The role of PCU and accounting for soil supplied N in NSW Sugarcane

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Project participants

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- Rick Beattie (Sunshine Sugar)
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- Marguerite White (ICD Project Services),
- Felice Driver and Dr Peter Sampson (SRA)
- Dianne Allen (Qld DSITI)
- Daniel Cozzolino (MIR modelling at UQ)
Project aims:

- Better account for soil N stocks in NSW sugarcane (mineral N to depth and PMN) - future refinement of the 6ES
- Synchronize N supply with crop demand using polymer coated urea - understand the N release characteristics in sugarcane soils and influence on yield
- Develop a rapid predictive test for PMN
Accounting for N stocks from 27 cane paddocks in NSW.

• 1m cores taken (3 per field) prior to N fertiliser application in 2016-17
• Analysed for Total C, N, pH
• Mineral N
• 0-20 and 20-40cm potentially mineralizable N
Key result: Some paddocks have soils that can supply a large amount of N to the crop.
Can EENFs produce higher yields when used at suboptimal rates?

- 5 recent meta-analyses showed **nil benefits to yield** using EENFs—studies rarely used sub-optimal N doses as studies focused on soil nitrous oxide emissions.
- 11 studies that used sub-optimal N doses show clear advantages to yield.
- When studying EENFs, critical to develop response curve vs standard fertiliser.

N release characteristics of PCU

- 10g PCU in mesh nylon bags spaced ~ \( \frac{1}{2} \) metre apart
- Separate bags for PCU 90 and PCU 270
- Bags were heat sealed and buried at depth equivalent to stool splitter fertilizer placement
- Bags located on-row in non-fertilized area of paddock immediately adjacent to trial plots
- Retrieved at \( T=0 \ 1 \ 2 \ 4 \ 6 \ 8 \) weeks and \( 3 \ 4 \ 5 \ 6 \ 9 \ 12 \ 15 \ 18 \ 24 \) months
- Extracted and analysed for TN to obtain release curves
Coraki Rainfall Nov 18 - Dec 19
(cumulative total 767.3mm)
More Profit from Nitrogen

Remaining N (%) vs. Time (Days)

- PCU 90
- PCU 270
- 2 per. Mov. Avg. (PCU 90)
- 2 per. Mov. Avg. (PCU 270)

Woodford Island Rainfall Oct 18 - Dec 19
(cumulative total 600.8mm)
Key Result:

T50% release from 90 day polymer was about 30 days under field conditions from 2 sites

T50% release from 270 day polymer was about 90 days under field conditions from 2 sites

Noting that both sites had warm and dry conditions
Field trials

- 2017: PCU 90
- 2018: 50:50 blend of PCU90:PCU270
- Plot size: 33m X 3 rows
- PCU pre-blended w/w
- Applied using conventional stool splitter- painstakingly calibrated for each N dose
Field site 1:
Stotts Creek (Tweed catchment)
Established 12/12/2016.
Variety: KQ228
Harvested 12/10/17
More Profit from Nitrogen

Stotts Creek (Tweed catchment) PCU 90

[Graph showing yield and biomass nitrogen as a function of N application rate for different treatments.]
Field site 1:
Stotts Creek (Tweed catchment)
Established 12/12/2016.
Variety: KQ228
Harvested 12/10/17

Field site 2:
Pimlico (Richmond Catchment)
Established 19/12/16.
Variety: Q193
Harvested 15/06/18
More Profit from Nitrogen

Pimlico (Richmond Catchment) PCU 90

Graphs showing the relationship between N Application rate (kg/ha) and Yield (T/ha) and Biomass N (T/ha). The graphs compare different application types such as Nil, Polymer, and Standard.
Field site 1:
Stotts Creek (Tweed catchment)  
Established 12/12/2016.  
Variety: KQ228  
Harvested 12/10/17

Field site 2:
Pimlico (Richmond Catchment)  
Established 19/12/16.  
Variety: Q193  
Harvested 15/06/18

Field Site 3:
Woodford Island (Clarence Catchment) Established 31/10/18.  
Variety: Q232  
Yield estimate 29/07/19
Woodford Island (Clarence Catchment)
50:50 blend of PCU90:PCU270
Leaf N content (%) over time

Polymer

Standard
Leaf N content (%) over time
Using multi-spectral imaging to monitor plot performance

160 day leaf N analysis
Field site 1:
Stotts Creek (Tweed catchment)
Established 12/12/2016.
Variety: KQ228
Harvested 12/10/17

Field site 2:
Pimlico (Richmond Catchment)
Established 19/12/16.
Variety: Q193
Harvested 15/06/18

Field Site 3:
Woodford Island (Clarence Catchment) Established 31/10/18.
Variety: Q232
Yield estimate 29/07/19

Field Site 4:
Coraki (Richmond Catchment)
Established 06/11/18.
Variety: Q203
Yield estimate 31/10/19
Coraki (Richmond Catchment)
50:50 blend of PCU90:PCU270
Key result:

- Generally flat N response curves from 4 sugarcane trials to increasing N dose
- Could not separate effects of PCU or urea on yield from matching N doses (noting all 4 crops trials had very dry starts and well below average rainfall for the growing season)
- In 2 of the 4 trials, PCU resulted in greater biomass uptake of N
- PCU also resulted in slightly higher soil residual nitrate (0-40cm) at harvest- data set not comprehensive for each plot and data not shown
- GNDVI shows promise at 160 days after ratoon emergence for estimating leaf N content (and possibly yield)
- Sugarcane yield was more limited by other constraints, eg, water availability, soil constraints resulting in low root penetration.
Calibration available for MIR and PMN for Richmond and Clarence Catchment sugarcane soils

Key result:
Correlation model developed for 14, 56 and 300 day PMN
Industry Outcomes

- PCU did not influence yield across 4 trials but it needs to be noted that potential N loss pathways (directly following fertilization) were low due to low rainfall
- The N response curves were generally quite flat, but yield still increased with increasing N input
- MIR provides a useful prediction for mineralizable N (especially long term mineralizable N) for NSW soils, and an analytical service is currently being considered
- Multispectral imaging is useful for predicting 160 day leaf N content which can correlate to yield
Recommendations

1. PCU is likely to have an impact where high rainfall directly after fertilization results in loss pathways for urea- needs a modelling approach to predict best response based on season, and better climate forecasting
2. Deep soil N and mineralizable N should be considered in calculating soil N supply to crop, with considerations within the 6ES
3. A better quantification of residual N in soil (after harvest) from PCU is still required. This would be taken into consideration with point 2 (above)
4. Because 56 and 300 day PMN are much greater than 14 day PMN (standard method), should we start looking in more detail at whole season soil N supply.
Visit

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