

Farming with a N fertiliser cap

Lessons from the Hinds and Selwyn Partner Farms & Science Evidence

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9th July 2020



1

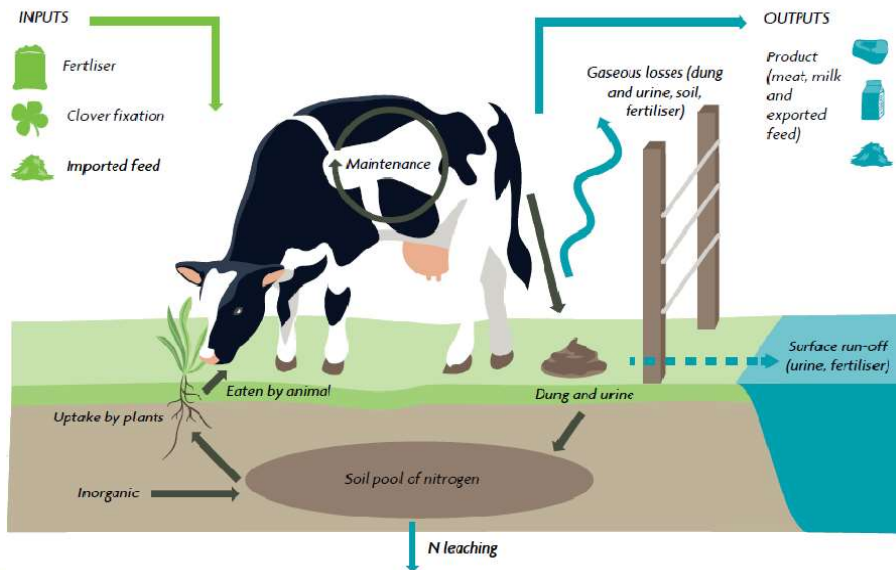
Presentation plan

- Current N fertilizer use in Canterbury
- What drives high N fertiliser use on farm?
- How to transition to a low N fertiliser system?
- How low can we go without affecting profit
- What is science telling us



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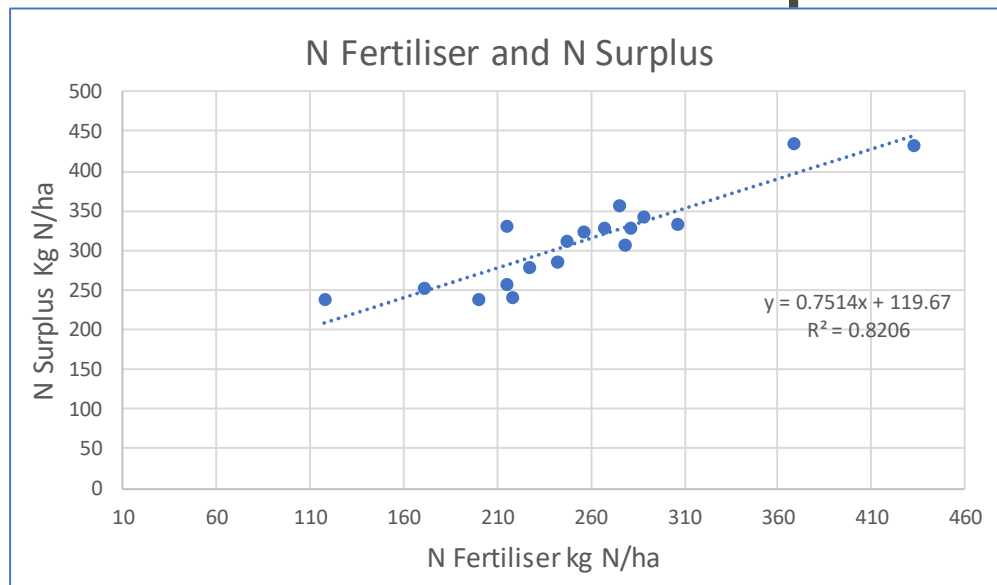
N fertiliser use and the nitrogen cycle



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N Fertiliser and N Surplus



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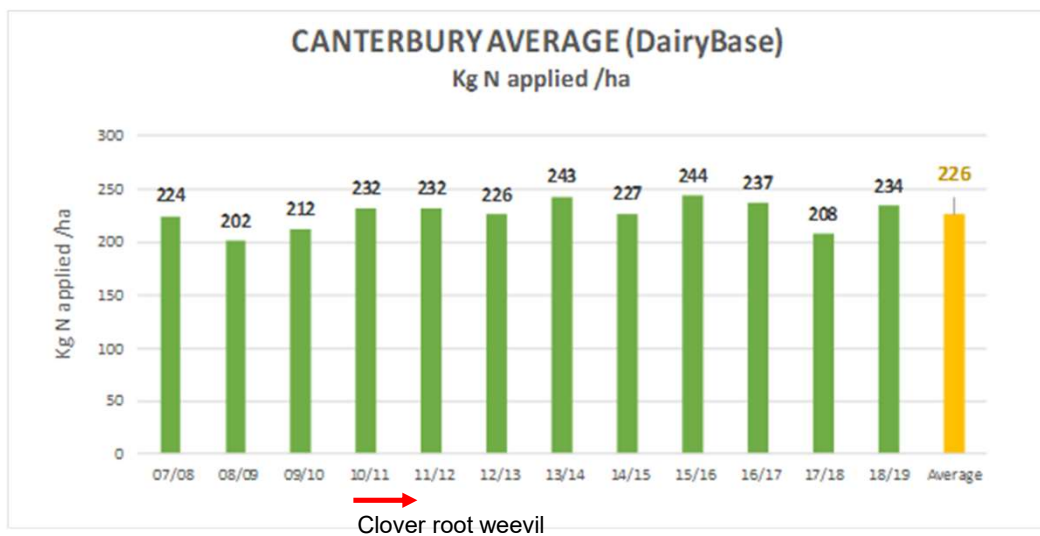
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N Cap – 190 kg N/ha

- Proposed to begin in July 2021
- Only pastoral need to report N use to regional councils
- Still to get clarity on:
 - Fertiliser use over which area (total/effective)
 - How effluent and non-effluent areas will be considered
 - How N use on crops in the milking platform will be considered
- How is this going to be monitored

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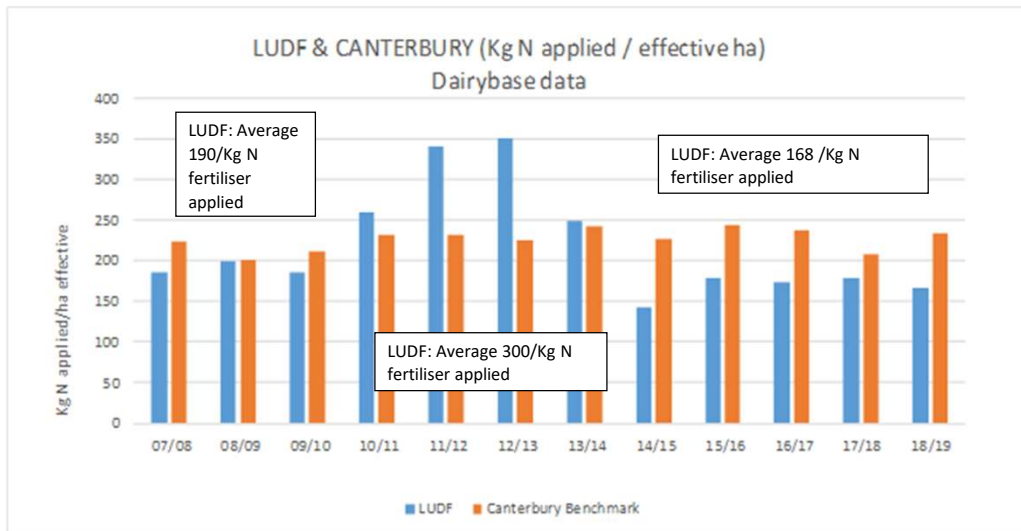
Canterbury Benchmarking = 227 kg N/ha

Irrigo = 227 kg N/ha (247 average last 4 years)

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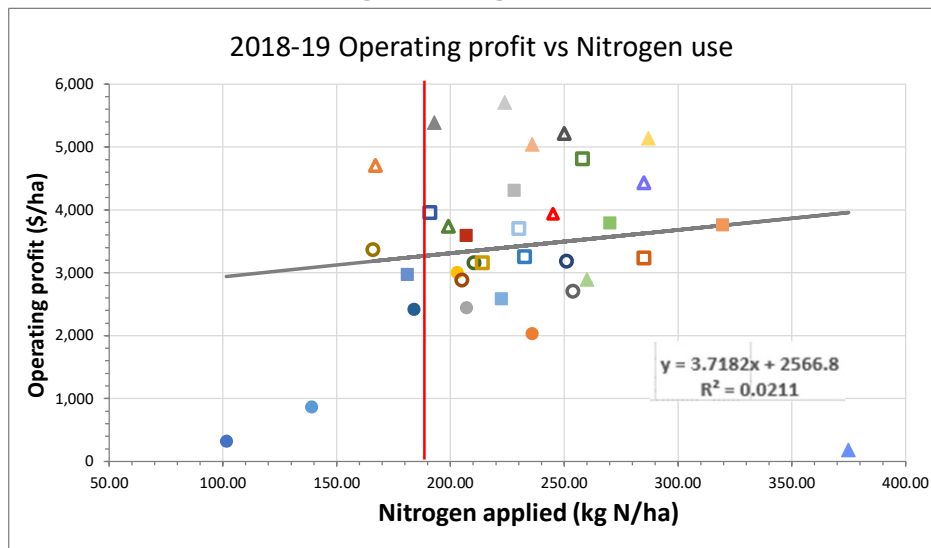
Nitrogen use at LUDF



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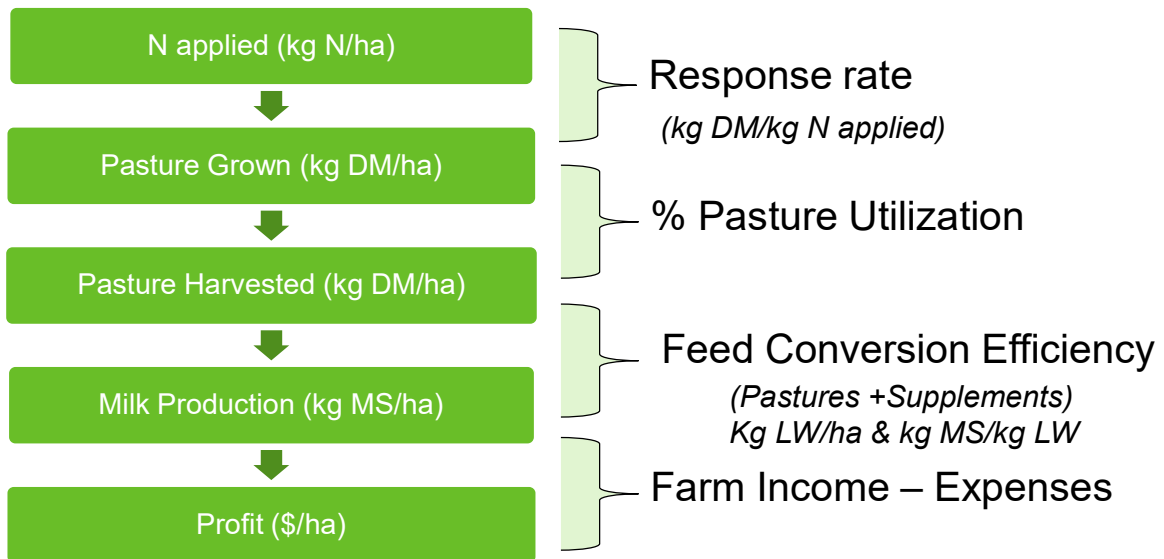
Kg Nitrogen applied & Operating profit per ha (Canterbury Dairybase 2018/19)



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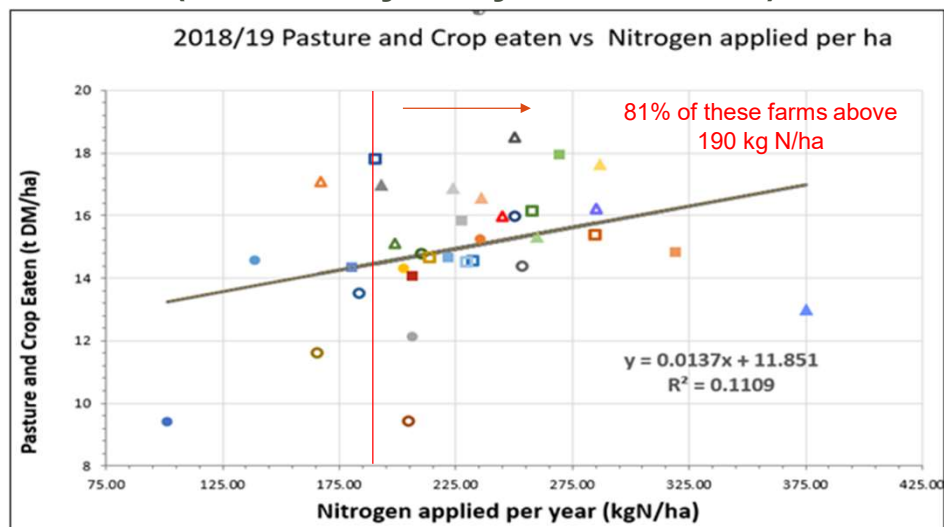
N Fertiliser use & Profit



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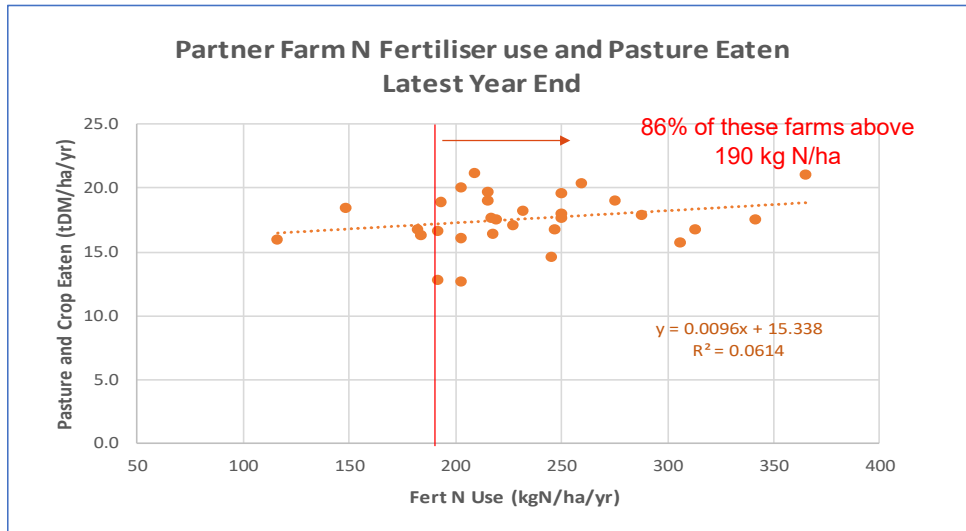
Kg N applied & pasture and crop eaten (Canterbury Dairybase 2018/19)



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Kg N applied / Pasture and crop eaten Hinds and Selwyn Partner Farms



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Tactical use of nitrogen

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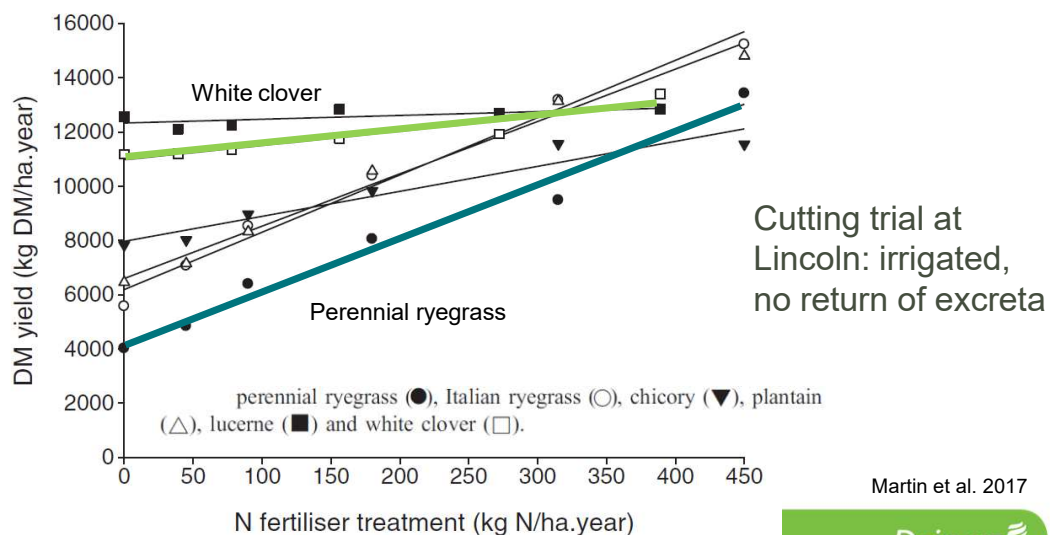
Some N fertiliser facts to remember

- Pastures with clover don't **need** N fertiliser, but
- NZ pastures are inherently N deficient – they will **respond** to N fertiliser
- Low (<6°) and **high** (>16°) soil temperatures inhibit pasture growth and response to N fertiliser
- It takes 20 (spring) to 40 days (autumn) to get **significant** yield response – use feed wedge
- For max response: optimal soil fertility, no weeds, pests or diseases

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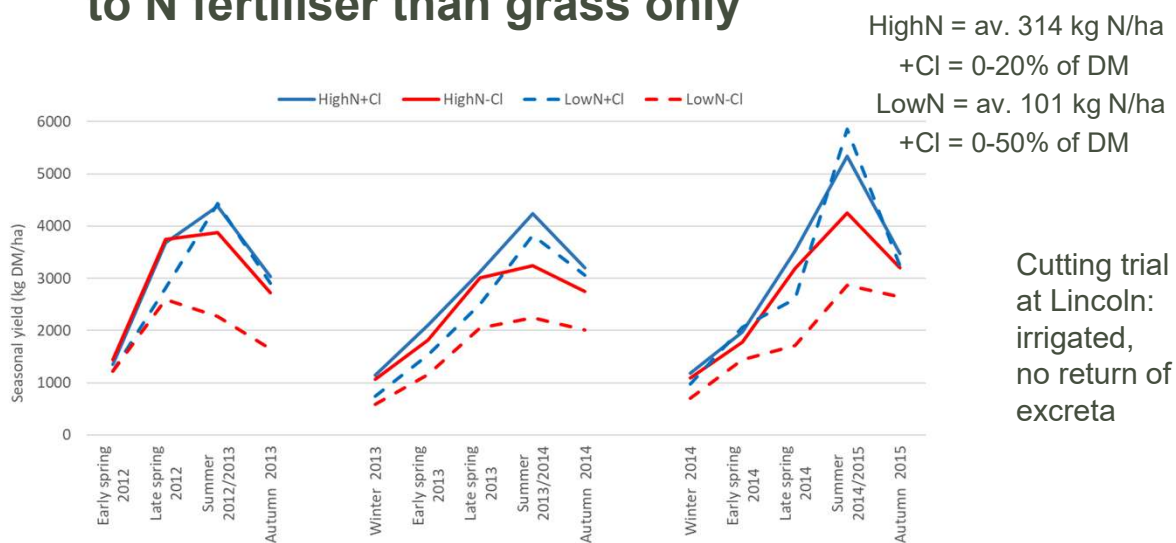
Grass and herbs respond well to N fertiliser, legumes hardly



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Grass+clover yields more and responds less to N fertiliser than grass only

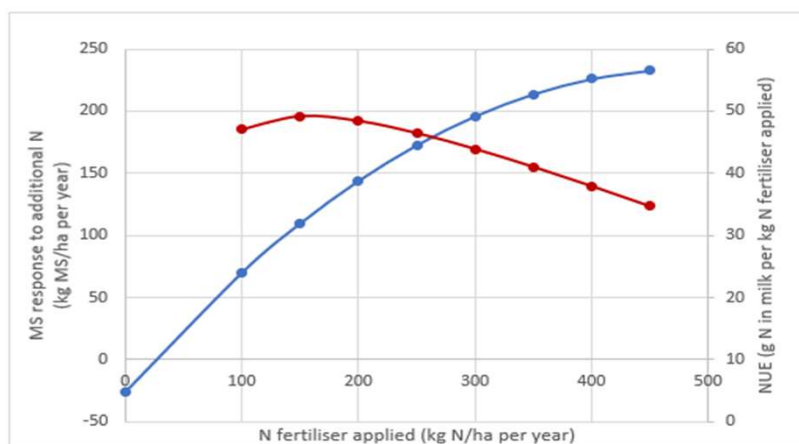


Chapman et al. 2018

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Response rates



N losses increase disproportionately with N fertiliser rates above 200 kg N/ha/year (Ledgard et al. 2007)

Diminishing returns with increasing rates

Clark 1997 – seven North Island studies

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Pastoral 21 (2011-2015) – reduced inputs, increased efficiency

Canterbury	"Low input"	LUDF	"High input"
Stocking rate (cows/ha)	3.5	3.9	5.0
Cow genetic merit (BW)			
N fertiliser (kg N/ha)	Up to 150	313	Up to 400
Grain feeding (kg/cow)	Up to 100	0	Up to 800
Standoff – urine collected	no	no	no
Average production (kg MS/ha)	1,700 (-24%)	1,821	2,241
Average operating profit (\$/ha)	4,300 (+2%)	4,395	4,205
Average N leached (kg N/ha)	32 (-30%)	39	46



Chapman et al. subm.



17

1st step to reduce N leaching and emission of nitrous oxide: tactical use of N fertiliser

- Apply less fertiliser on effluent area (e.g. aim for same total N)
- Apply low rates of N per application (e.g. 25 kg N/ha)
- Graze at 2.5-3 leaves for max response and quality
- Use fertiliser when feed is required or when response rates are high to carry over feed
- Don't apply to heavy stocked areas – front of paddocks, around troughs

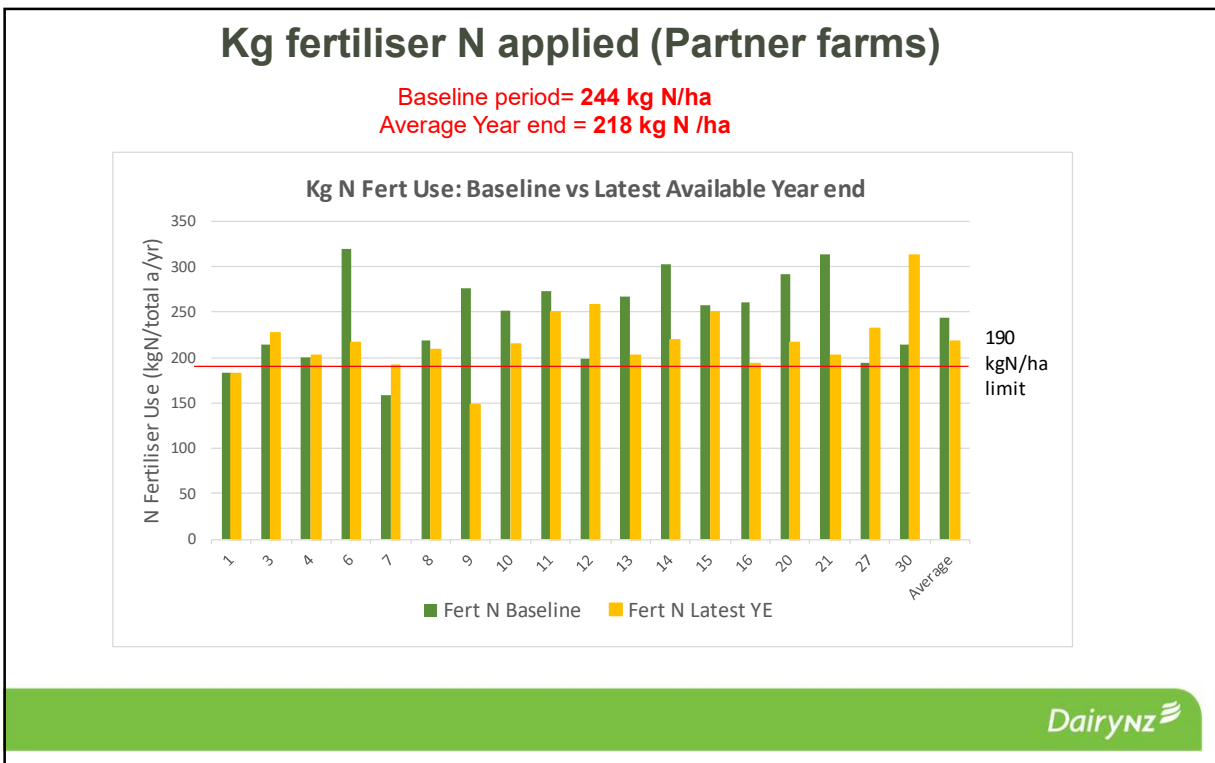
Pinxterhuis 2019



18



19



20

High N use - common mistakes

- Inadequate monitoring and recording of N use
- Following the cows specially when on fast rounds (< 20 days)
- Using high rates at each application that cannot be taken by plants being at risk of being lost
- Extra N boosted grass poorly utilized e.g. excessive pre-grazing mowing or topping

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Transition period to lower N use

- Significant reductions (+ 60 kg N/ha) will require time to adapt to new system
- Successful transition better to do in stages rather than in one blow
- Clover needs time to re-establish and be actively fixing
- Ensure all other limitations are lifted

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Transition to low N

330 – 280 kg N

Most farms could take this step without major effect

280 – 230 kg N

Good planning and management is required

230 – 190kg N

Last 40 Kg N could be challenging

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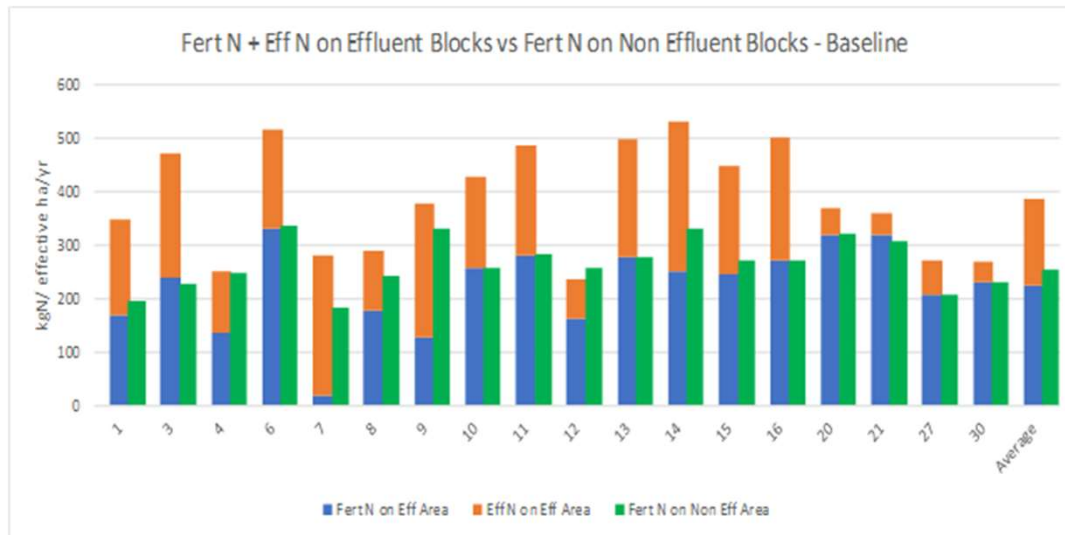
Top Tips – farmers using <200 kg N

- Efficient Irrigation/ less drainage less N loss
- Having a plan with good monitoring
- Lower N fert use on effluent blocks
- Placing of Fertiliser and precision tracking
- Slower grazing rounds (2.5-3 leaf stage)
- Timing of application (no N Jan or Feb)
- (Sustain/N-Protect) Gibberellic acid , Fertigation
- Lower Rates

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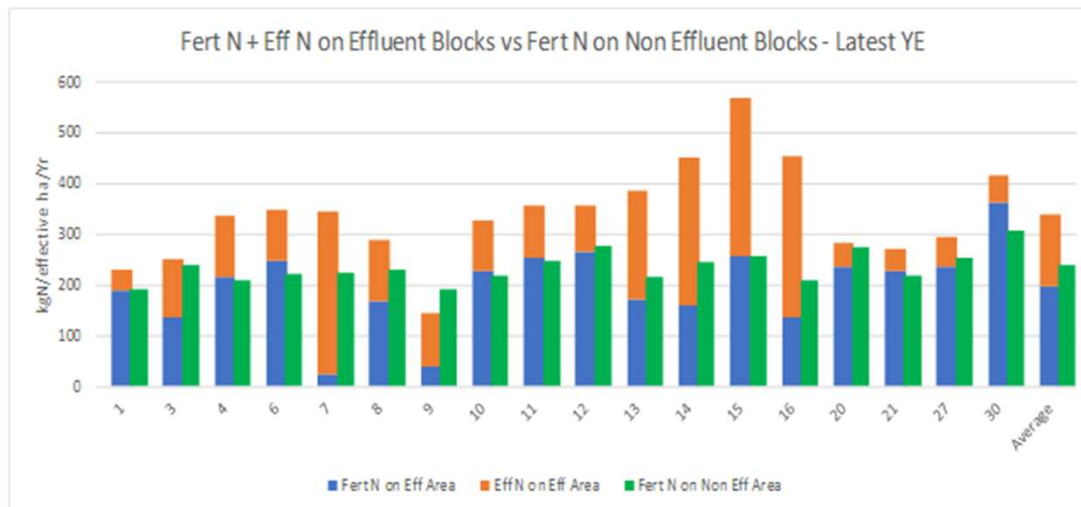
Kg N applied effluent/non effluent blocks: Baseline Period



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Kg N applied effluent/non effluent blocks: Year end



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Kg N use – Summary

2018/19 – Dairybase

- Canterbury Dairy Base = 234 kg N/ha
- Canterbury Benchmarking = 227 kg N/ha

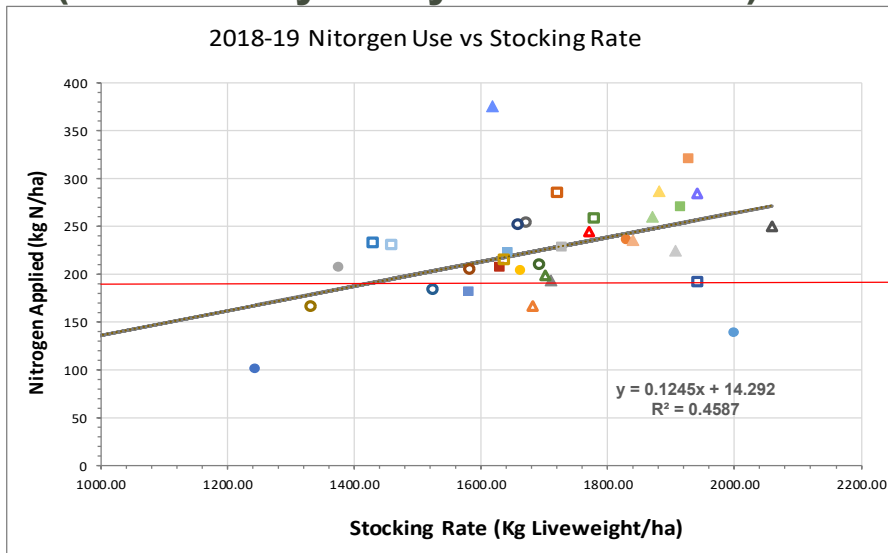
Hinds and Selwyn (year-end)

- Partner Farm year end = 218 kg N/ha (OS)

Irrigo Data

- 227 kg N/ha (247 average last 4 years)

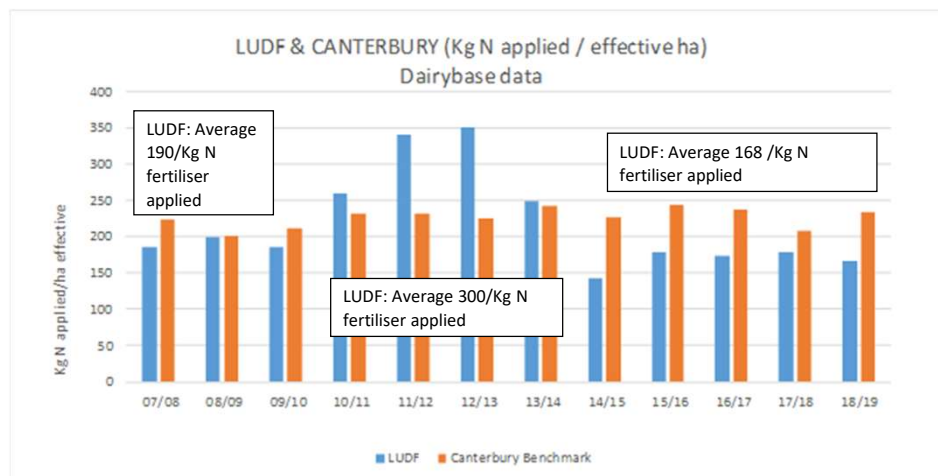
Kg Nitrogen applied & SR kg LW/ha (Canterbury Dairybase 2018/19)



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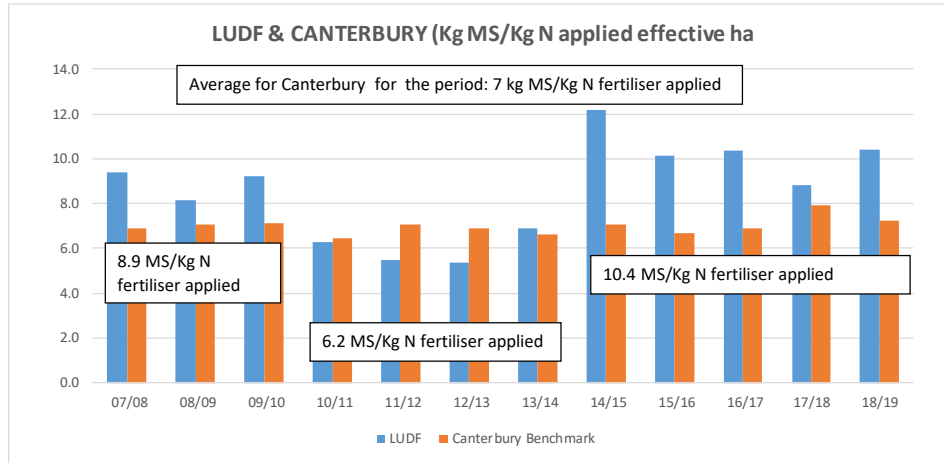
Nitrogen Use at LUDF



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N use efficiency LUDF



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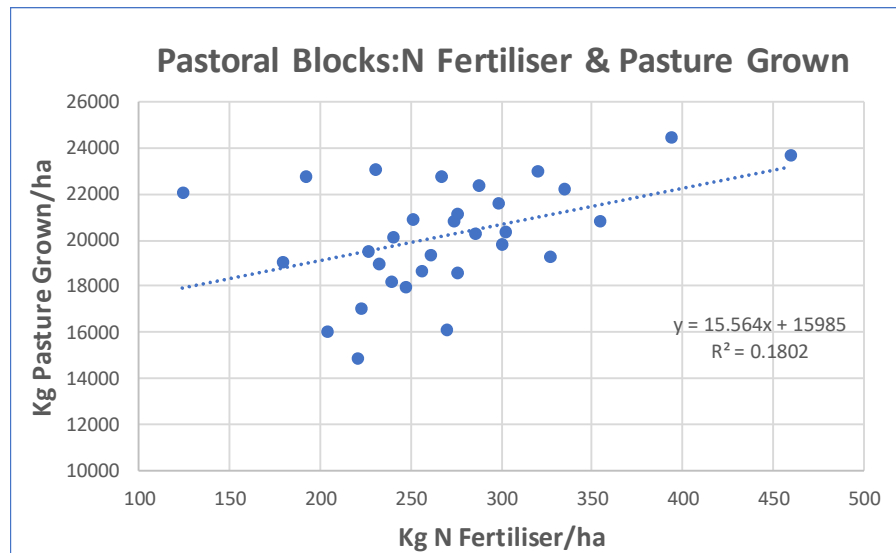
↓ N Fertiliser Input

- Easy gains where high N is used without compromising profit i.e. 250+ kg N/ha
- **Timing:** avoid high drainage/low growth months late autumn/winter; match to feed demand
- **Rate** per application/ lower rates on effluent blocks
- **Type of N** (currently not in Overseer)

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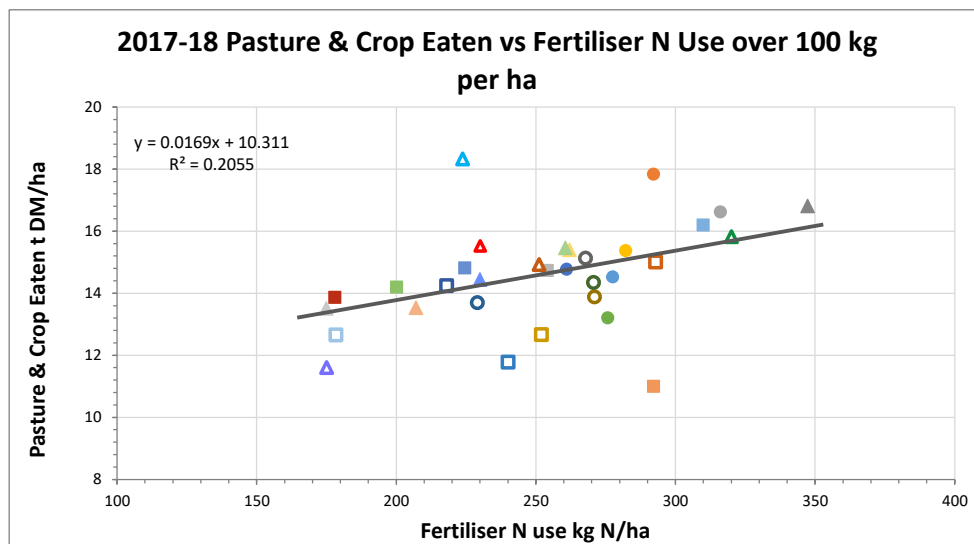
Partner farms N fert & Pasture grown



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Canterbury Benchmarking Group

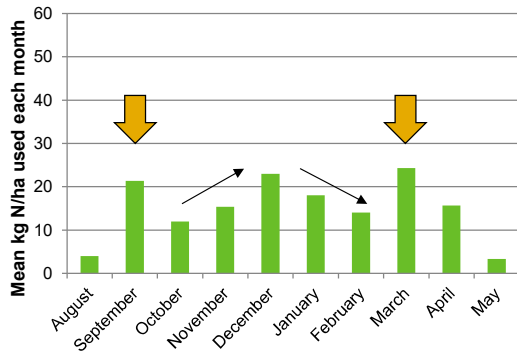


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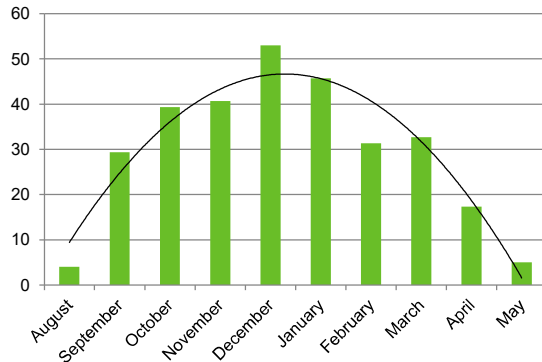
34

P 21 Nitrogen fertiliser use pattern

Lower input system
Average total = 156 kg N/ha/y



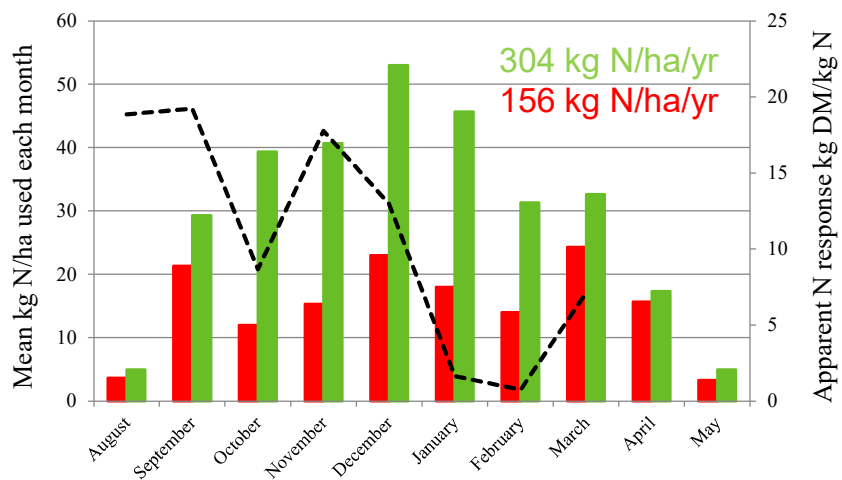
High input system
Average total = 304 kg N/ha/y



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P 21 Nitrogen fertiliser response



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36

Canlac: Changes to N applied

Season	2015/16	2016/17	2017/18
Avg fertiliser application rate (kg N/ha)	29	27	28
Number of applications to farm	9.9	8.3	8.0
N fertiliser applied (kg N/ha)	293	243	224
N Effluent applied (kg N/ha)	22	33	36
Total N (kg N/ha)	315	276	260

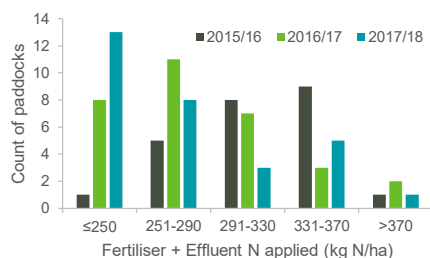
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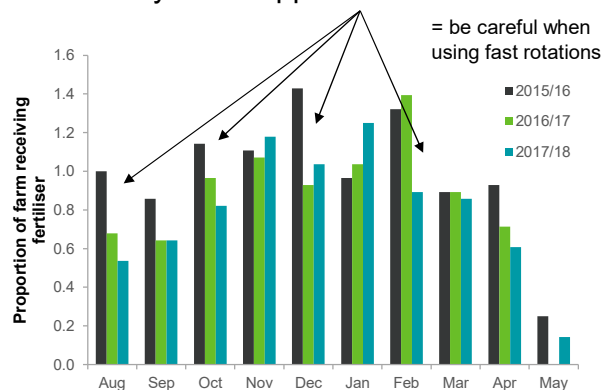
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Similar rate, so reduction driven by fewer applications



Moved from most paddocks getting 291-370 to <250 kg N/ha



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Key Learnings Mick Oconnor 2019-20

- Dropped January/February out and noticed yellowing; herbage analysis and discovered need K not N
- First round all farm mid-August 80 kg SustainN
- Second round 80 kg/ha urea (? Sustain?), start split application assume 20h September half farm then 5th October (need to check on dates)
- Apply maintenance fertiliser July so don't use SOA as sulphate applied in maintenance dressing (save cost)
- DHL focus irrigation efficiency and N use

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Fertigation

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Agronomic Benefits?

- Once in soil solution no difference in form of N
- Response to 1 kg N applied granular vs liquid
 - all else being equal, will grow the same amount of dry matter (DM) regardless of state, form or application method
 - Uptake by leaves up to 5%
 - Research to date shows no difference in yield

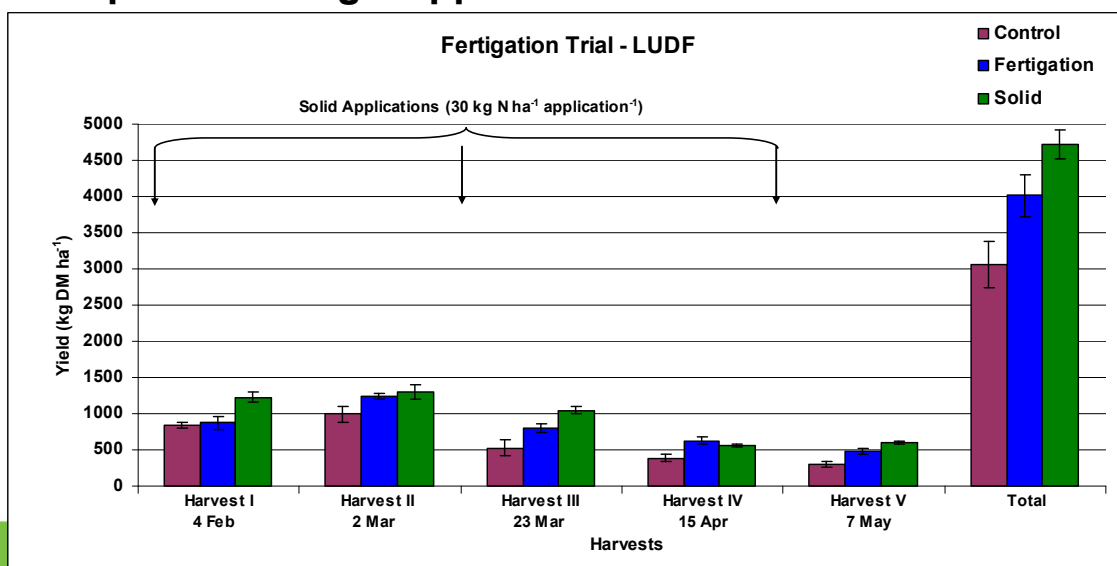
Ravensdown plot trial at LUDF

- Objective: To determine the relative effectiveness of using fertigation-N compared to solid urea fertiliser-N on pasture growth.
- Rationale for the treatments:
 - Test if any benefit of applying fertigation-N in small amounts at frequent intervals compared to single applications of solid urea-N.

Methods – conducted LUDF

- 15 pasture plots (5.0m x 2.5m).
 - (i) dissolved urea solution (fertigation) and
 - (ii) solid urea fertiliser; plus
 - control treatment of no fertiliser.
- The fertigation-N was applied at equivalent rate of 2.5 kg/ha as urea in solution twice per week; total of 30 kg N/ha over 6 week periods.
- Solid urea fertiliser was applied once every 6 weeks at a rate of 30 kg N/ha per application.

The results show that there was no advantage of using fertigation to deliver frequent small amounts of N compared to single applications of solid urea-N.



Benefits liquid fertilisers

- Allow better use of existing on-farm equipment (sprayers and/or irrigators)
- Offer flexibility with timing and better accuracy
 - when applied with well calibrated equipment
- Liquid N can be mixed with other products
 - pesticides or growth stimulants such as gibberellic a.
- Benefits need to be balanced against any additional costs (liquid N and cost to apply)

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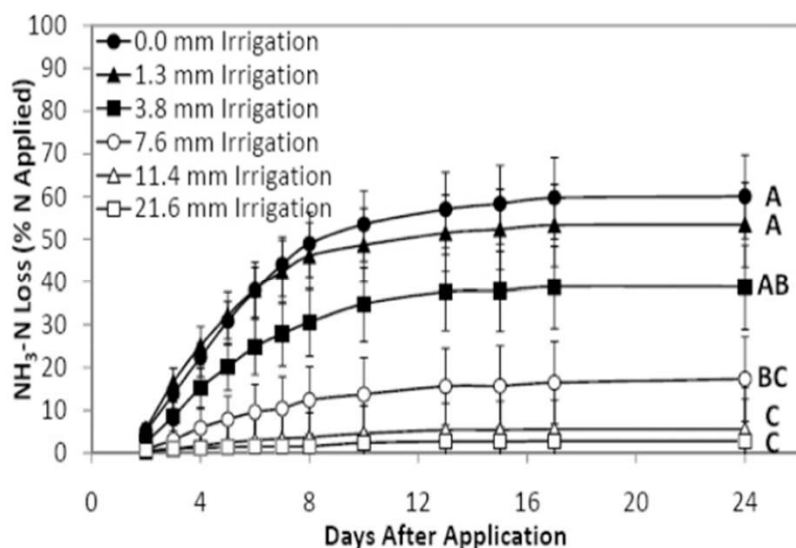
Environmental Advantages

- Ammonia losses applying 15-30 kg N
 - plus 4-5 mm irrigation ~ 4%
 - Plus 15mm irrigation ~ <1%
- Average volatilisation losses spring-autumn 18%
- Fertigation has advantage of the N being applied with water, immediately reducing risk volatilisation

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Cumulative loss NH_3 over 24 days with & without irrigation



If apply >10mm irrigation at time of application form of N liquid or granular no difference in volatilisation

(Holcomb & Horneck 2010)

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Less N

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Less N

- Active ingredient unknown
 - Thought growth promotant possibly cytokines
- Trials have shown same DM response to
 - Applying 20 kgN/ha plus less N compared to
 - Applying 40 kg N/ha as urea
- Only at above rates & not all trials +ve due to:
 - A brew so possible variation in active ingredient
 - Applied in range of conditions for growth
- Science community not actively endorsing

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Sustain and N-Protect

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Sustain and N-Protect

- Urea coated urease inhibitor
- Slows the conversion of N to ammonia gas (volatilisation) so more N for plant growth
- Conditions for volatilisation
 - Hot, dry and windy and
 - moist soil in cooler situations
- Phased N combination of Sustain, fine elemental sulphur and fine lime

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What is the reduction in N loss?

- When: If get <5-10mm rain within 8 hours applied
- Claim 50% reduction ammonia volatilisation losses
- **Average volatilisation loss 18%** spring to autumn
- Say apply 40 kg N and volatilisation losses 20%
 - $40 \times 20\% = 8$ kg N potential lost
 - 50% reduction = 4 kg N not lost
- Recommend apply 10% less N as coated urea
 - Reduces N applied and no difference in cost

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Gibberellic Acid



53

Gibberellic acid (GA)

- Growth hormone found in plants
- Applying GA late winter initiates stem elongation (replaces need for accumulated long days; providing pasture has been vernalised)
- Best response when applied with N
- Ryegrass, white clover, fescue, weeds all respond



54

GA effects on pasture & yield

- Promotes stem elongation and tiller size
- Responses range 50-980 kg DM/ha
- Relative responses best at lower temperatures
- LUDF trial shows autumn increased 330 kg DM/ha
- Next grazing can be slow especially if hard grazed
- Has the potential in autumn however ..
 - One trial showed no difference in N leached (lysimeters comparing GA to 25-50-100 kg N/ha)