

Supplementary Material

Fate of fertiliser nitrogen in a ryegrass–kikuyu dairy pasture system

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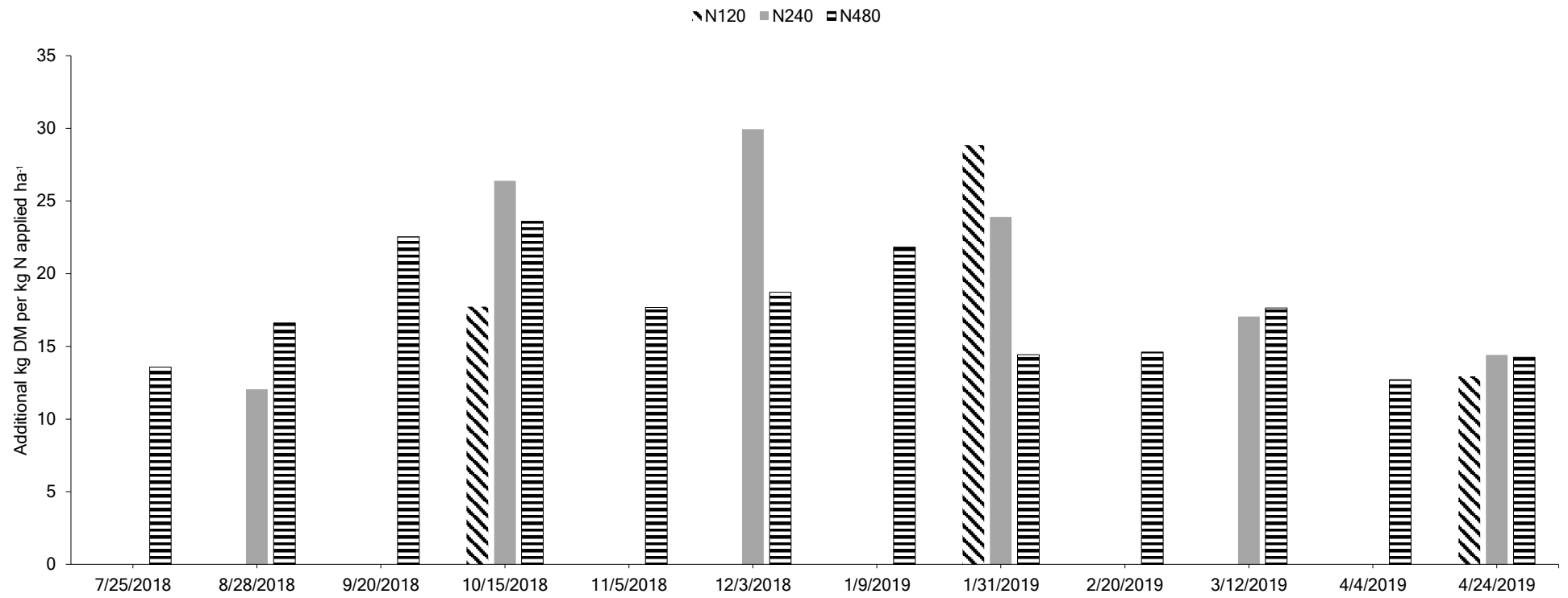
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Supplementary data A. Experiment 1: Total ¹⁵N fertilizer recoveries in respective sample fractions (soil and roots) and percent ¹⁵N recovery in soil of an initial application of 40 kg urea-¹⁵N ha⁻¹ made 21 days prior to cut 1 for pastures receiving urea applications of 120, 240 and 480 kg N ha⁻¹ year⁻¹ applied in 40 kg N ha⁻¹ applications (N120, N240, N480, respectively). Subsequent applications of 40 kg N ha⁻¹ made after cut 1 were, none for N120, once at cut 2 for N240, each cut for N480. Results between the N rates for each cut followed by the same letter are not significantly different at $P \leq 0.05$. Standard errors are in brackets. ¹⁵N = labelled nitrogen.

Treatment	N120	N240	N480
¹⁵ N recovery in soil fraction (kg ha ⁻¹)	16 (1) ^a	22 (2) ^a	19 (3) ^a
¹⁵ N recovery in roots (kg ha ⁻¹)	9 (3) ^a	7 (3) ^a	11 (6) ^a
¹⁵ N recovered in soil fraction (%)	40 (4) ^a	55 (10) ^a	48 (13) ^a

Supplementary data B. Experiment 2, Total soil mineral N (nitrate and ammonium) and nitrate kg N ha⁻¹ before the start (13/06/2018) and at the end (24/04/2019) of the experiment in pastures receiving urea applications of 120, 240 and 480 kg N ha⁻¹ year⁻¹ applied in 40 kg N ha⁻¹ applications (N120, N240, N480, respectively). Results between the N rates for sampling event followed by the same letter are not significantly different at $P \leq 0.05$. Standard errors are in brackets.

Treatment	N0	N120	N240	N480
13/06/2018				
Total mineral N (kg N ha ⁻¹) (0-70 cm)	63 (12) ^a	58 (8) ^a	66 (2) ^a	79 (4) ^a
Nitrate (kg N ha ⁻¹) (0-70 cm)	23 (4) ^a	24 (7) ^{ab}	31 (3) ^b	41 (1) ^b
Nitrate (kg N ha ⁻¹) (0-10 cm)	12 (4) ^a	12 (3) ^a	21 (0.4) ^a	33 (1) ^b
24/04/2019				
Total mineral N (kg N ha ⁻¹) (0-70 cm)	77 (7) ^a	75 (2) ^a	85 (11) ^a	88 (5) ^a
Nitrate (kg N ha ⁻¹) (0-70 cm)	16 (0.5) ^a	19 (3) ^{ab}	24 (2) ^b	47 (5) ^c
Nitrate (kg N ha ⁻¹) (0-10 cm)	7 (1) ^a	9 (0.2) ^a	12 (1) ^b	34 (5) ^c



Supplementary data C. Experiment 2, Temporal additional dry matter of >5 cm plant shoots of pastures receiving urea applications of 120, 240 and 480 kg N ha⁻¹ year⁻¹ applied in 40 kg N ha⁻¹ applications (N120, N240, N480, respectively) during 25 July 2018 to 24 April 2019

Supplementary data D. Experiment 2, Marginal N response efficiency of >5 cm plant shoots of pastures receiving urea applications of 120, 240 and 480 kg N ha⁻¹ year⁻¹ applied in 40 kg N ha⁻¹ applications (N120, N240, N480, respectively) during 25 July 2018 to 24 April 2019. Due to the different frequencies of N application, marginal N responses could only be calculated after the fourth (15/10/2018), eight (31/01/2019) and twelfth (24/04/2019) pasture cuts.

Treatment	Cut Date	N fertiliser applied (kg N ha ⁻¹)	Plant shoot >5 cm DM yield (kg DM ha ⁻¹) at 75 % utilisation	Plant shoot >5 cm response to applied N (kg DM ha ⁻¹)	Marginal N fertiliser applied (kg N ha ⁻¹)	Marginal Plant shoot >5 cm DM yield (kg DM ha ⁻¹)	Marginal N response efficiency (marginal kg ha ⁻¹ increase in Plant shoot >5 cm DM per marginal kg N ha ⁻¹ applied)
N0	25/07/2018	40	93	0			
N120	25/07/2018	40	441	348			
N240	25/07/2018	40	426	332			
N480	25/07/2018	40	636	543			
N0	28/08/2018		27	0			
N120	28/08/2018		163	137			
N240	28/08/2018		176	150			
N480	28/08/2018	40	691	665			
N0	20/09/2018		148	0			
N120	20/09/2018		257	109			
N240	20/09/2018	40	818	670			
N480	20/09/2018	40	1049	901			
N0	15/10/2018		184	0			
N120	15/10/2018		300	116	40	710	18
N240	15/10/2018		571	386	80	829	10
N480	15/10/2018	40	1128	944	160	1515	9
N0	5/11/2018	40	313	0			
N120	5/11/2018	40	1063	750			
N240	5/11/2018	40	1187	874			

Tracking ¹⁵N fertilizer in pasture

N480	5/11/2018	40	1020	707			
N0	3/12/2018		346	0			
N120	3/12/2018		646	301			
N240	3/12/2018		669	324			
N480	3/12/2018	40	1095	749			
N0	9/01/2019		406	0			
N120	9/01/2019		476	70			
N240	9/01/2019	40	1238	832			
N480	9/01/2019	40	1279	873			
N0	31/01/2019		272	0			
N120	31/01/2019		304	32	40	1154	29
N240	31/01/2019		397	125	80	1000	13
N480	31/01/2019	40	849	577	160	752	5
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N0	20/02/2019	40	341	0			
N120	20/02/2019	40	672	331			
N240	20/02/2019	40	808	467			
N480	20/02/2019	40	926	584			
N0	12/03/2019		272	0			
N120	12/03/2019		379	108			
N240	12/03/2019		487	215			
N480	12/03/2019	40	978	706			
N0	4/04/2019		210	0			
N120	4/04/2019		274	64			
N240	4/04/2019	40	669	460			
N480	4/04/2019	40	718	508			
N0	24/04/2019		58	0			
N120	24/04/2019		73	15	40	517	13
N240	24/04/2019		175	117	80	741	9
N480	24/04/2019	40	628	570	160	1110	7