (Ave. of 6 replicates).

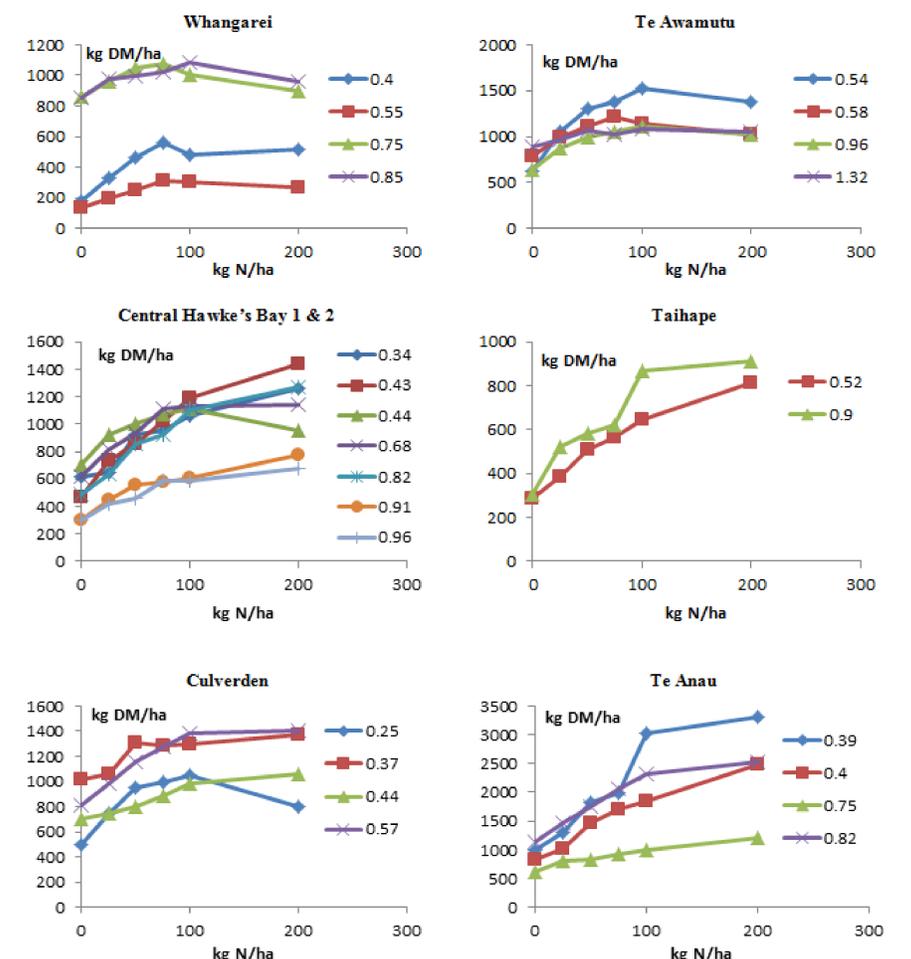


Figure 2. Pasture DM yield responses to N fertilisation under low and high total soil N levels, Autumn 2014 (Ave. of 6 replicates).

CONCLUSION

- There was a greater response at the lower total soil N levels at seven of the 12 measurement events (spring and autumn) but no difference at the other five measurement events. In spring, only two sites at Te Awamutu and Culverden had a differential response related to total soil N levels. This proportion increased to five out of six in autumn (Whangarei, Te Awamutu, Central Hawke's Bay 1 & 2, Te Anau, and partly in Culverden).
- Total soil N was partially successful in predicting DM response to N fertilisation but maybe a less sensitive predictor of N availability within the growing season because it is less dynamic compared to indices of available N (McDonald et al. 2014).
- While total soil N could be used to predict pasture DM production response, the present study shows that there is a need to understand and investigate further other factors that may affect N availability such as organic matter quality, pasture composition, individual plot total N levels (spatial variation) etc.