



PastoralRobotics

productivity / profitability / clean streams



Optimised **N**itrogen **E**fficiency

New Technologies to Reduce Nitrate Leaching from Grazed Pastures

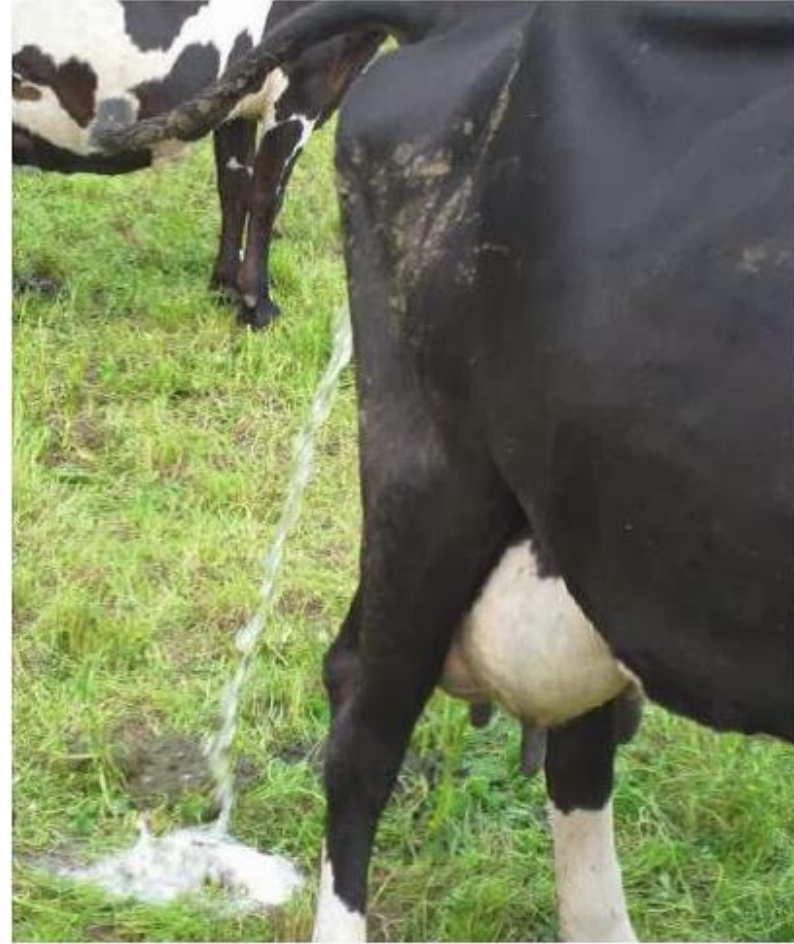
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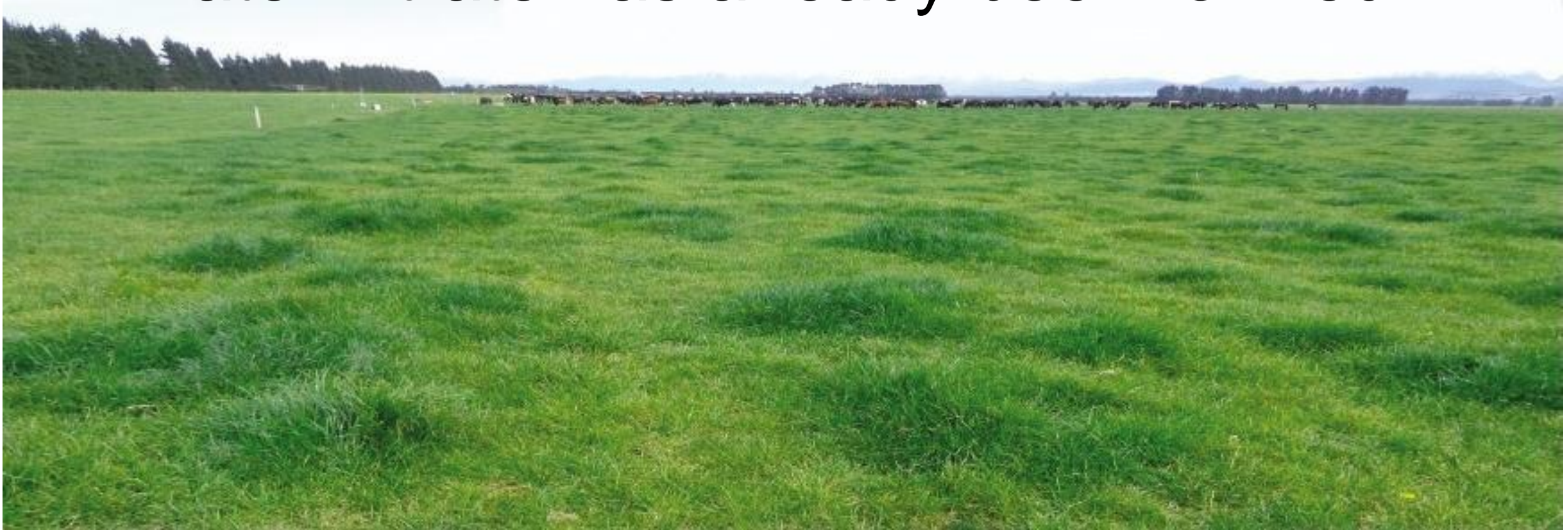
Grazed dairy farming in NZ has two major environmental problems-

Problem One-
leaching of
nitrate-N formed
in urine patches



www.ew.govt.nz

Once the urine patch is visible, it is too late: nitrate has already been formed





Leaching of
nitrate causes
eutrophication





Our solution to this problem will allow -

- **The continuation** of dairy farming at current stocking rates in sensitive catchments
- **Increased** stocking rates in many areas
- **More new** dairy farms to be established

A person wearing a red cap and a blue shirt is riding a red and black ATV through a lush green field. The field is populated with a large herd of black and white cows. In the background, there are rolling green hills and several large trees under a clear sky. The overall scene is a rural farm setting.

**But first; other options for
reducing nitrate leaching from
urine patches**



Options for reducing nitrate leaching

(1) Installing cow homes



Allows excreta to be collected and spread, but

Requires huge capital investment
Ammonia volatilisation losses

(2) Stand-off pads and/or use of other forages



Less capital required, but

Increased labour costs, and higher skill levels required, and
Soil pugging from use of winter forages is a major limitation



Or maybe we could....

(3) Feed cows salt to make them drink and urinate more:-

Reduces nitrate leaching by up to 15%, but-

More salt in the milk, and a potential animal ethics issue.

(4) Apply DCD (2 or more times/yr) to the entire farm:-

It worked, but high cost, and gets into milk – now withdrawn from market.

(5) Simply reduce cow numbers:-

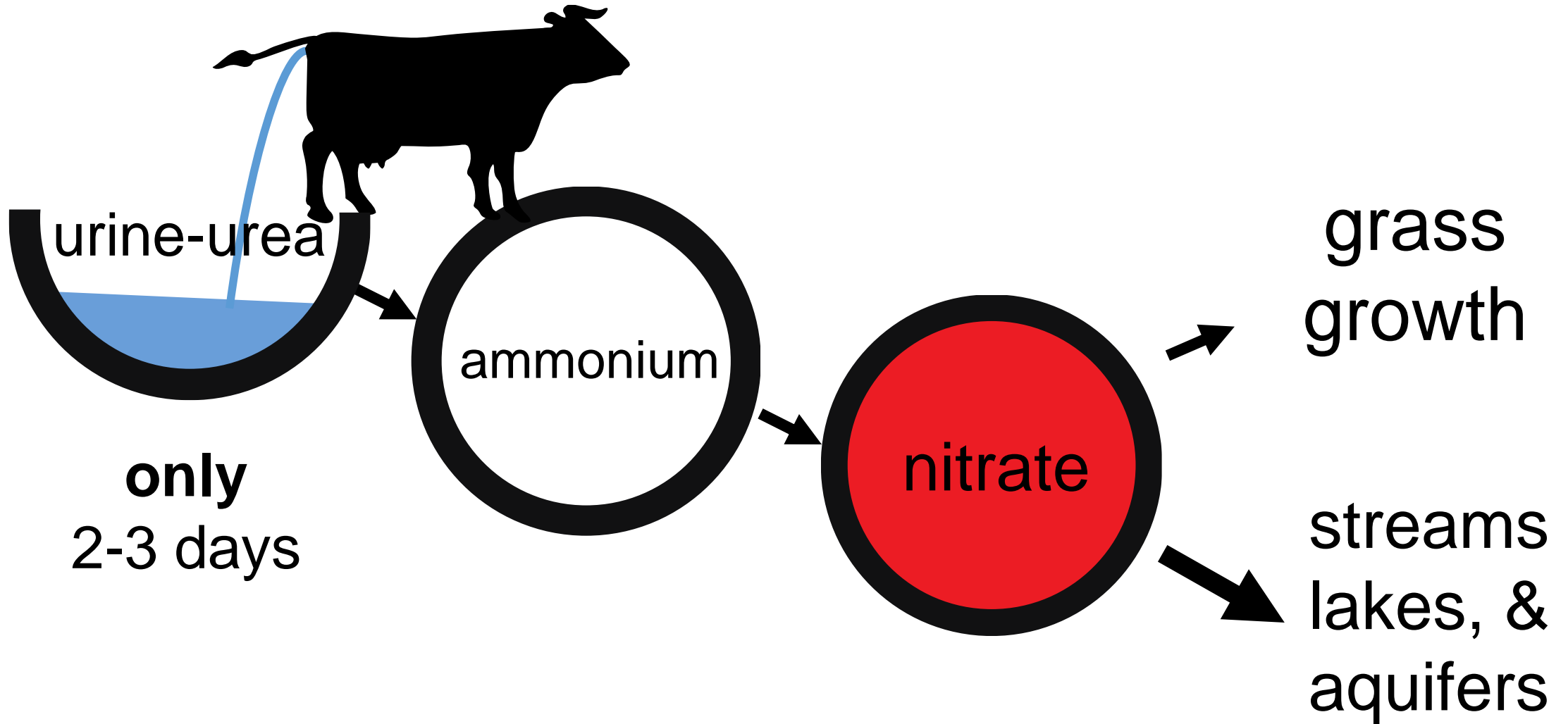
Less nitrate leaching of course, but

\$500/ha less profit for a mere 10% reduction in leaching

(and remember that NZ farmers receive no government subsidies).

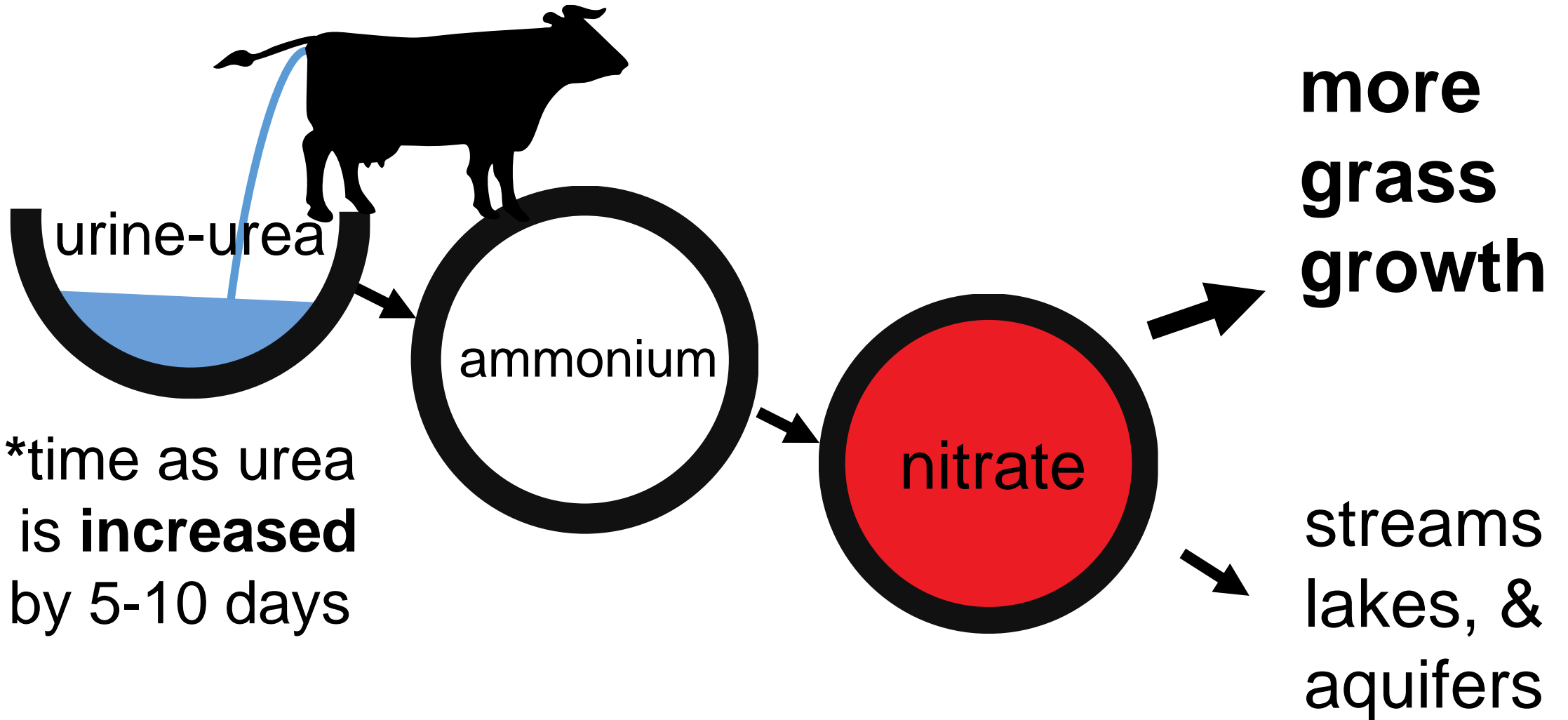


Where does the nitrate come from?





Our Solution – ‘Detect and Treat’ fresh urine*





Spikey®

does the detecting



How Spikey[®] works

After the cows leave the paddock Spikey[®] is towed over the grazed area (ideally daily), detecting fresh urine patches and spraying ORUN[®].

Spikey[®] detects fresh urine by measuring soil conductivity; fresh urine gives a very clear 'spike', which triggers an instantaneous spray of the patch with ORUN[®]. It only takes 20 minutes per day on the average farm.



Spikey[®]

also applies the ORUN[®]



What is ORUN[®]?

- ORUN[®] is a part-patented mix of the urease inhibitor nbpt and the growth-promotant gibberellic acid
- The nbpt in ORUN[®] keeps the urine-urea as urea for 5-10 days, allowing it to spread – nearly doubling the size of the urine patch, before the urea is converted to ammonium-N
- The gibberellic acid combines to maximise the recovery of N by the pasture, thereby reducing losses.





Massey University Results

70% increase

in herbage N uptake

30% reduction

in nitrous oxide
emissions

50% reduction

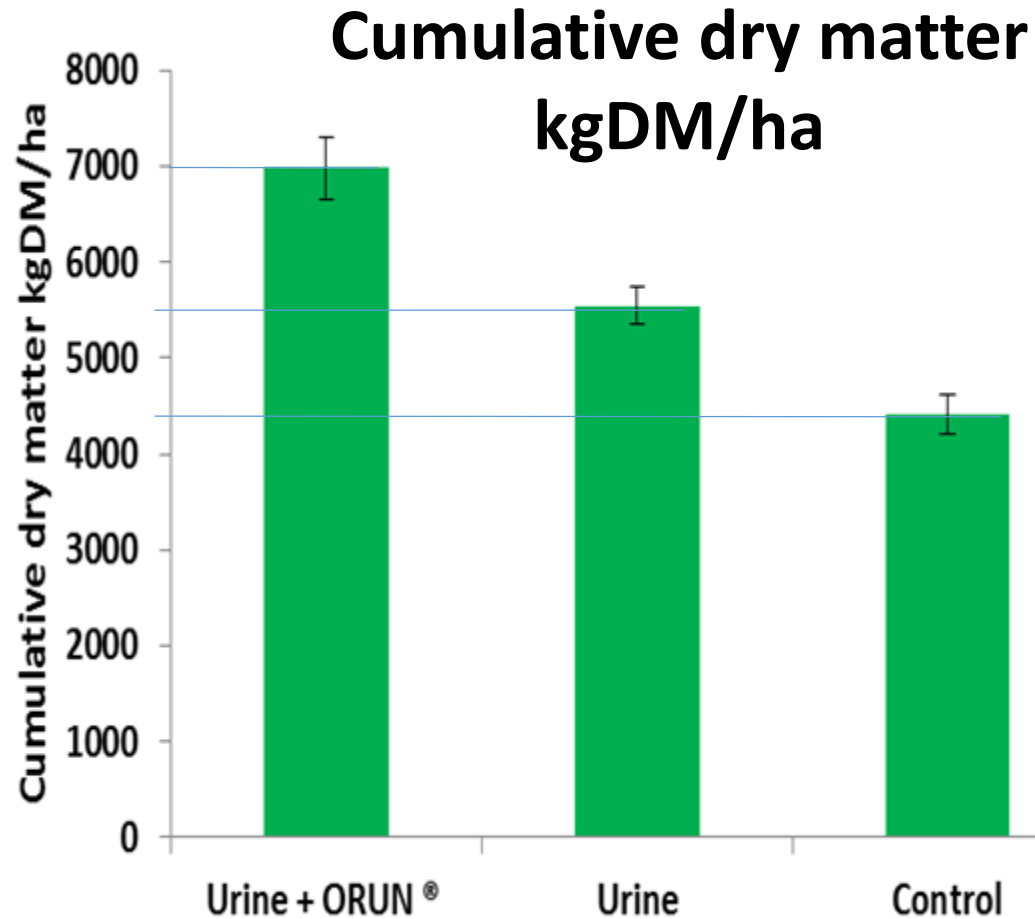
in nitrate leaching



**Massey
University**



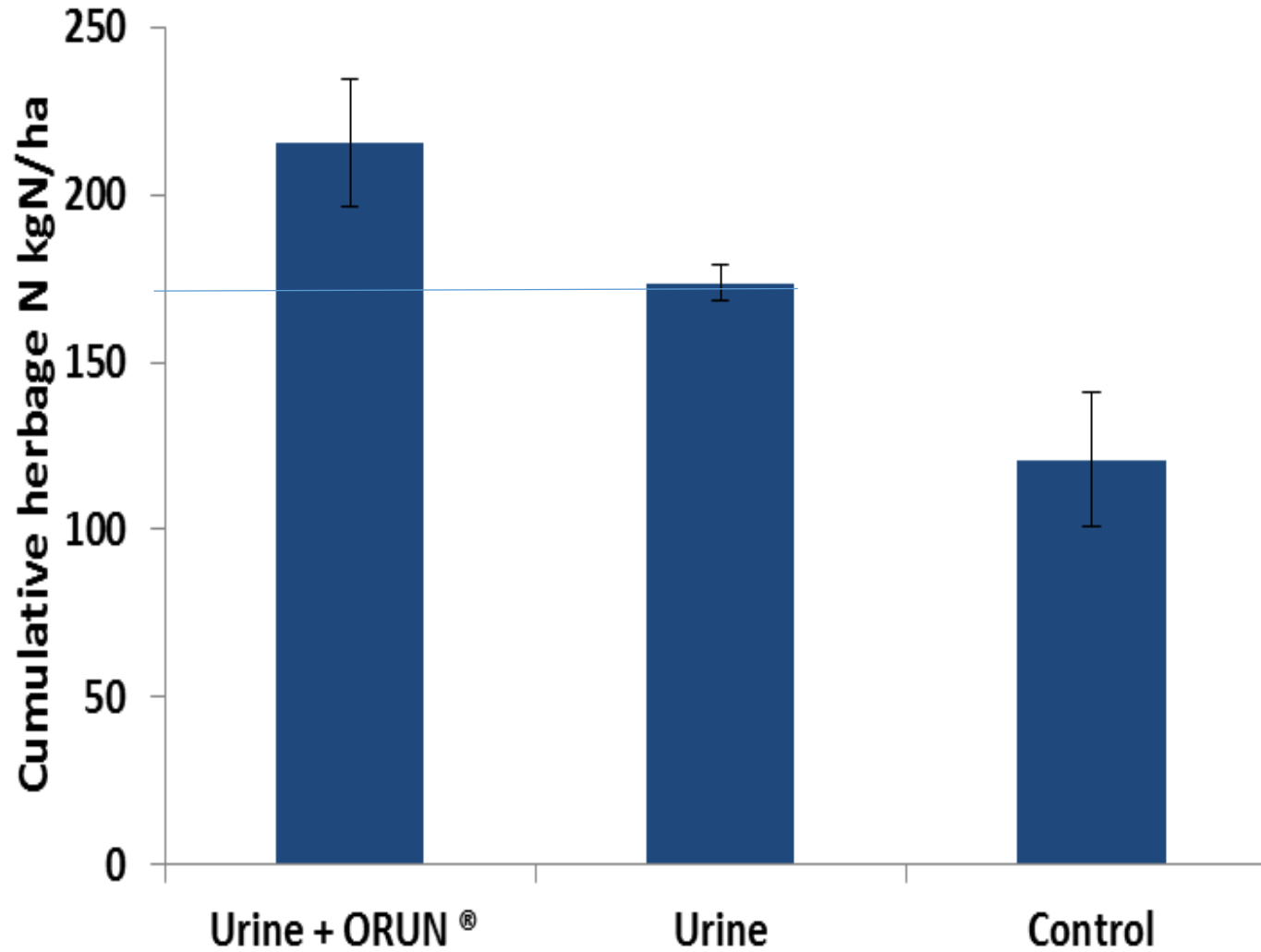
Massey University: Pasture growth



Estimated increase of 6% in overall pasture production annually, giving additional income of twice the combined treatment costs



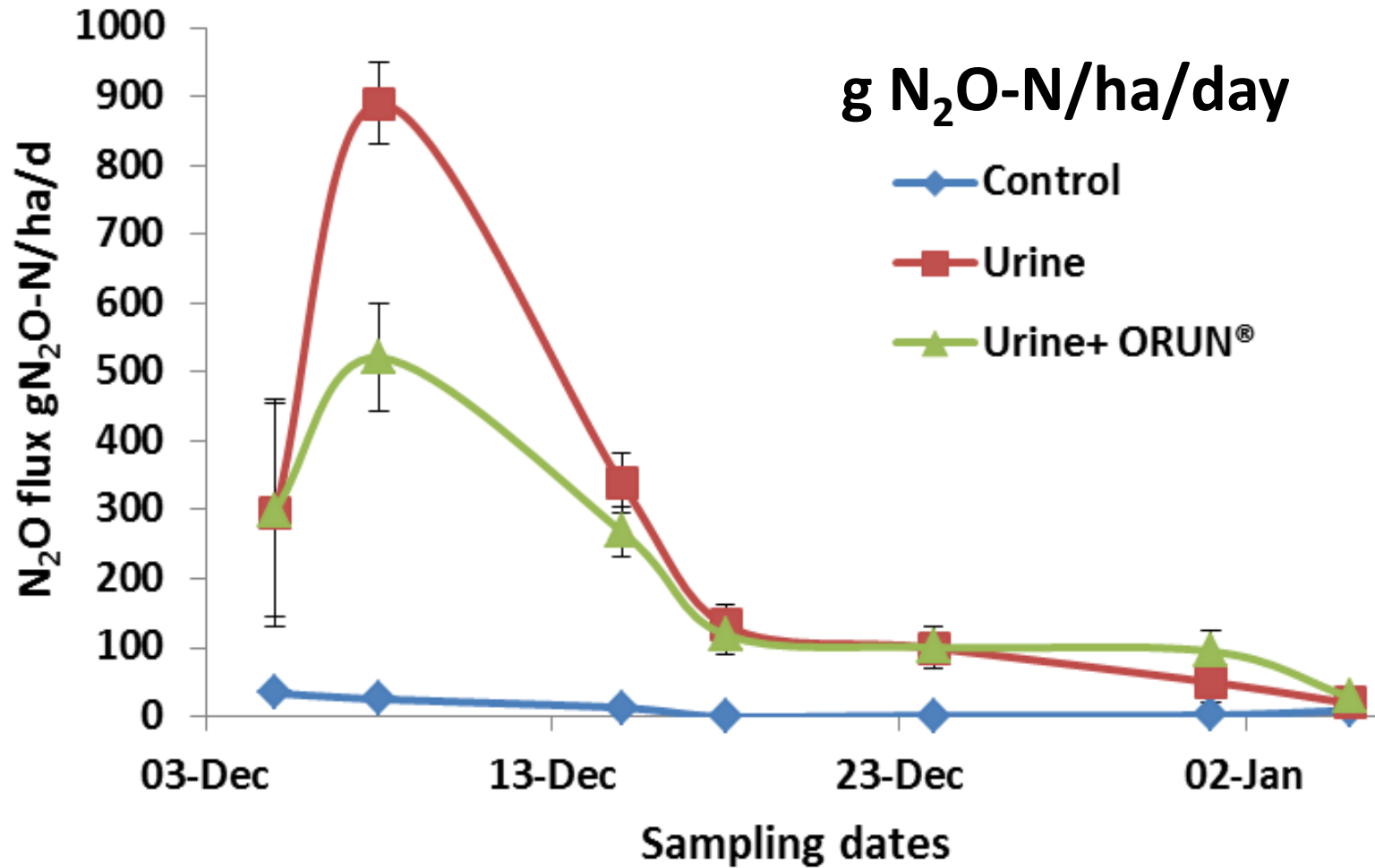
Massey University: herbage N uptake



ORUN[®] increases N uptake by 70% above untreated urine (similar results spring and autumn)



Massey University: nitrous oxide emissions



ORUN[®] reduces nitrous oxide emissions by 30% in first 14 days



Massey University: nitrate movement down soil



Soil nitrate below the root zone (>40 cm) was reduced from 34 kgN/ha to 18 kgN/ha, an estimated 50% reduction in leaching

**Also - no nbpt residues have
been detected in milk from
farms using nbpt!**





Commercial Spikey® - 2016



A longer term objective is the integration of Spikey® into the 'OVERSEER' farm nutrient management model



Near-future technology integration with Spikey®

2017

‘Mini-ME®’
robotised tow
vehicle



As well as
freeing time,
this enables:

- GPS location of patches
- Pasture measurement
- Pasture management
- Individual weed control
- pH measurement
- Pasture analysis (eg, IR)
- Soil analysis
- Worm and dung beetle delivery

Problem Two -

**Surface-applied
granular urea is by far
the main source of
fertiliser N in NZ, but it
is very inefficient, due
to many loss
mechanisms**

**N recovery ranges from
5–50% on pasture**

Our solution to Problem Two is -

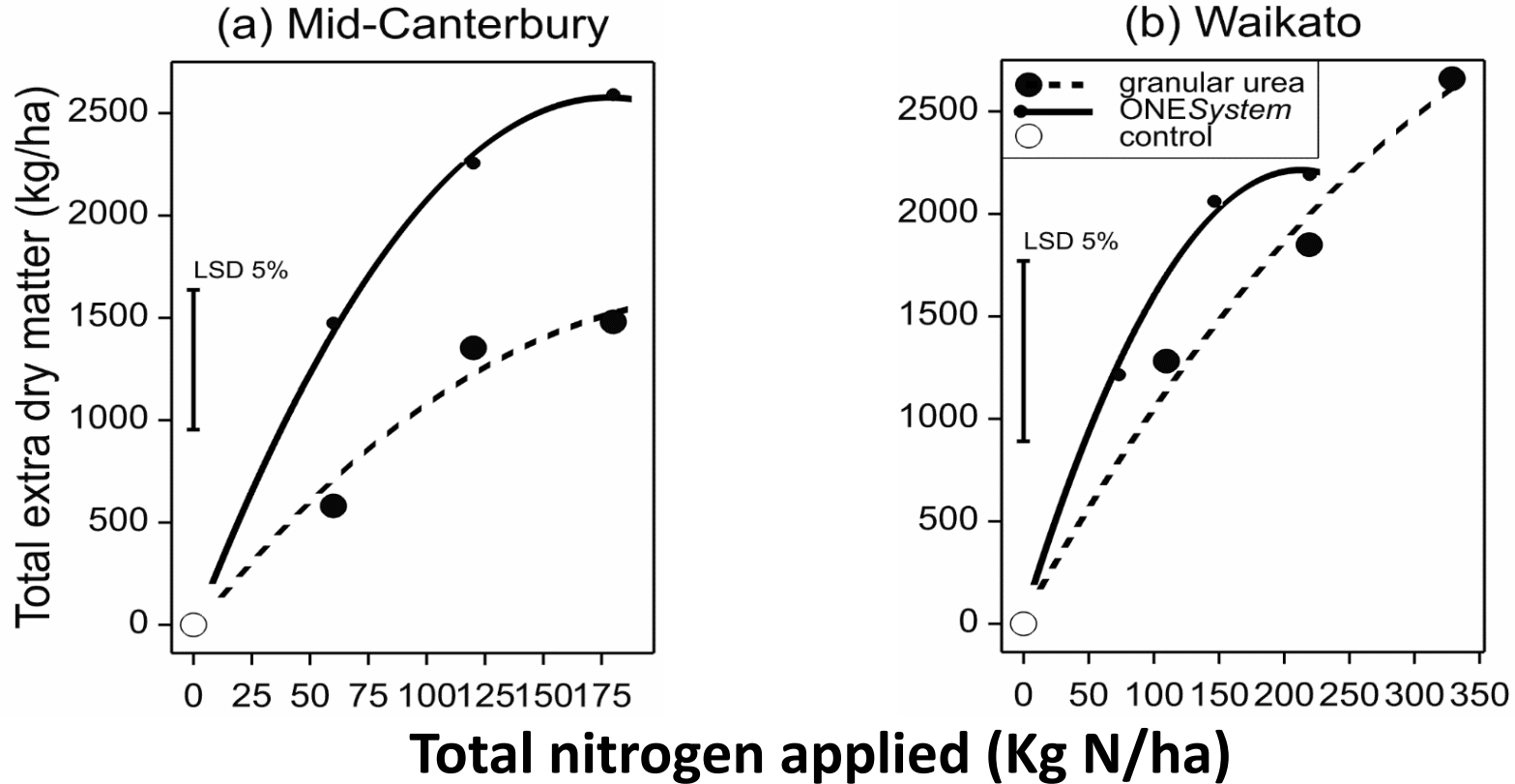


Optimised **N**itrogen **E**fficiency

Prilled urea sprayed with a dilute solution
of nbpt during spreading



Pasture growth with granular urea and ONEsystem[®]



Total pasture extra dry matter (EDM) at Canterbury (Fig. 2a, Site C) and Waikato Fig. 2b, Site W) experiments from increasing rates of nitrogen applied as either granular urea (dashed lines) or as ONEsystem[®] (solid lines). The dotted lines with associated numbers give the predicted total application of N for granular urea and ONEsystem[®] to achieve EDM of 1250 kg/ha at either site.

Reasons for ONEsystem® efficiency

- Better coverage – 10 times more particles
- Some foliar uptake occurs (10 kg N/ha?)
- Less ammonia volatilisation
- Less nitrate leaching

Conclusions (i)

Spikey®

- Almost 100% success in detecting fresh urine patches
- ORUN® spray increases N recovery by 70%
- Nitrate leaching reduced 50%
- Nitrous oxide emission reduced 30%
- Easily incorporated into dairy farm management

Conclusions (ii)

ONEsystem[®]

- Prilled urea wetted with nbpt solution
- On at least twice as effective/kg N as granular urea
- Works by reducing all N-loss mechanisms
- Plant N recovery increased from 30-40% to 75-100%
- Spikey[®] urine treatment can be incorporated



***“Knowing is not enough; we must apply
Willing is not enough; we must do”***

Johann Goethe 1749-1832



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Thank you – Danke sehr