AGRICULTURE VICTORIA

Predicting N excretion in commercial grazing system dairy farms

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Improving N management on dairy farms is best facilitated through reducing N excretion. Predictive relationships between dietary N intakes and N excretion have been developed for confinement based systems. Milk urea N (MUN) has also been used as an indicator of excess N in confinement based dairy systems.

Similar relationships could be useful for nutrient and manure management for grazing system farms. The objective of this research was to develop predictive relationships between N excretion, N use efficiency (NUE), and MUN using data readily collected on a variety of commercial grazing system dairy farms, and to compare these relationships with those reported in the literature for confinement based systems.

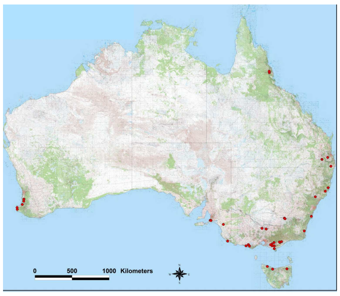

Figure 1. Location of grazing system dairy farms

Method

Feed intake, N excretion and MUN data were determined from samples and information collected at five quarterly visits over a year on a representative range of 43 Australian commercial grazing system farms (n=227, Figure 1).

- Grazed DMI for each herd on each farm at each visit was calculated using an animal performance method.
- Milk data, supplement and pasture N concentrations, and DMI were used to calculate N intakes and NUE (Table 1).
  - N excretion = N intake - milk N
  - Feed NUE = N intake / milk N × 100.
- Milk urea N was measured in vat (bulk tank) samples containing both morning and evening milkings.
- Linear regression relationships between Excreted N or NUE and N intake or Milk N secretion; between MUN and dietary crude protein (CP) or NUE were estimated and compared with the literature (Figure 2, Table 2).

Table 1. Mean (range) in energy corrected milk yield, dietary N and CP, excreted N, MUN and NUE calculated for the commercial dairy farms.

ECM	Total N intake	CP	Excreted N	MUN	NUE
(kg/cow/day) 22 (9- 36)	(g/cow/day) 545 (268-983)	(%) 19 (9-30)	(g/cow/day) 433 (199-793)	(mg/dL) 12 (3-22)	(%) 21 (11-39)

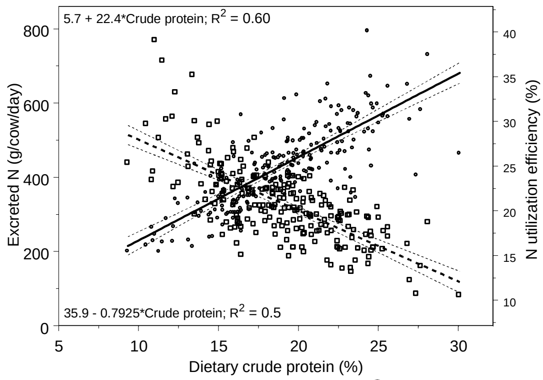

Figure 2. Change in N excreted (——, ○) and NUE (– – -, □) by grazing system dairy cows in response to dietary CP intake, showing 95% confidence bounds.

Table 2. Regression equations comparing N excretion, N use efficiency and milk urea N with N intake, dietary crude protein concentration from the literature and using data from this study.

Regression equations	R^2	Source
N excretion (g/cow/day)		
N_{Exc} = 0.55Int + 43 (below 400 g/c/d)	0.78	Castillo et al. 2000
N_{Exc} = 0.90Int - 89 (above 400 g/c/d)	0.87	Castillo et al. 2000
Manure N output = 0.710NI + 7	0.894	Yan et al. 2006
$N_{excretion}$ = 0.62(NI) + 30	0.78	Kebreab et al. 2001
Manure N output = 0.8NI − 19.8	0.698	Arriaga et al. 2009
ExcrN = 0.84N_{In} - 23.6	0.97	**This study**
N use efficiency (%)		
N_{mi} = -0.0002Int + 0.36	0.21	Castillo et al. 2000
Milk N/N intake = −0.672 CPc + 350	0.13	Yan et al. 2006
NUE = -0.009376N_{In} + 25.9	0.08	**This study**
NUE = -0.7925CP + 35.8792	0.5	**This study**
Milk urea N (mg/dL)		
CP = 0.269 MUN + 13.7	0.839	Broderick and Clayton 1997
CP = 0.45MUN + 9.98	0.779	Nousiainen et al. 2004
CP = 0.41 MUN + 13.8	0.19	**This study**
N Efficiency = –0.004 MUN + 0.309	0.626	Broderick and Clayton 1997
N Utilization = –0.73MUN + 37.8	0.768	NousiaInen et al. 2004
NUE = –0.34MUN + 25.2	0.1	**This study**
Excess N intake = 11.0 MUN + 313	0.772	Broderick and Clayton 1997
ExcrN = 11.13MUN + 289.62	0.17	**This study**

Results

Significant (*P<0.001*) relationships observed for data from commercial grazing systems were similar to the literature for confinement based research and commercial herds. Smaller coefficients of determination were recorded for this study, most likely due to the variability in herd and grazing management and bulk tank sampling.