Monitoring $N_2O$ emissions in south-east Queensland pineapple and ginger farming systems

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Action on the ground program
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Project 143 : Improved fertiliser, soil and irrigation management in SEQ ginger production; controlled release nitrogen fertiliser trials monitor nitrous oxide emissions, fallow rotations for carbon and disease management

Project 218 : Improved fertiliser management in south east Queensland intensive horticulture- pineapple and strawberry; controlled release nitrogen fertiliser trials to test for nitrous oxide emission reduction
Why $\text{N}_2\text{O}$?

- 296 times more potent than $\text{CO}_2$
- Soils contribute 65% of global emissions
- 80% of Australia's reported emissions from Agriculture soils
- 32% linked to nitrogen fertiliser
- AotG – Opportunity to determine $\text{N}_2\text{O}$ production levels for horticulture

IPCC 2006, AGO 2007
Controlled release nitrogen fertiliser

• 20 year old technology
  - Moisture, temperature controlled
  - expensive
  - alternatives for lower value crops
• Pineapples - basal four month 50% CR N based on a popular blend
• Ginger and strawberry – 8 and 10 month 100% CR N blends compared against fertigation (farm practice)
Fertiliser application rates

- Application rates – Farm Practice followed industry recommendations CRN at ~70% industry standard; cost equivalent to FP.
- Ginger (1000kg ha) and strawberries (20g plant) higher value crops with different nutrient application methods, one-off application vs. fertigation program. CRN application is around 5 -10% more expensive than Farm Practice in fertiliser cost.
- Study area 4000m$^2$ per treatment
N$_2$O monitoring

- Static PVC chambers
- 16 chambers per farm
- Monitor plant bed and wheel tracks
- 3 samples / hour / chamber (10am-2pm)
- 1-2 day per week + >15mm rain
- Soil moisture, temperature, NO$_3$-N and NH$_4$-N
- Time series analysis

Saggar et al, 2004; Mosier and Mack, 1980
Cumulative emissions - pineapples

<table>
<thead>
<tr>
<th></th>
<th>GH(^1)</th>
<th>GH(^2)</th>
<th>EL(^1)</th>
<th>EL(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{N}_2\text{O}) emissions kg/ha</td>
<td>3.22</td>
<td>6.09</td>
<td>2.92</td>
<td>2.36</td>
</tr>
<tr>
<td>Mineral N inputs kg/ha</td>
<td>54</td>
<td>82</td>
<td>96.5</td>
<td>133</td>
</tr>
</tbody>
</table>

- Cumulative \(\text{N}_2\text{O}\) emissions (g ha\(^{-1}\)) for each treatment.
- The mineral N fertiliser inputs (kg ha\(^{-1}\)) applied at the planting stage.

- Huang et al 2012 1.16kg/ha \(\text{N}_2\text{O}\)
- CR Nitrogen\(^1\) Farm practice \(^2\).
### Mean daily $N_2O$ flux (g ha day$^{-1}$) pineapple

<table>
<thead>
<tr>
<th>Site</th>
<th>Block</th>
<th>Bed</th>
<th>Wheel track</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasshouse</td>
<td>Farm Prac</td>
<td>41.69</td>
<td>18.18</td>
<td>59.87</td>
</tr>
<tr>
<td></td>
<td>CR nitrogen</td>
<td>22.30</td>
<td>10.16</td>
<td>32.46</td>
</tr>
<tr>
<td>Elimbah</td>
<td>Farm Prac</td>
<td>13.66</td>
<td>9.06</td>
<td>22.71</td>
</tr>
<tr>
<td></td>
<td>CR nitrogen</td>
<td>15.00</td>
<td>17.13</td>
<td>32.13</td>
</tr>
</tbody>
</table>

Means relative to spatial representation; 74% bed and 26% wheel track over three months.
Combined raw daily means g ha day$^{-1}$
Start-up fertiliser applied to sub-surface at Glasshouse Mountains for both treatments.
Mean daily $\text{N}_2\text{O}$ flux (g ha day$^{-1}$) - Ginger

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Beerwah</td>
<td>Fertigation</td>
<td>140.47</td>
<td>75.09</td>
<td>215.56</td>
</tr>
<tr>
<td></td>
<td>C Release</td>
<td>145.15</td>
<td>106.16</td>
<td>251.31</td>
</tr>
</tbody>
</table>

4 month cumulative emissions

- Fertigation - 26.76 kg/ha
- C Release N - 30.11 kg/ha

AUC analysis indicated a 2.04% difference in favour of farm practice
Ginger – Fertigation (standard practice) vs. 8 month controlled release nitrogen trial. Time series analysis of the 2013/14 season.
Discussion

• Important role soil moisture plays in creating conditions for N₂O production, research suggests temperature influential

• short term increase N₂O emissions >90g ha day⁻¹ after >15mm rain.

• High emissions observed in the wheel tracks for all treatments; compaction + ↑ rain
  - denitrification; ↑ leaching
  - sugarcane studies reported similar
Discussion

• Plant and soil nutrient data so far suggests CRN use consistent with standard practice.
• More consistent results from 100% CRN blends than 50%, soil type and management history have influence.
• In-field harvests in ginger show a 15-20% ↑.
• Two seasons of use in ginger and now 40% of plants under CRN.
• Pineapple harvest 6 - 8% reduced harvest.
• Strawberry 5% reduced harvest.
Conclusions

- Preliminary findings
- More investigations are required to verify the benefits associated with controlled release fertiliser use in pineapples in low pH soils - placement and seasonal timing to quantify N$_2$O emissions in pineapples
- Information currently available comparing new fertiliser technologies is limited
- Limited CRN studies for subtropical horticulture in general
Acknowledgements

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