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Queensland Government

Effect of reduced fertiliser rates in combination with a nitrification inhibitor (DMPP) on soil nitrous oxide emissions and yield from an intensive vegetable production system in sub-tropical Australia

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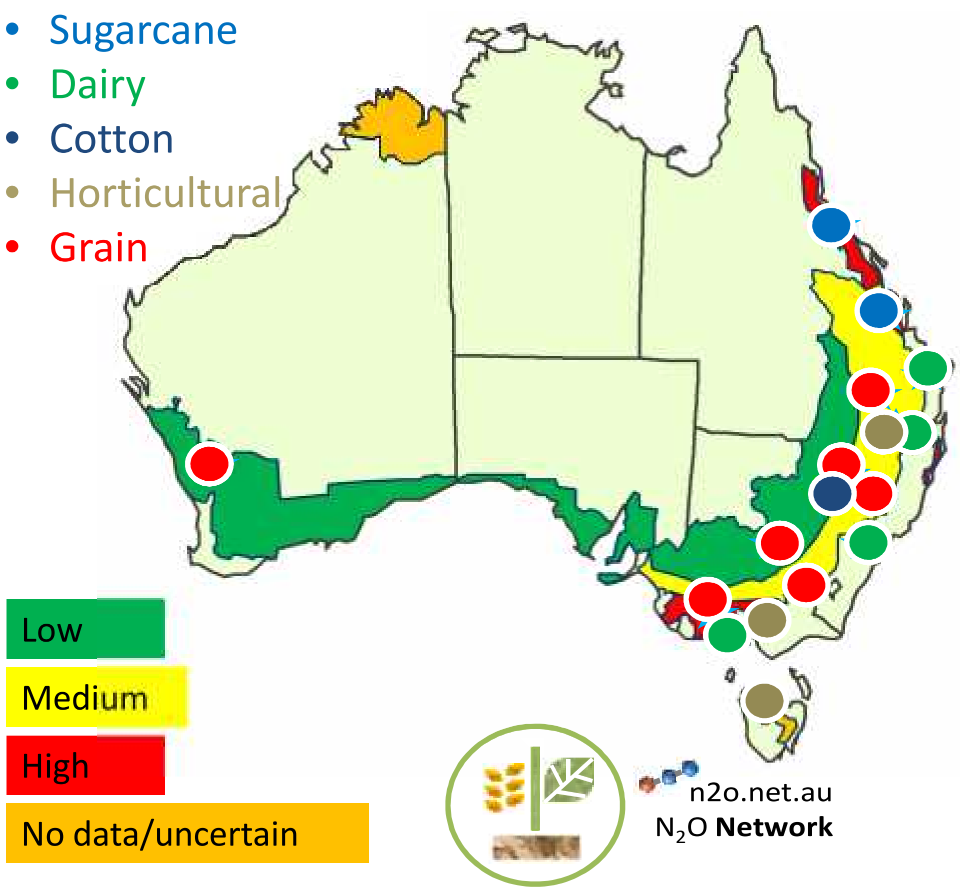
Background

GHG emissions from horticultural production systems

- High emissions of nitrous oxide (N_2O) from heavily fertilised sub-tropical vegetable production systems have been reported (>200kg N_2O ha^{-1} yr^{-1})
- In Australia horticulture represents only a small proportion of land used for agriculture (0.15%) but accounts for 6 to 12% of nitrogen fertilizer use.
- Aside from the high fertiliser N inputs vegetable crop residues incorporated into the soil after harvest can contain large amounts of N (up to 450 kg N ha^{-1} yr^{-1}) and lead to elevated N_2O emissions.
- Nitrification inhibitors have been promoted as an effective method to reduce nitrous oxide (N_2O) emissions from fertilised agricultural fields, but little data on vegetable cropping systems.
- It has been shown that nitrification inhibitors can lead to elevated post-harvest emissions.

National Agricultural Nitrous Oxide Research Program



Research activities

1. Automated GHG monitoring network
2. Manual chamber monitoring network
3. Define nitrogen response curves
4. Determine ^{15}N mass balance
5. Estimate N_2O and N_2 = total N gas loss
6. Crop-soil modelling

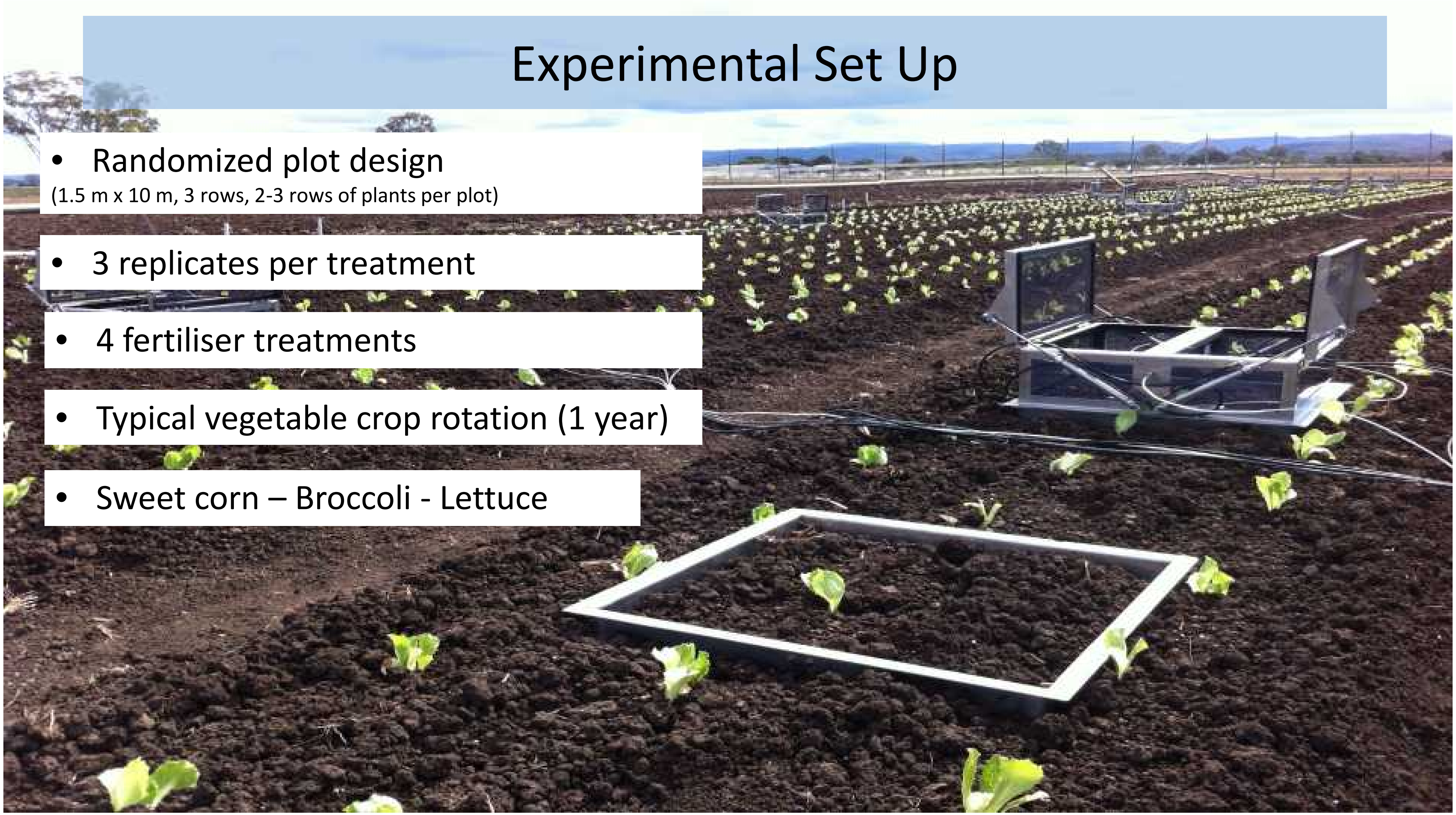
- 23 projects in total (5 cropping systems)
- Total investment **<u>($50M</u>**) 2012-2016

Research Site

- Gatton Research Station
- Lockyer Valley (80km west of Brisbane)
- Subtropical Climate (predominately summer rainfall)
  (18.7 to 31.2°C summer, 6.8 and 21.4°C winter, 773mm rain)
- heavy clay soil
  (*Haplic, self-mulching, black, Vertisol*, 60% clay)

Experimental Set Up

- Randomized plot design
(1.5 m x 10 m, 3 rows, 2-3 rows of plants per plot)
- 3 replicates per treatment
- 4 fertiliser treatments
- Typical vegetable crop rotation (1 year)
- Sweet corn – Broccoli - Lettuce



Experimental Set Up

4 different fertiliser treatments:

1) **Standard grower practice (SGP)** – i.e. standard grower practice of Nitrophoska® and urea fertilizer N application rates (340kg-N/ha/yr).
2) **100% DMPP** – addition of DMPP coated fertiliser (ENTTEC Nitrophoska® and ENTTEC® urea) with SGP N application rates (340kg-N/ha/yr).
3) **80% DMPP** – addition of DMPP coated fertiliser (ENTTEC Nitrophoska® and ENTTEC® urea) with a 20% reduced N application rate compared to SGP (272kg-N/ha/yr).
4) **60% DMPP** – addition of DMPP coated fertiliser (ENTTEC Nitrophoska® and ENTTEC® urea) with a 40% reduced N application rate compared to SGP(204kg-N/ha/yr).

Hypothesis

- N_2O emission from a sub-tropical vegetable rotation can be reduced by the use of DMPP coated fertiliser.
- The use of DMPP will allow for a reduction of N fertiliser rates (compared to the SGP) without affecting yield

Objectives

- Quantify N_2O emissions from a typical vegetable rotation (1 year) in sub-tropical Australia
- Assess the influence of DMPP in combination with reduced fertiliser N rates on emissions of N_2O and yield

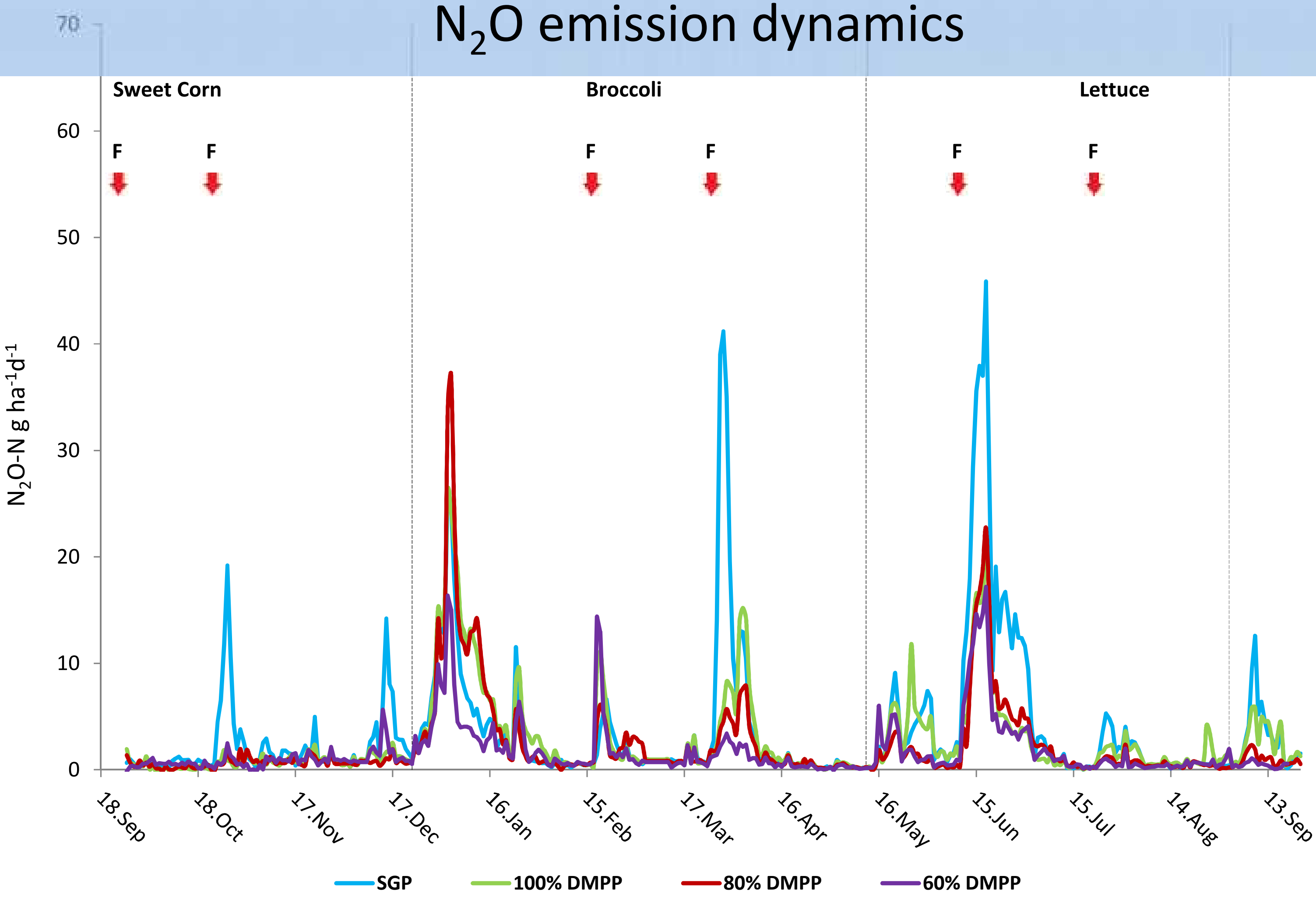
Methodology

- Automatic Chambers

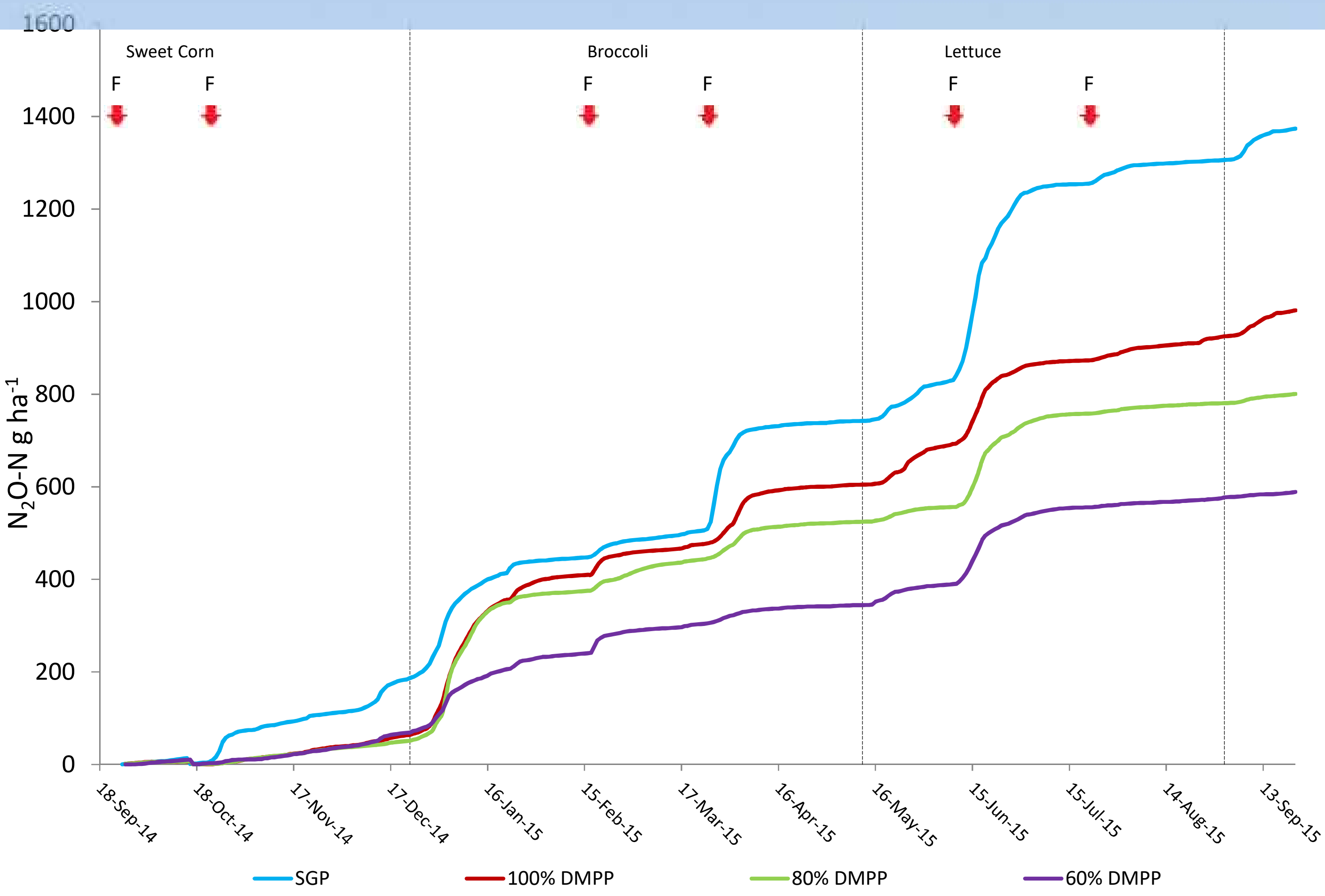
8 fluxes day^{-1} * 4 treatments* 3 replicates
>30,000 single N_2O flux measurements

Results

N_2O emission dynamics



Cumulative emissions



Summary

	Average N_2O Flux [g-N ha-^{1}day^{-1}]	Annual N_2O Flux [kg-N ha^{-1} year^{-1}]	Percentage of applied N
SGP	3.75	1.37	0.40
100% DMPP	2.68	0.98	0.29
80% DMPP	2.19	0.80	0.29
60% DMPP	1.62	0.59	0.29
Se	0.27	0.10	-
LSD **($p<0.05$)**	1.23	0.45	-

Total yield [t ha^{-1}]

Treatment	Sweet Corn	Broccoli	Lettuce
SGP	10.9	11.7	68.8
100% DMPP	11.7	11.5	65.8
80% DMPP	11.3	10.4	68.0
60% DMPP	11.3	9.4	61.9
SE	0.20	0.39	1.47
LSD	-	1.05	-

Conclusions

- Overall N_2O emissions from this sub-tropical vegetable cropping system were low (emission factors 0.29-0.40%).
- N input from vegetable crop residues incorporated into the soil after harvest can lead to substantially elevated N_2O emission.
- DMPP shows a great potential in reducing N_2O emissions from such an intensive vegetable system.
- The use of DMPP allowed for a reduction (40%) of N fertiliser rates (compared to the SGP) without affecting yield in two out of three crops.
- More long term studies are required to determine long term effect reduced rates of DMPP fertiliser for different crops.


Thank You!