Pasture species for nitrogen mitigation

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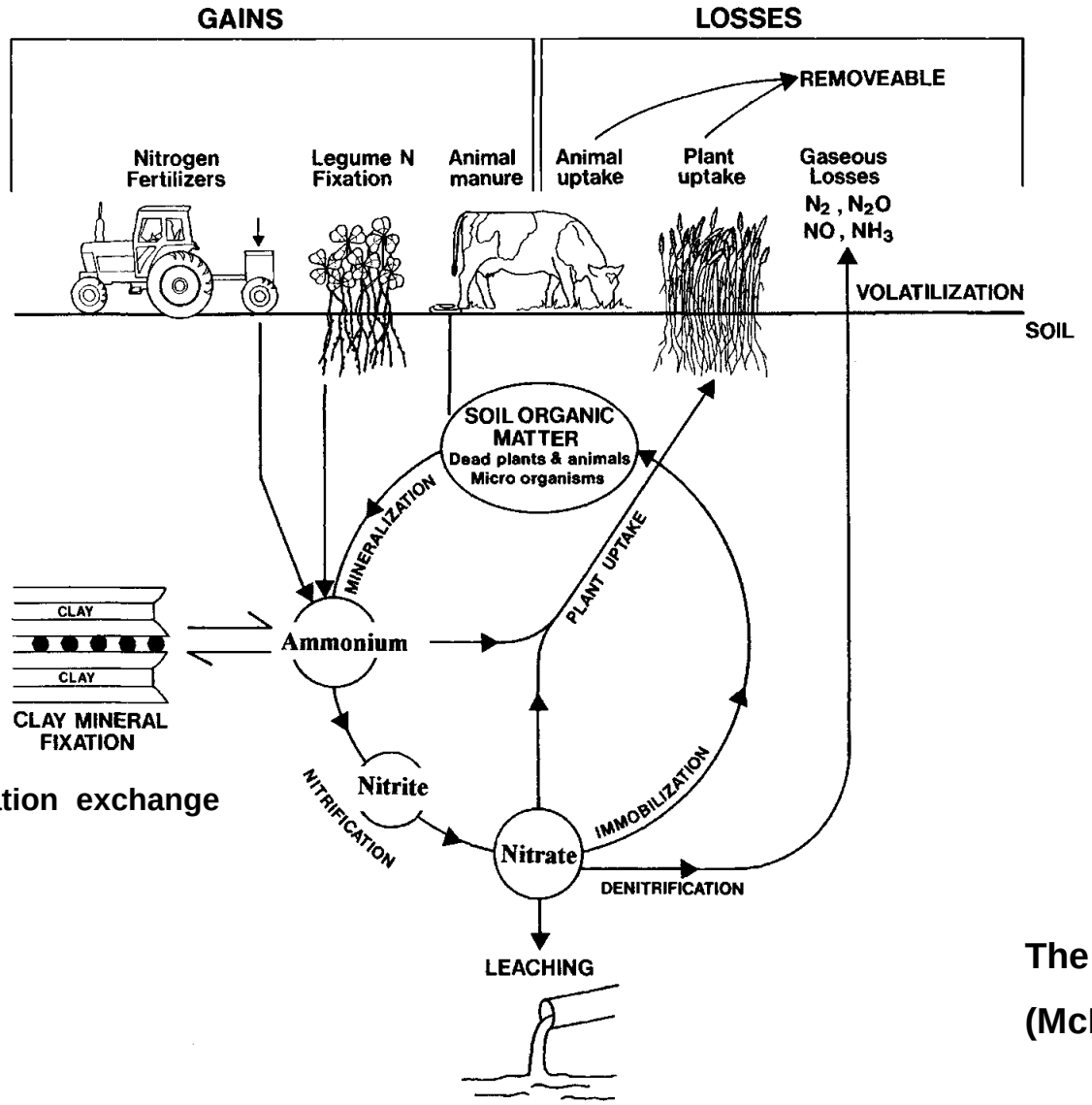
Introduction

- Substantial reductions in nitrate leaching sought
- Urine patch is primary source of nitrate leaching
- Main factor influencing amount of N excreted is N consumed relative to demands
- Logical pathway to reduce N excretion is to manipulate N eaten, proportion N excreted in urine and N uptake by animal

Identify the 'intervention points' to reduce nitrate leaching losses

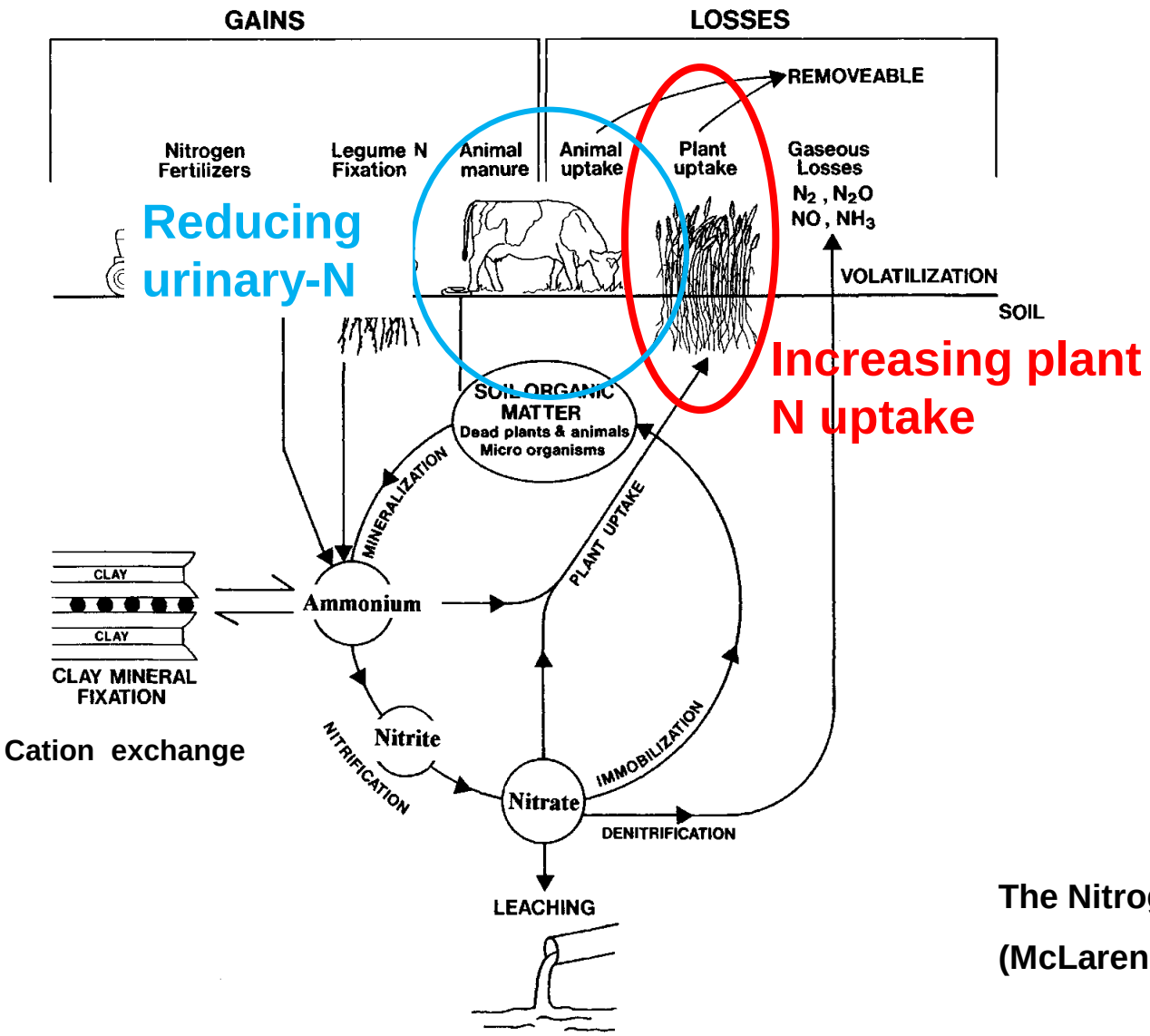


Cation exchange

The Nitrogen Cycle

(McLaren & Cameron, 1996)

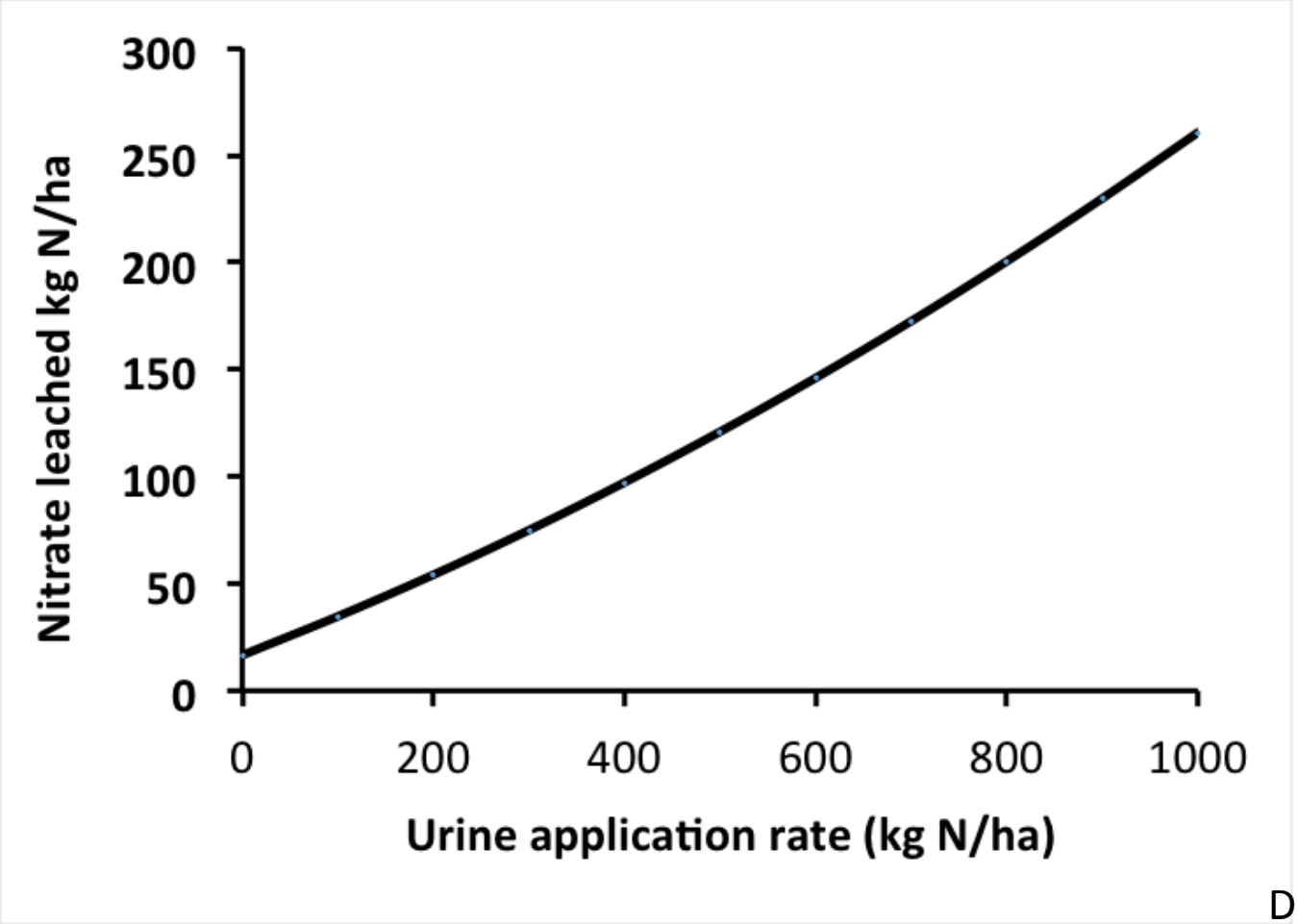
Identify the 'intervention points' to reduce nitrate leaching losses



The Nitrogen Cycle

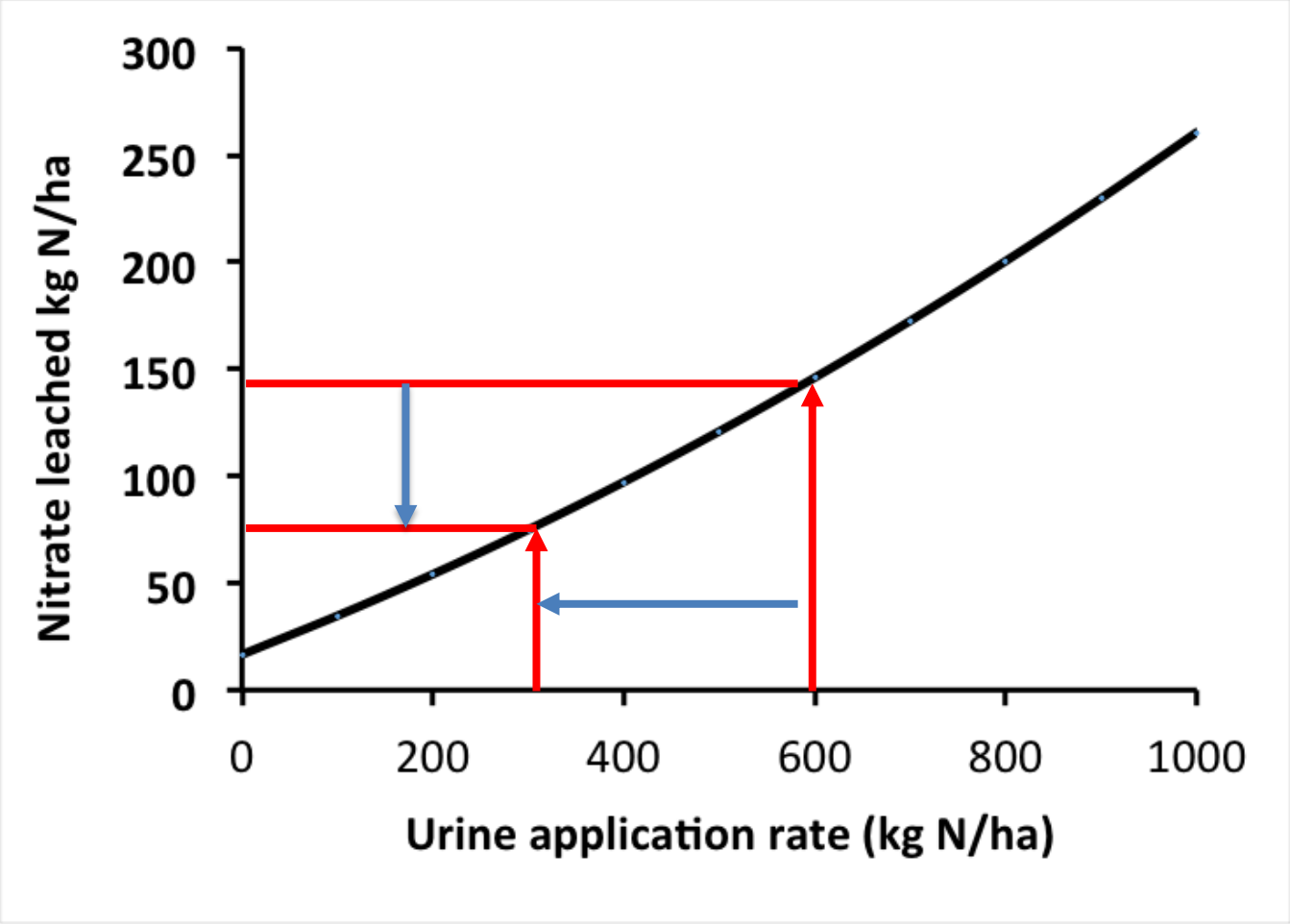
(McLaren & Cameron, 1996)

Urine patch N and N leaching



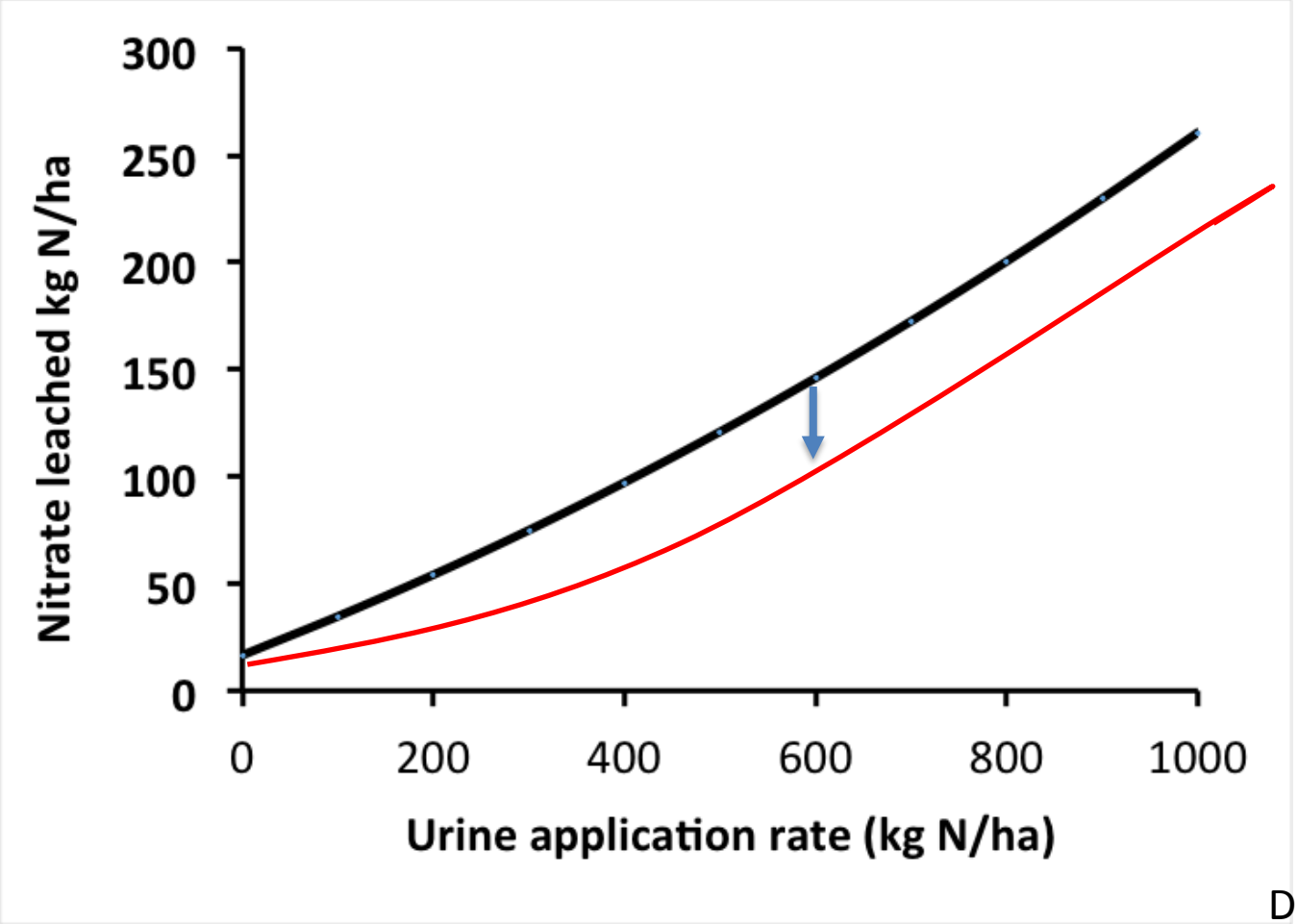
Di and Cameron, Nutr. Cycling and Agro. (2007)

Reducing N excretion in urine



Di and Cameron, Nutr. Cycling and Agro. 2007

Increasing plant N uptake



Di and Cameron, Nutr. Cycling and Agro. (2007)

Alternative forages for reduced N excretion

Perennial ryegrass-white clover

Diverse pasture with chicory, plantain and red clover

N excretion and milksolids production from diverse and ryegrass-white clover pastures

	Ryegrass	Diverse
CP(%) diet	26.3	23.7
N intake (g N/d)	609	550
Milksolids (kg/d)	1.5	1.5
Milk N excretion (g N/d)	101	112
Urine N concentration (g N/L)	5.8	3.4
Urine N excretion (g N/d)	426	353

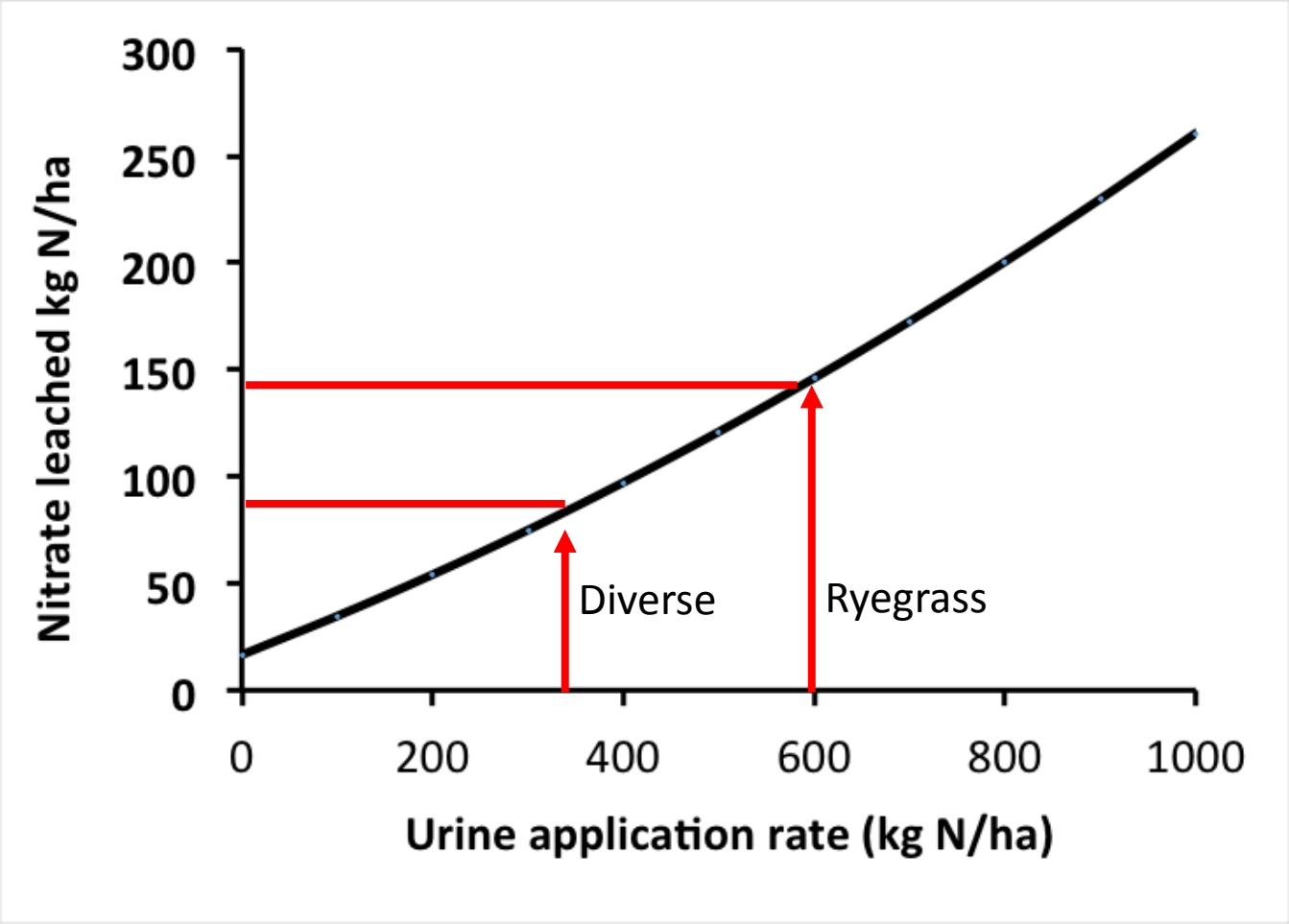
Totty et al. (2013) J Dairy Sci

N excretion and milksolids production from diverse and ryegrass-white clover pastures

	Ryegrass	Diverse
CP(%) diet	18.6	18.2
N intake (g N/d)	551	497
Milksolids (kg/d)	2.1	2.0
Urine N concentration (g N/L)	6.1	4.9
No. urinations (no./cow/d)	12.6	14.0
Urination volume (L/urination)	2.0	2.2

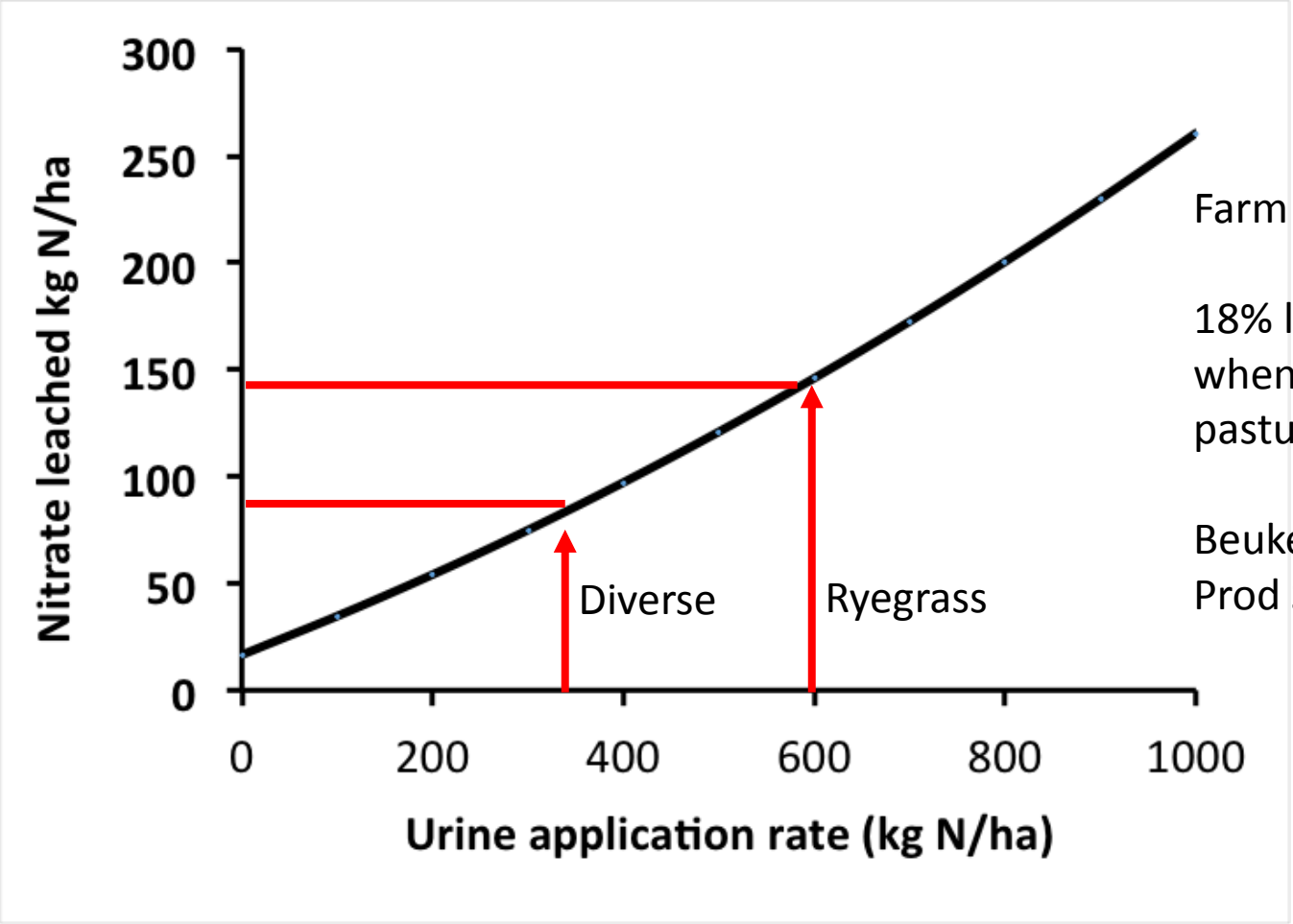
Edwards et al. (2015) NZ Soc. An. Prod

Urine patch N and N leaching



Di and Cameron, Nutr. Cycling and Agro. 2007

Urine patch N and N leaching



Farm systems modelling

18% lower nitrate leaching when 50% farm in diverse pasture

Beukes et al. 2015, Animal Prod Sci.

Di and Cameron, Nutr. Cycling and Agro. 2007

Alternative forages for increased N uptake

Perennial ryegrass-white clover

Diverse pasture with chicory and plantain

Italian ryegrass-white clover

Tall fescue-white clover

Relationship between N leached and plant N uptake

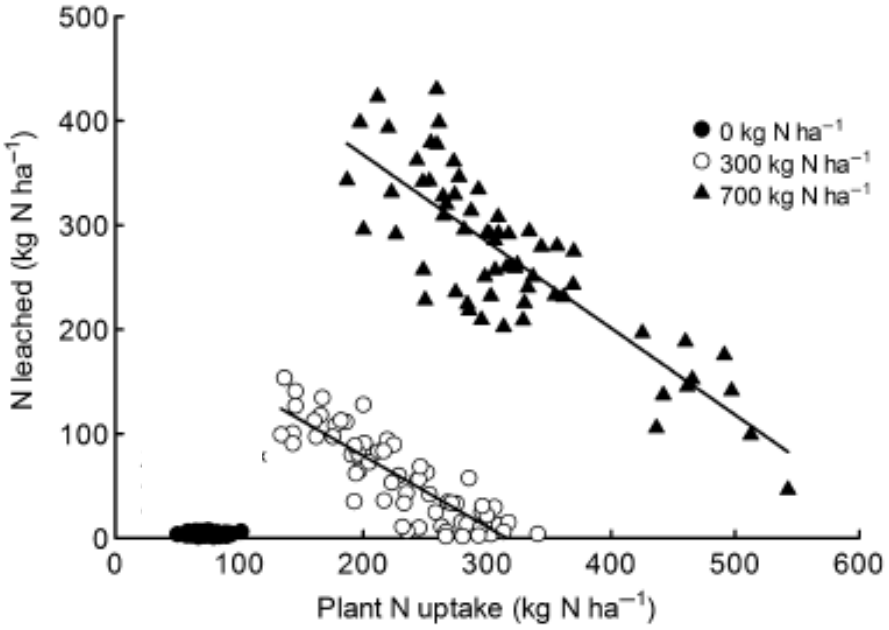
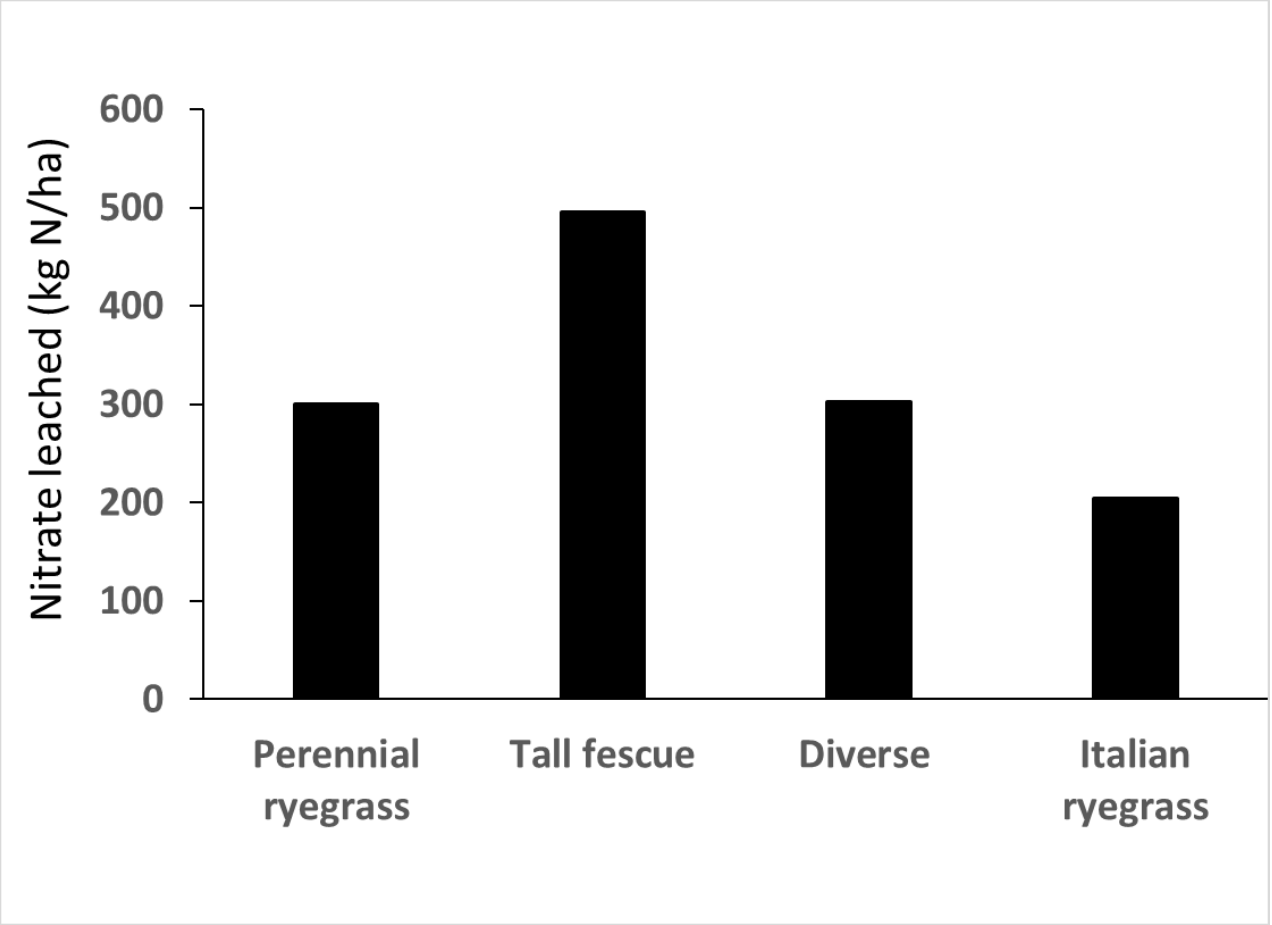


Figure 1 Relationship between total plant N uptake (kg N ha^{-1}) and total N leached (kg N ha^{-1}). N treatments (applied as cow urine); (●) = 0 kg N ha^{-1}, (○) = 300 kg N ha^{-1}, (▲) =700 kg N ha^{-1}.

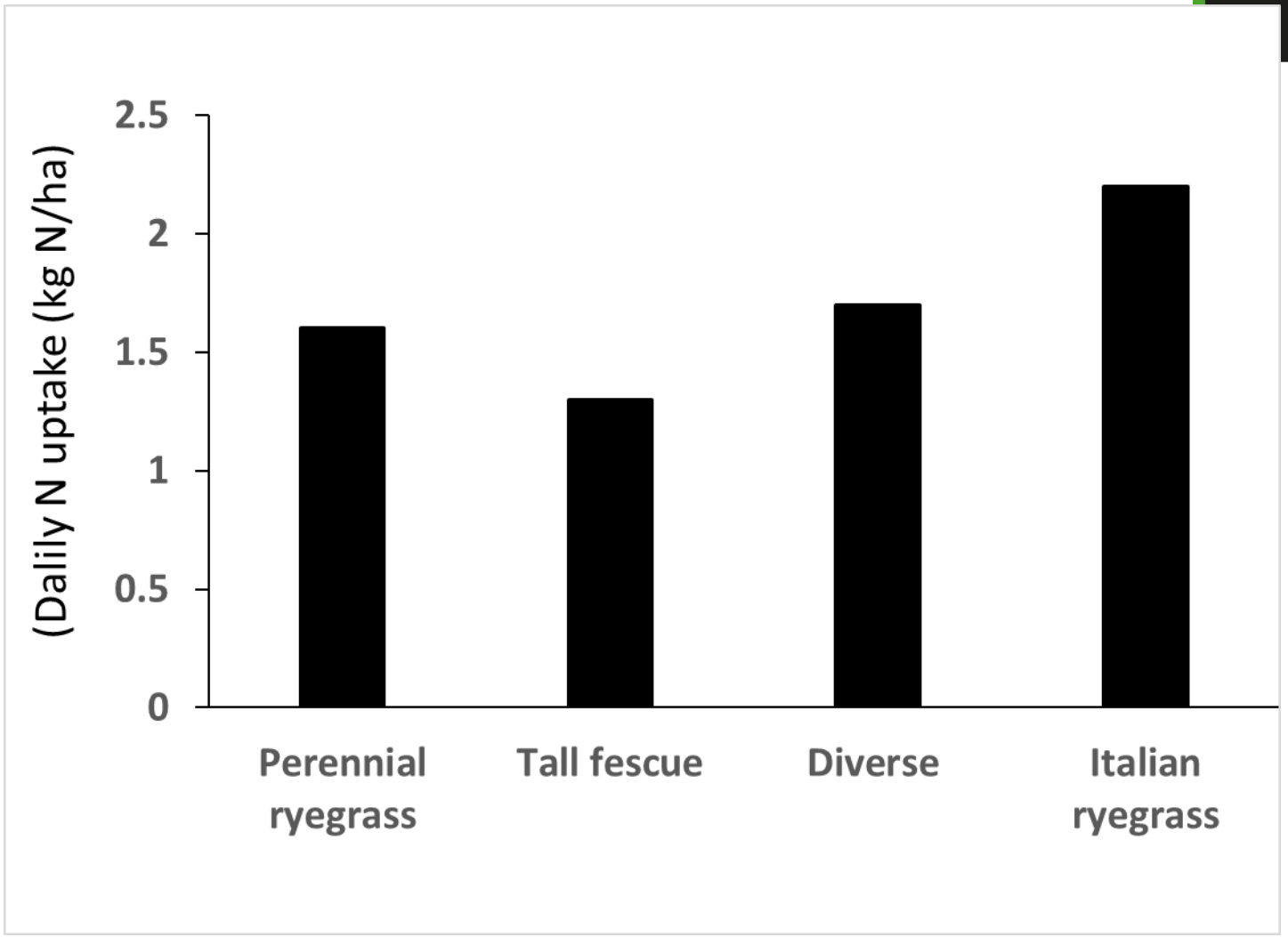
Moir et al. (2013). Grass and Forage Science

Nitrate leaching from urine patches in standard and diverse pastures



Malcolm et al (2014). Soil Use and Management

N uptake from standard and diverse pastures



Malcolm et al (2014). Soil Use and Management

Conclusions

- Processes of plant N uptake and use must be clearly defined so that right interventions can be targeted
- Some productive forage species/mixtures already shown to reduce total N intake and urinary N excretion and increase N uptake
- Comparative information needed on critical and external N requirements, and N and C constituents

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