Quantifying the contribution of plants and soils to CH_4 fluxes and net seasonal N_2O emissions in an agricultural wetland

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The Delta

- Tidal marsh drained for agriculture in 1800's

http://www.sitesatlas.com/Flash/USCan/static/CAOF.htm

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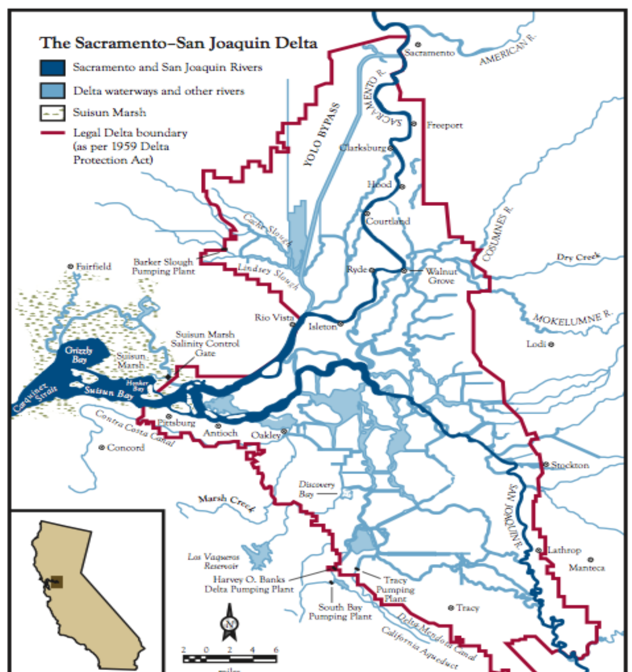

http://users.humboldt.edu/ogayle/hist383/DebateBay-DeltaEcosystem.html

The Delta

- Tidal marsh drained for agriculture in 1800's
- Supplies water for 25 million people, supports $2 billion agriculture industry, and crucial wildlife habitat
- Soil subsidence of organic soils caused by drainage and agricultural use has resulted in health, safety, environmental, and economic concerns

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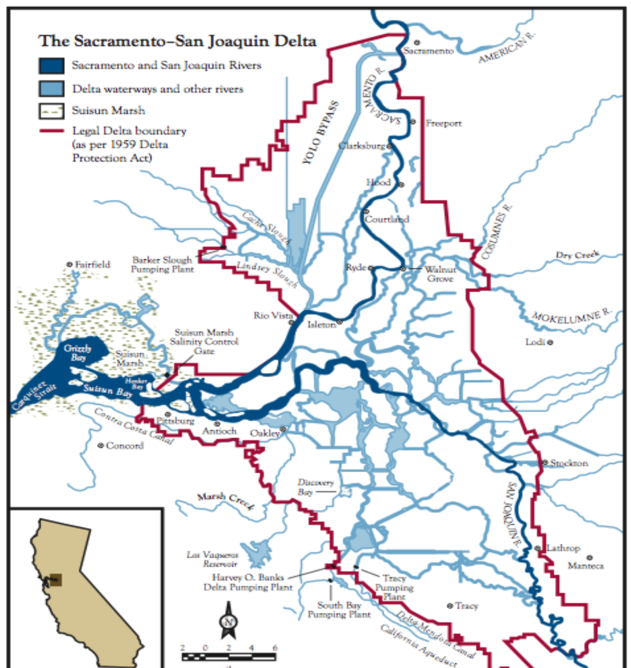


http://users.humboldt.edu/ogayle/hist383/DebateBay-DeltaEcosystem.html

http://ca.water.usgs.gov/projects/central-valley/land-subsidence-monitoring-network.html

Rice as a solution?

- Flooded conditions mimic Delta formation
- Potential to reverse or mitigate soil subsidence
- Wildlife habitat
- Anaerobic conditions favorable for methane emission
- Methane contributes to global climate change

Questions

What is the net contribution of living rice plants to CH_4 emission and subsurface carbon pools?

How does nitrogen management affect carbon cycling in the Delta rice system?

Pulse Labeling Experiment

Stable Isotope Label

- 99.9 atom% $^{13}CO_2$
- Two events- each lasting 14 days

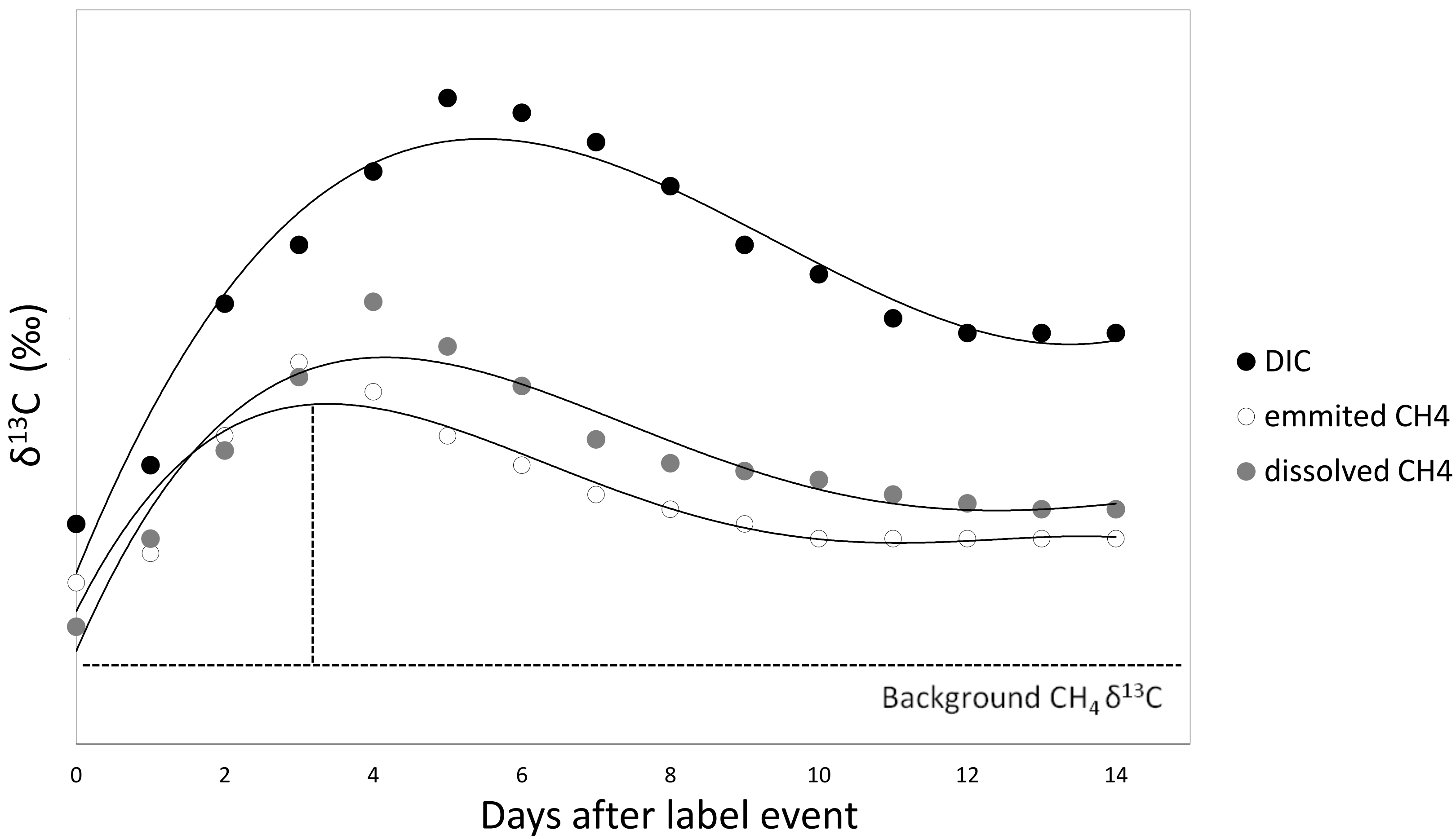
Measurements

- CH_4, N_2O emissions
- Pore water (0-10 cm depth): DIC, DOC, porewater CH_4 (pCH_4)

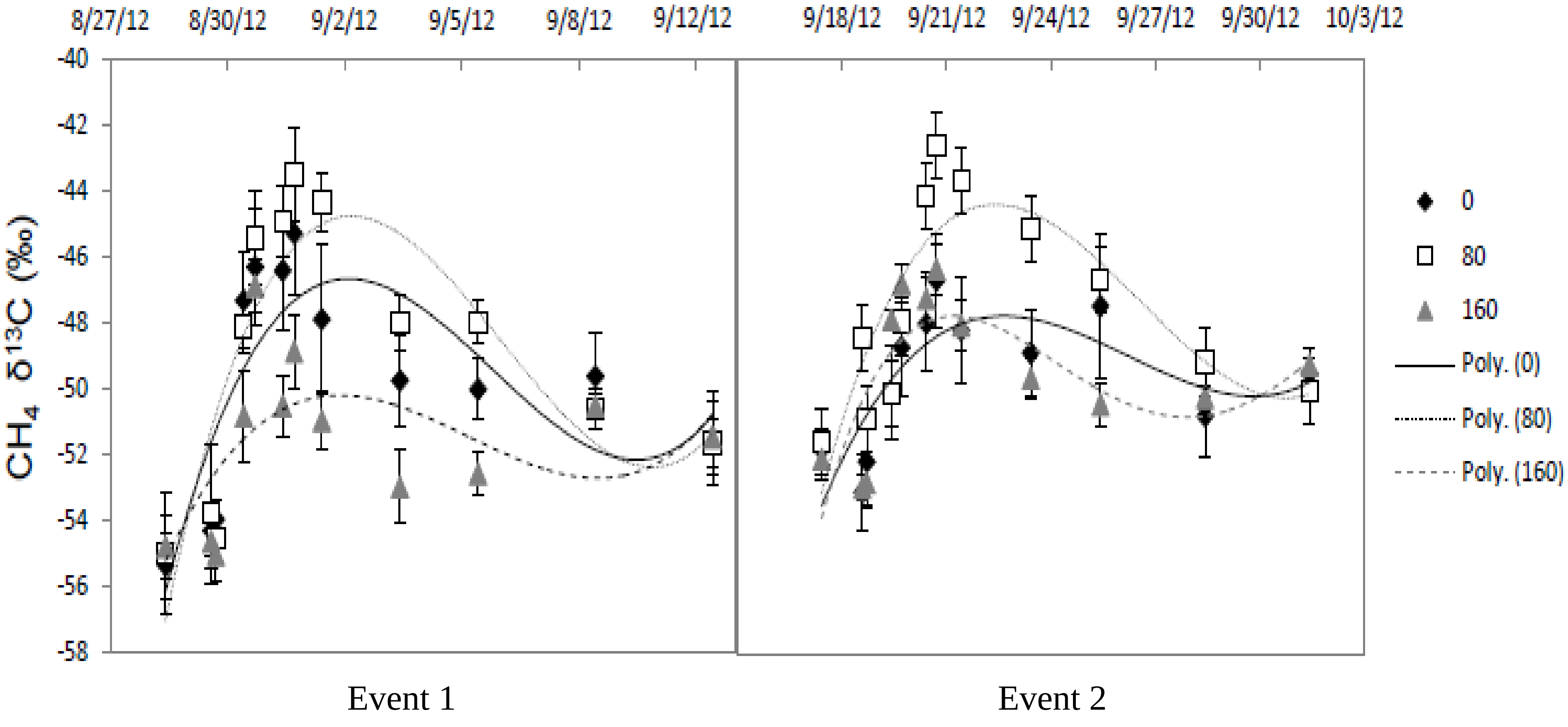
N Treatments

- Three treatment rates: 0, 80, and 160 kg N/ha

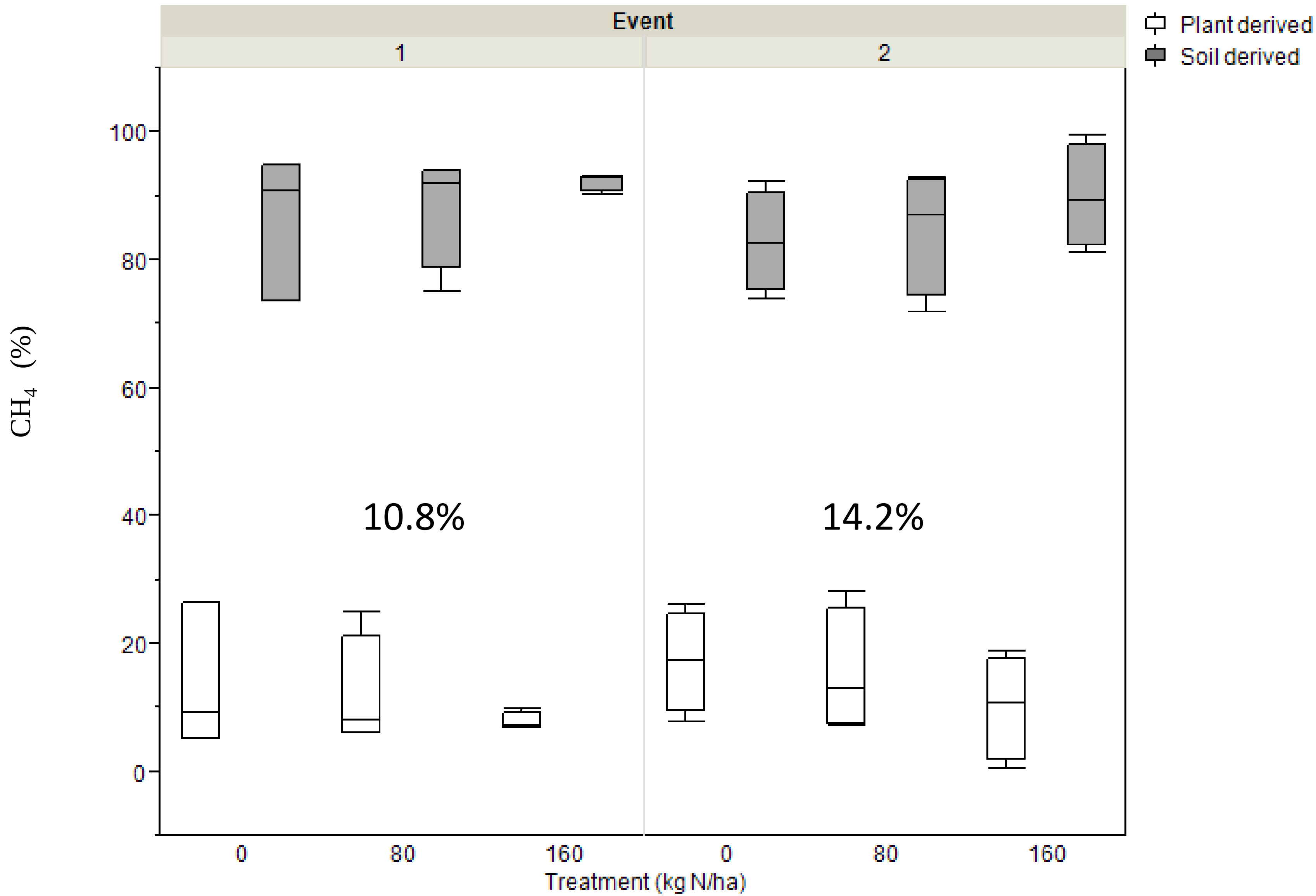
Expected response to label over time



Actual response: Emitted CH_4

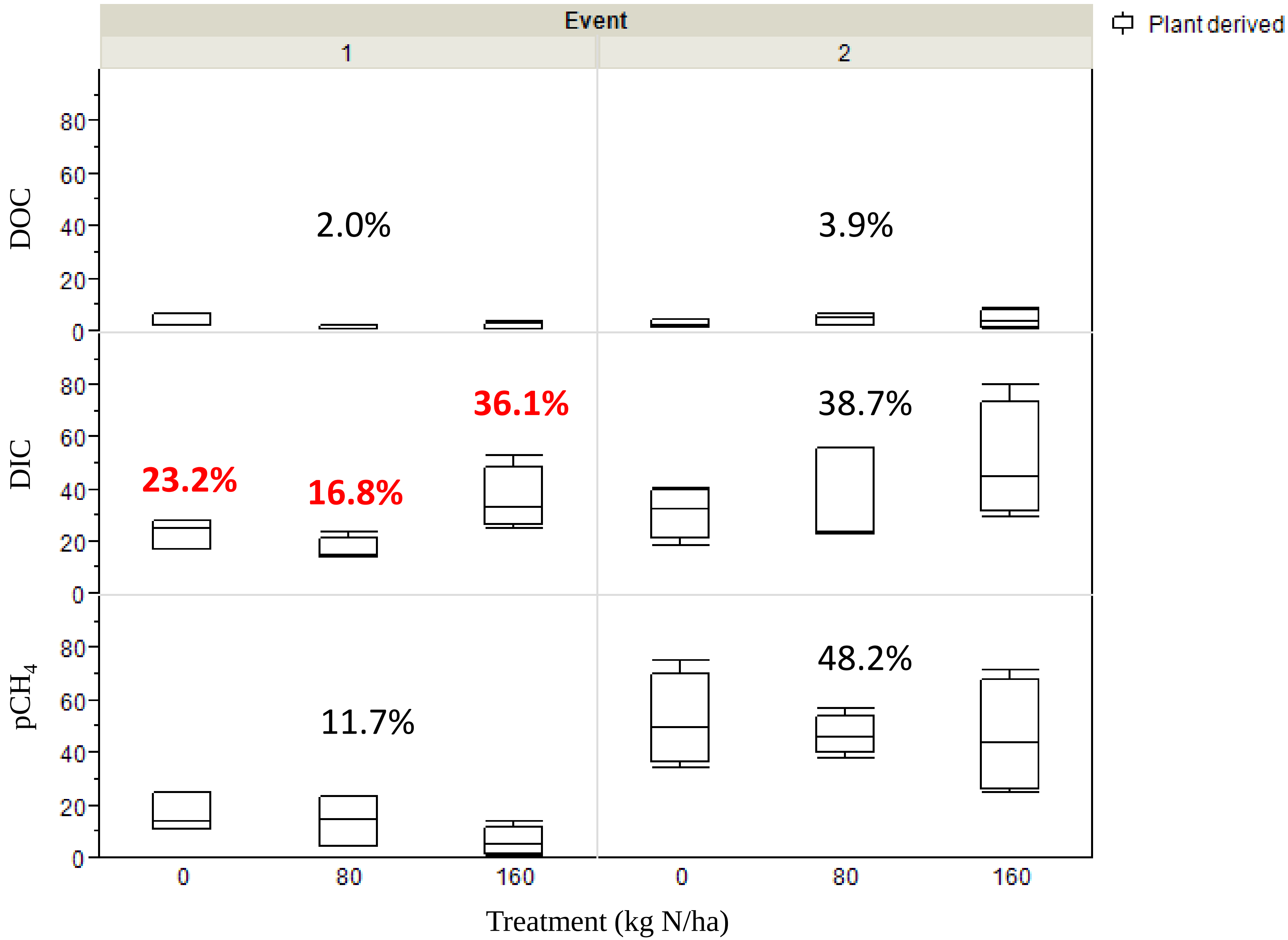


CH_4 source

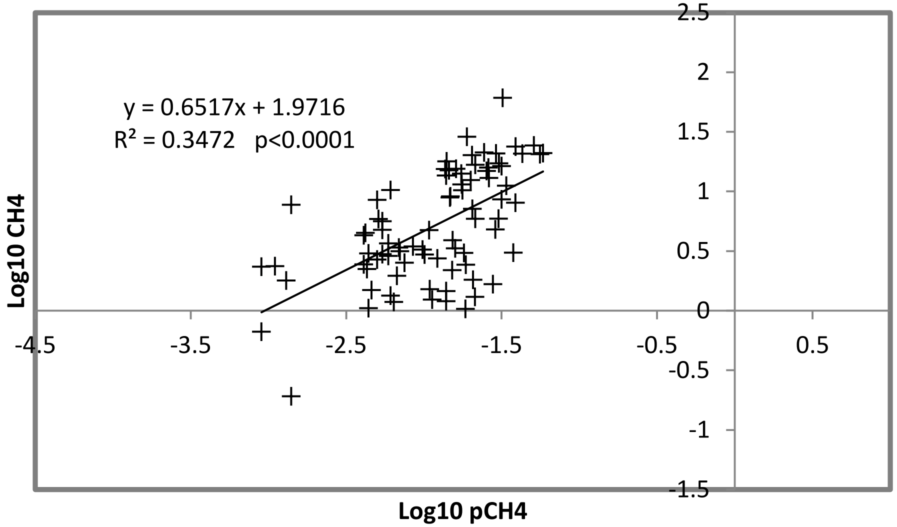


Event
1
2
Plant derived
Soil derived
100
80
60
40
20
0
CH4 (%)
10.8%
14.2%
0
80
160
0
80
160
Treatment (kg N/ha)

Dissolved C pools source

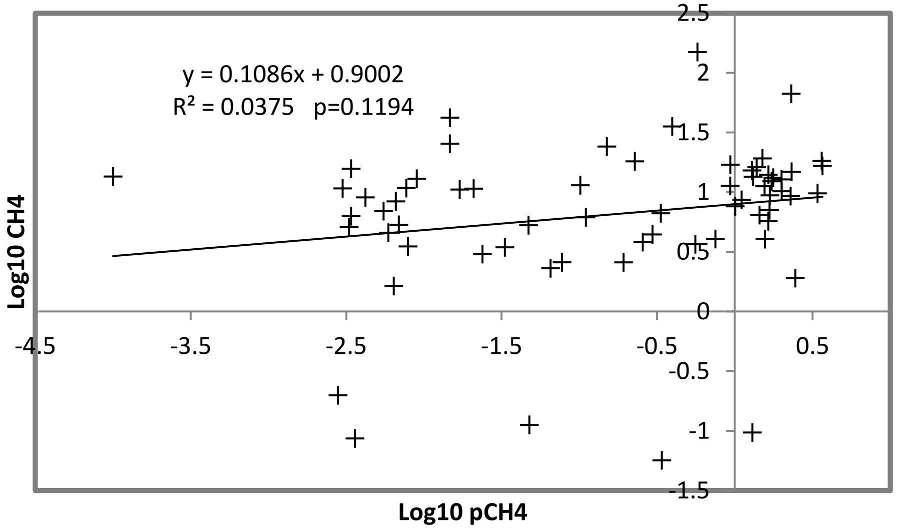


Emitted CH_4 and pCH_4



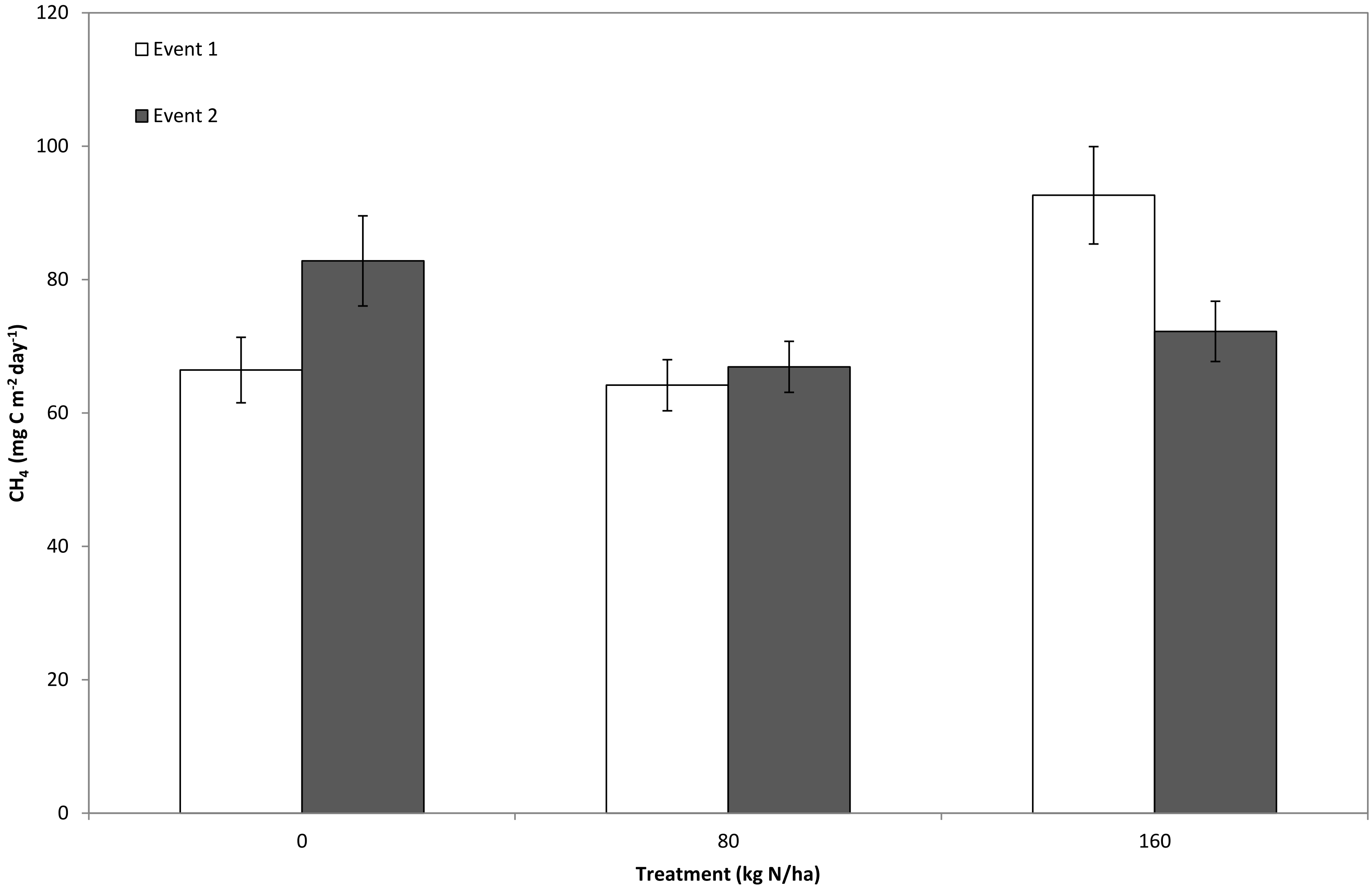
Recent plant contribution

pCH_4: 11.7% CH_4: 10.8%

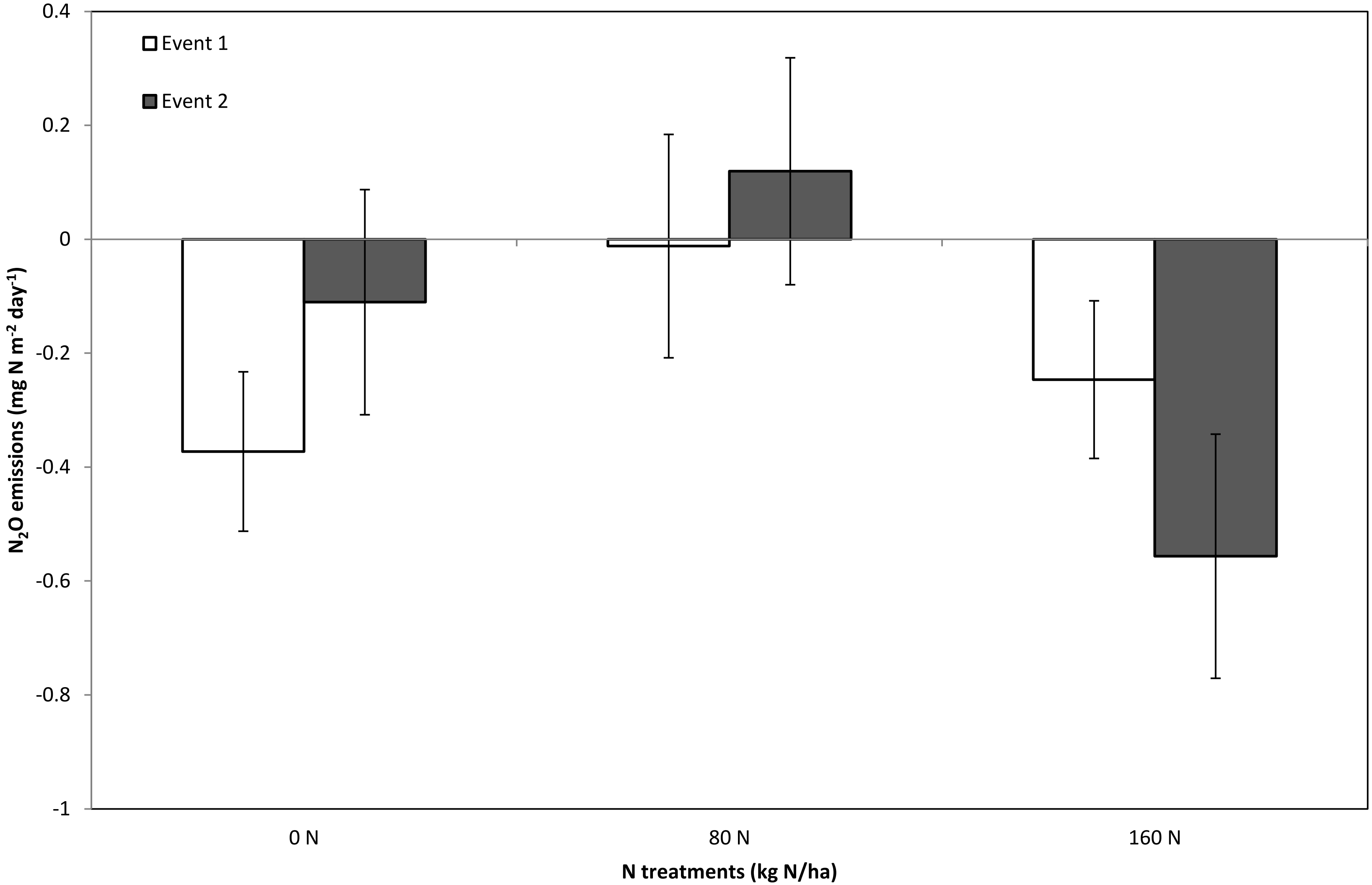


pCH_4: 48.2% CH_4: 14.2%

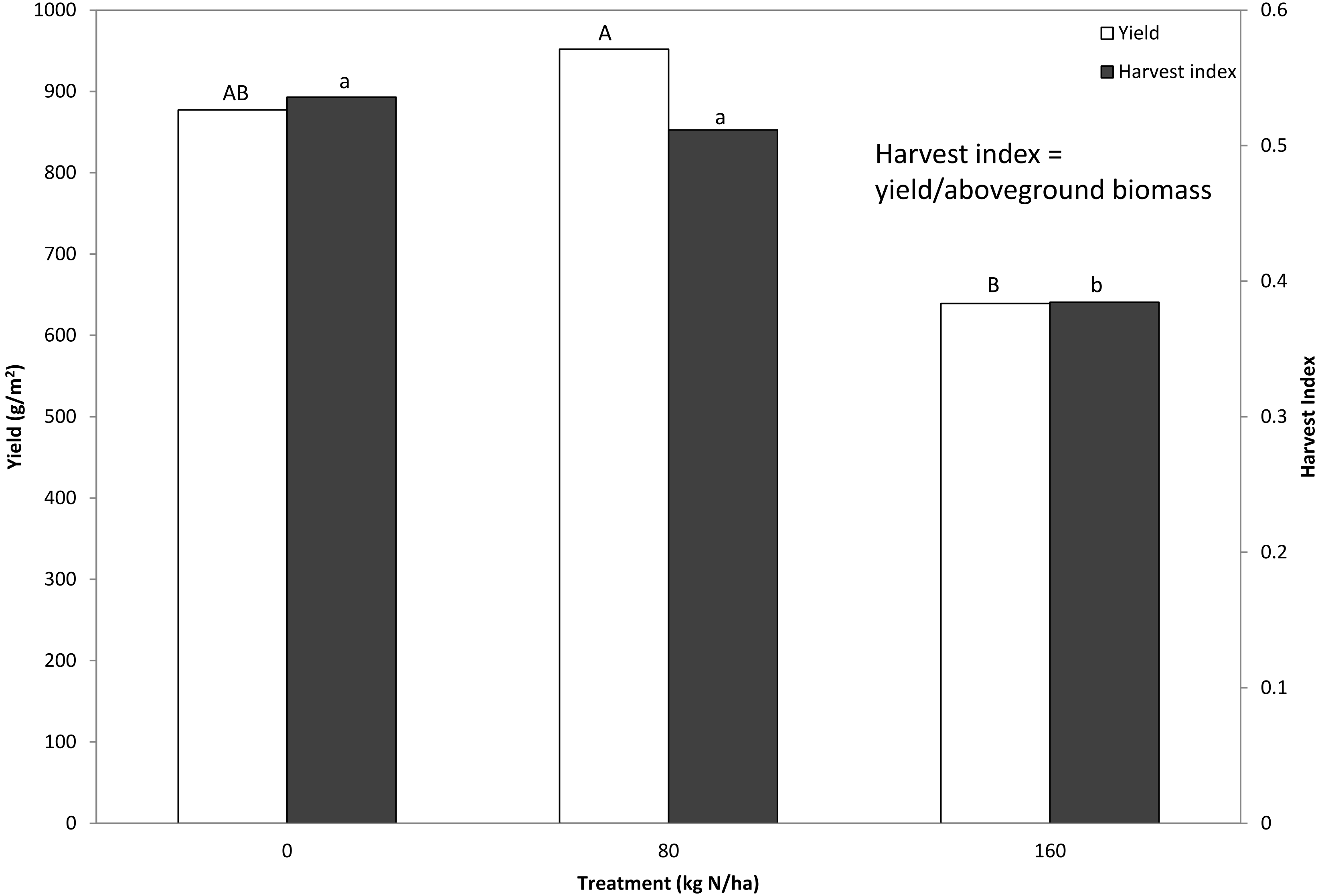
Average CH_4 emissions



Average N_2O emissions



Yield and harvest index response



Conclusions

- CH_4 emissions averaged 73.5 mg C m^{-2} day^{-1} with recent plant photosynthates contributing around 12.6%
- We saw N_2O consumption, with average uptake of -0.199 mg N m^{-2} day^{-1}
- There was no response to N rates on CH_4, N_2O, or plant contributions (except DIC, event 1)
- Yield and harvest index declined at highest N rate

Acknowledgements

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Thank you. Questions?