First year observations in tall fescue fields under conventional and enhanced efficiency fertilization: seed yield, groundwater nitrate and greenhouse gases

Optimizing Grass Seed Production in the Southern Willamette Valley: Protecting Groundwater and Air Quality

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Research jointly funded by:
USDA – NRCS Oregon Conservation Innovation Grant
Oregon Department of Agriculture Fertilizer Grant

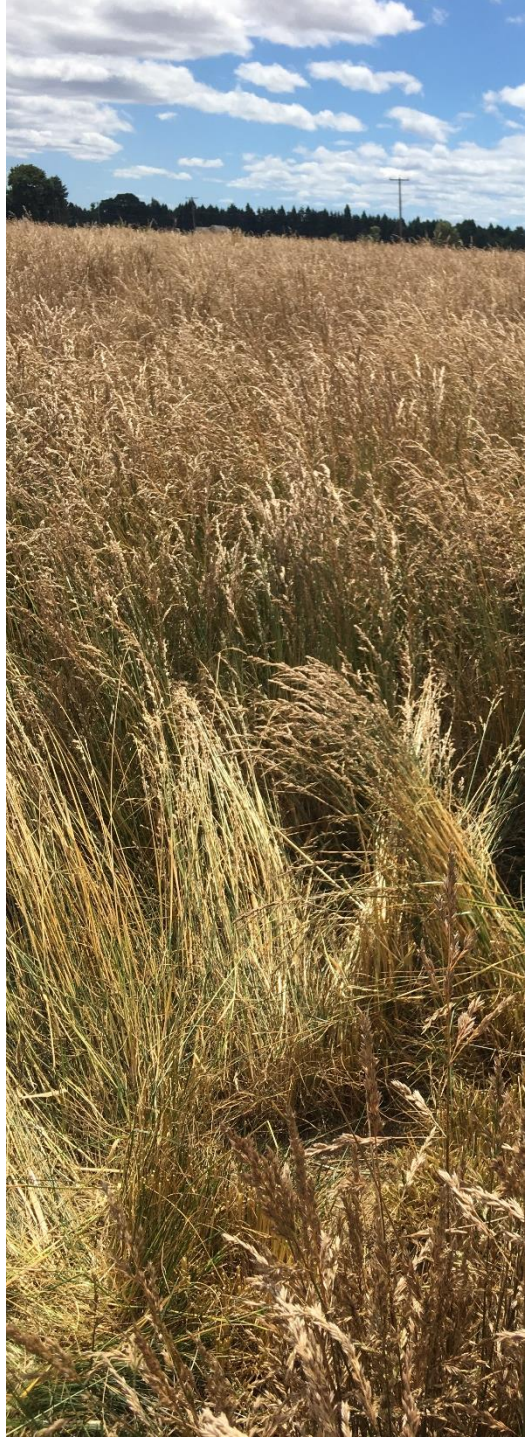
Project scope

- *ODA Grant*: comparing conventional and enhanced efficiency fertilizers
- *USDA Conservation Innovation Grant*: 0-100% of conventional fertilizers

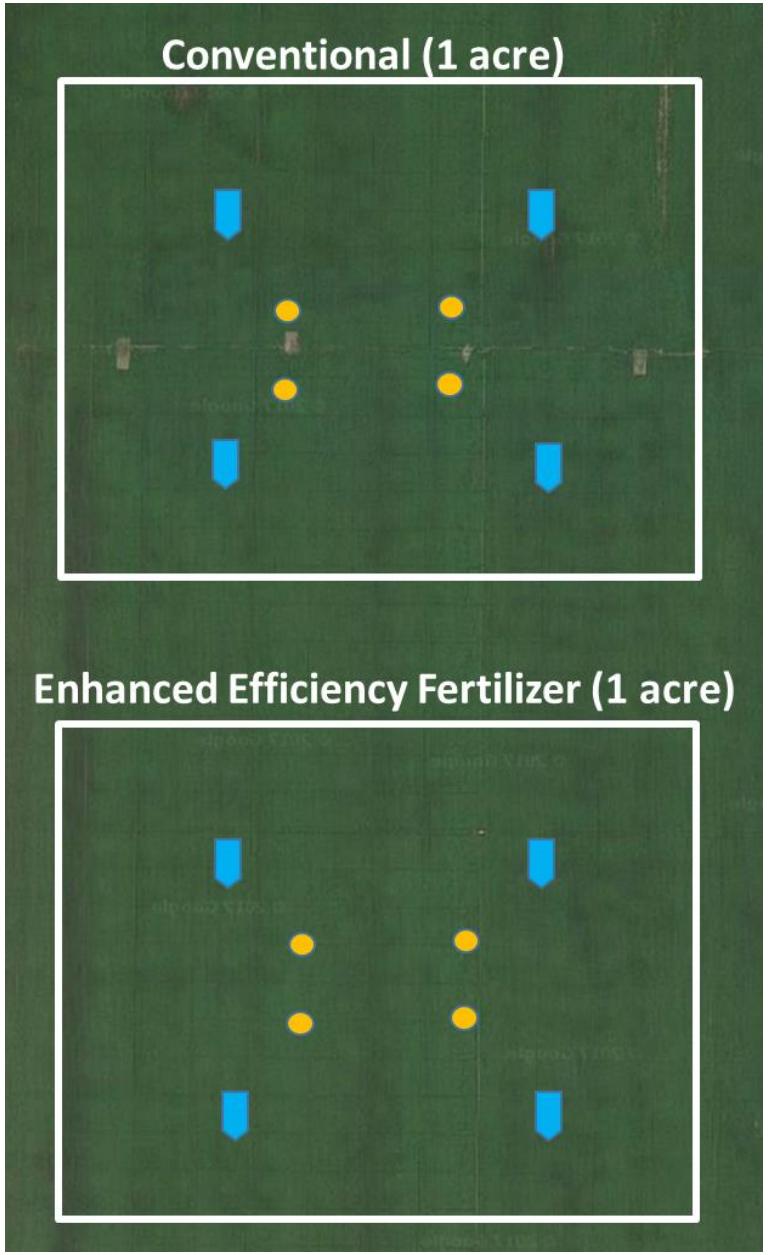
To assess ground water nitrogen leaching and nitrous oxide gas emissions from tall fescue crops

Why? To address the groundwater nitrate problem and the release of greenhouse gases into the atmosphere.

Hypothesis for ODA Grant: Increased efficiency fertilizer will be released more slowly, keeping more nitrogen available for plant uptake and losing less to groundwater and the atmosphere



Experimental Design



4 sites in contrasting soil types

- 1 acre conventional fertilizer
- 1 acre enhanced efficiency fertilizer
- EF fertilizer applied at same rate & time as conventional practice by each grower

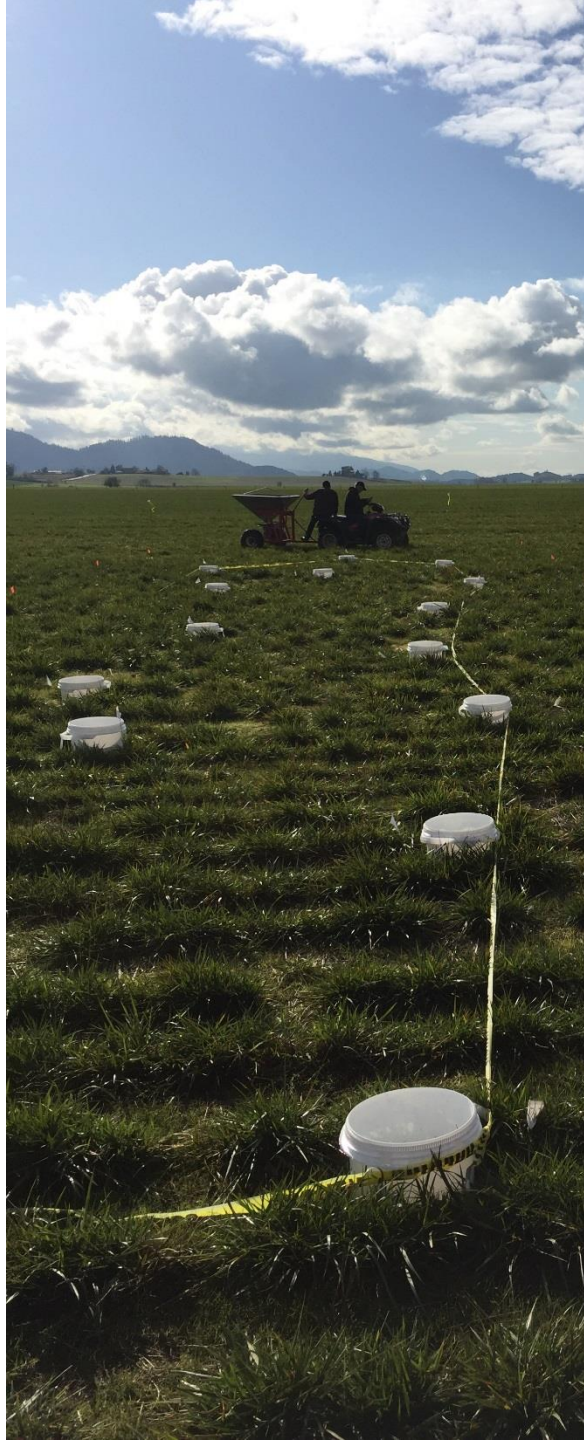
Measurements

- 4 lysimeters – NO_3^- and NH_4^+ in groundwater
  - installed in Spring 2018
- 4 gas flux chambers – N_2O and CO_2 emissions
  - installed in Fall 2017
- Sampled twice per month

Questions

How do different fertilizers affect:

1) groundwater N levels;
2) greenhouse gas emissions;
3) seed yield in tall fescue fields?



General soil characteristics

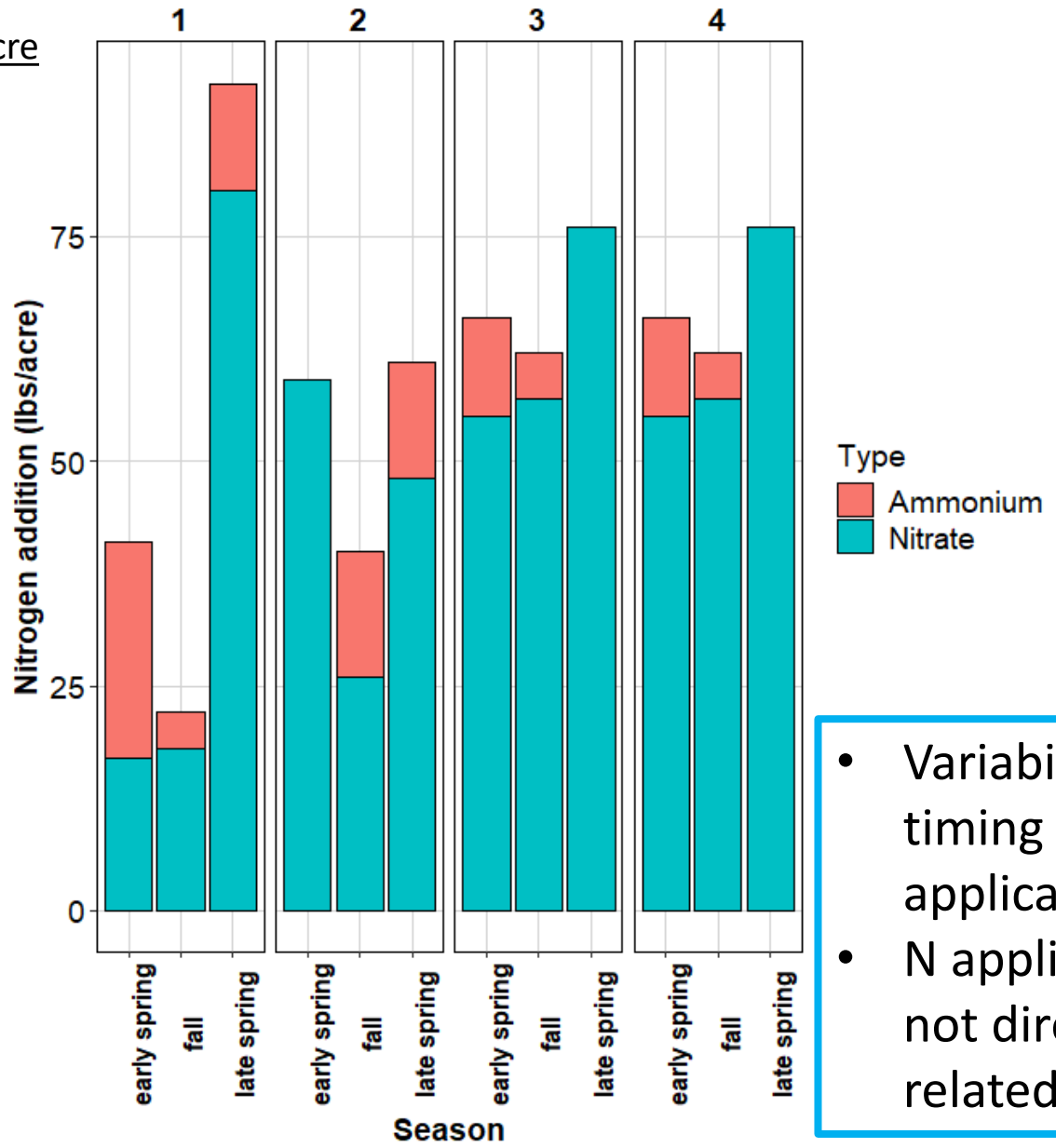
Field	Soil type[1]	Year planted	Soil moisture [%]	pH	Organic C [%]
1	Holcomb silt loam	2016	5.86	5.26	2.64
2	Malabon silty clay loam	2013	9.76	6.47	2.58
3	Salem gravelly silt loam	2016	6.11	6.06	2.52
4	Malabon silty clay loam	2016	8.16	6.15	2.64

[1]NRCS Web Soil Survey

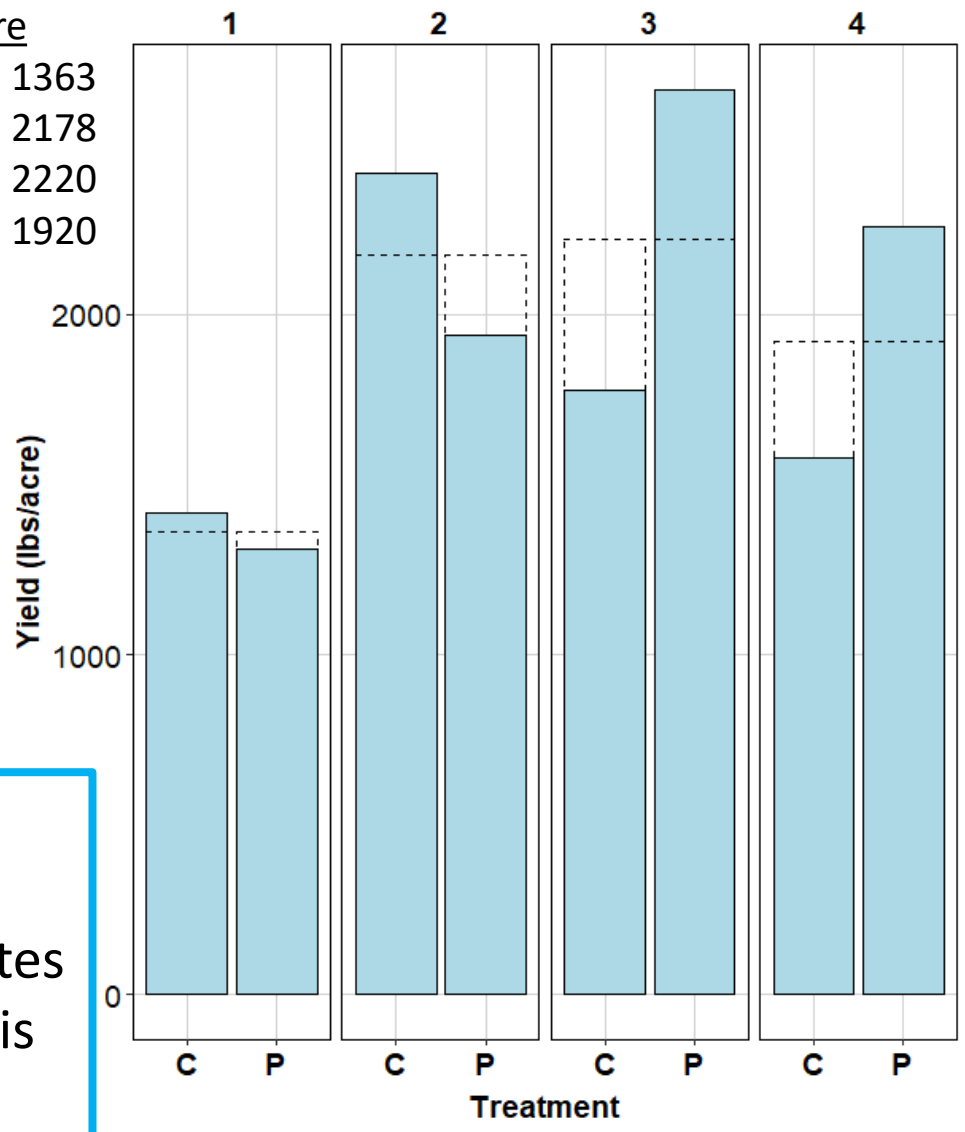
- Variability in summer soil moisture and pH likely reflects differences in soil type

Year 1 fertilizer additions and seed yield

Total lbs N/acre
Field 1 = 155
Field 2 = 160
Field 3 = 204
Field 4 = 204

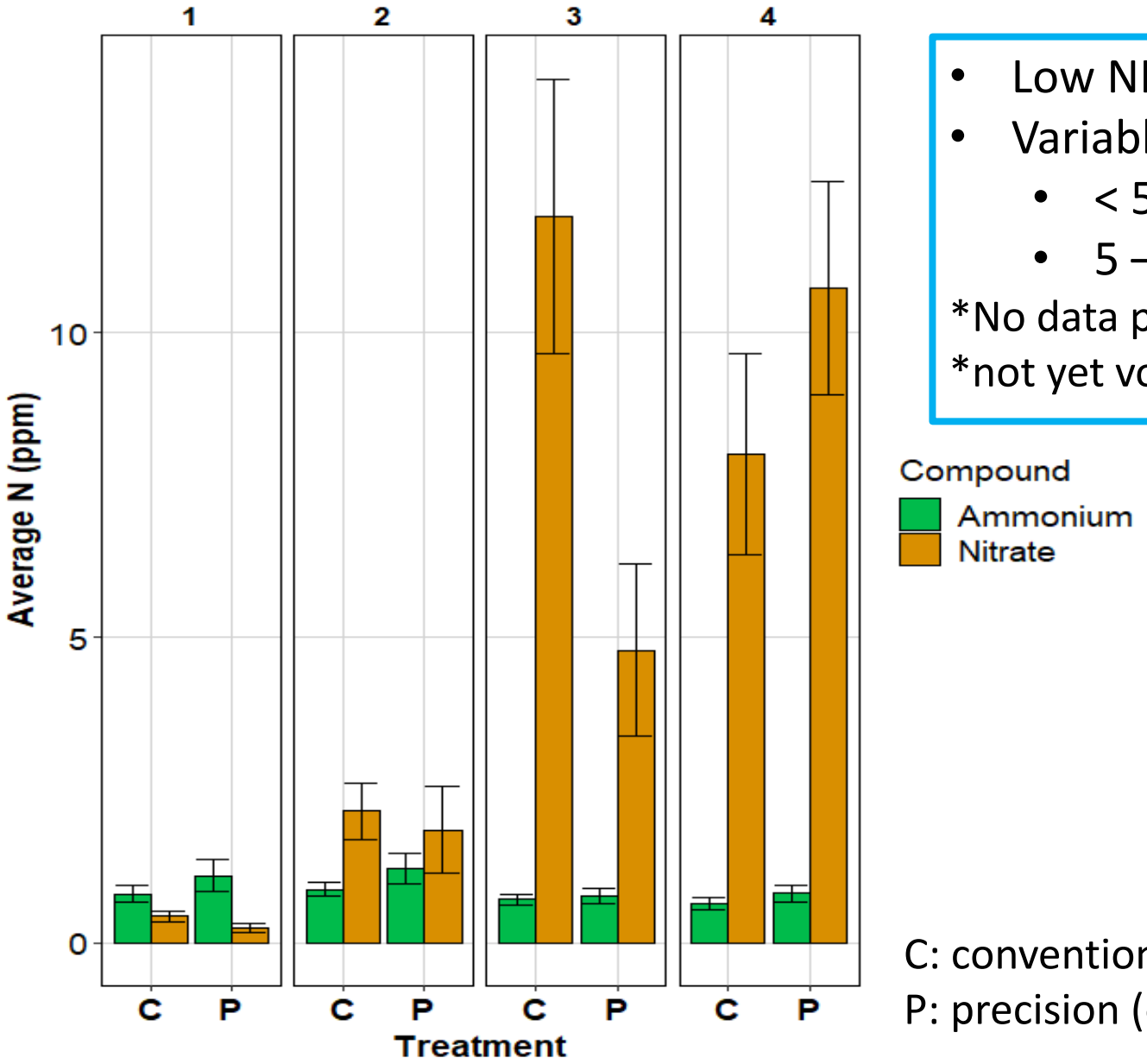


Average lbs seed/acre
Field 1 = 1363
Field 2 = 2178
Field 3 = 2220
Field 4 = 1920



- Variability in timing and N application rates
- N application is not directly related to yield

Year 1 average nitrogen concentrations in groundwater



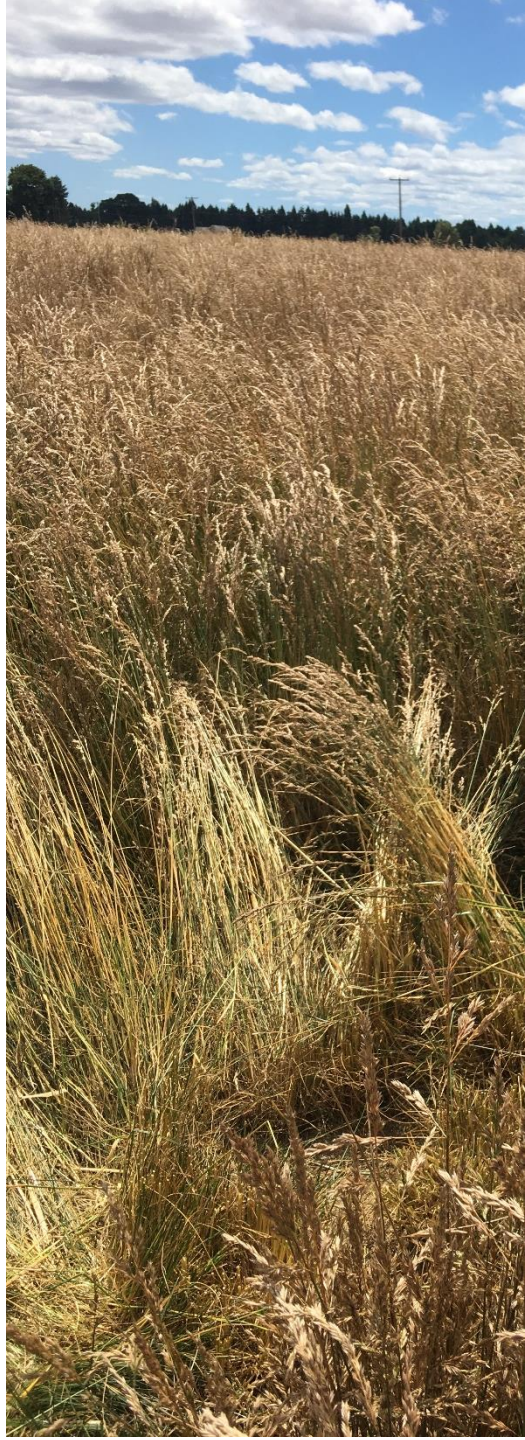
- Low NH_4^+ concentrations
- Variable NO_3^- concentrations
  - < 5 ppm in 2 fields
  - 5 – 10 ppm in 2 fields

*No data prior to March 2018

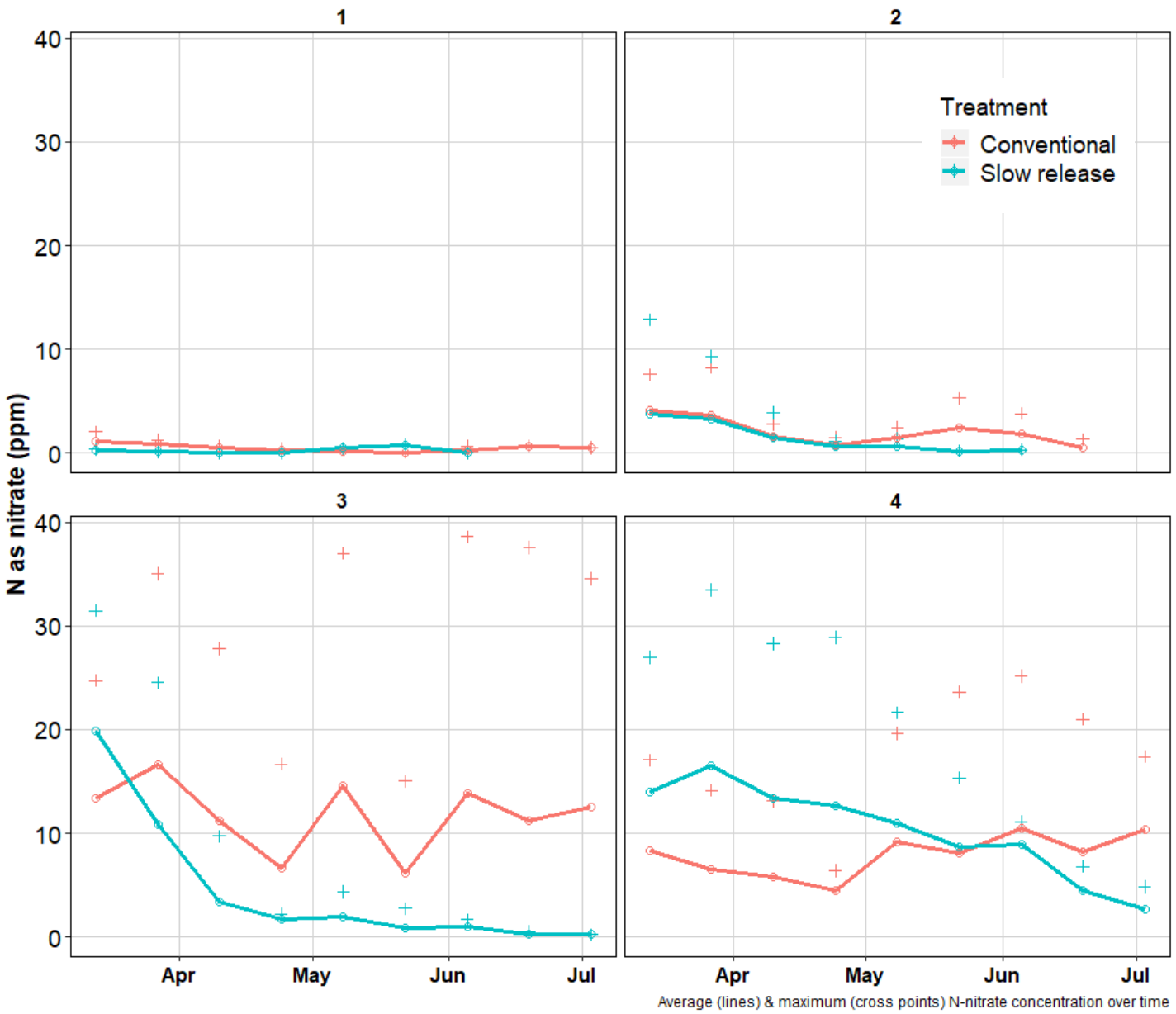
*not yet volume-weighted

C: conventional

P: precision (enhanced efficiency)



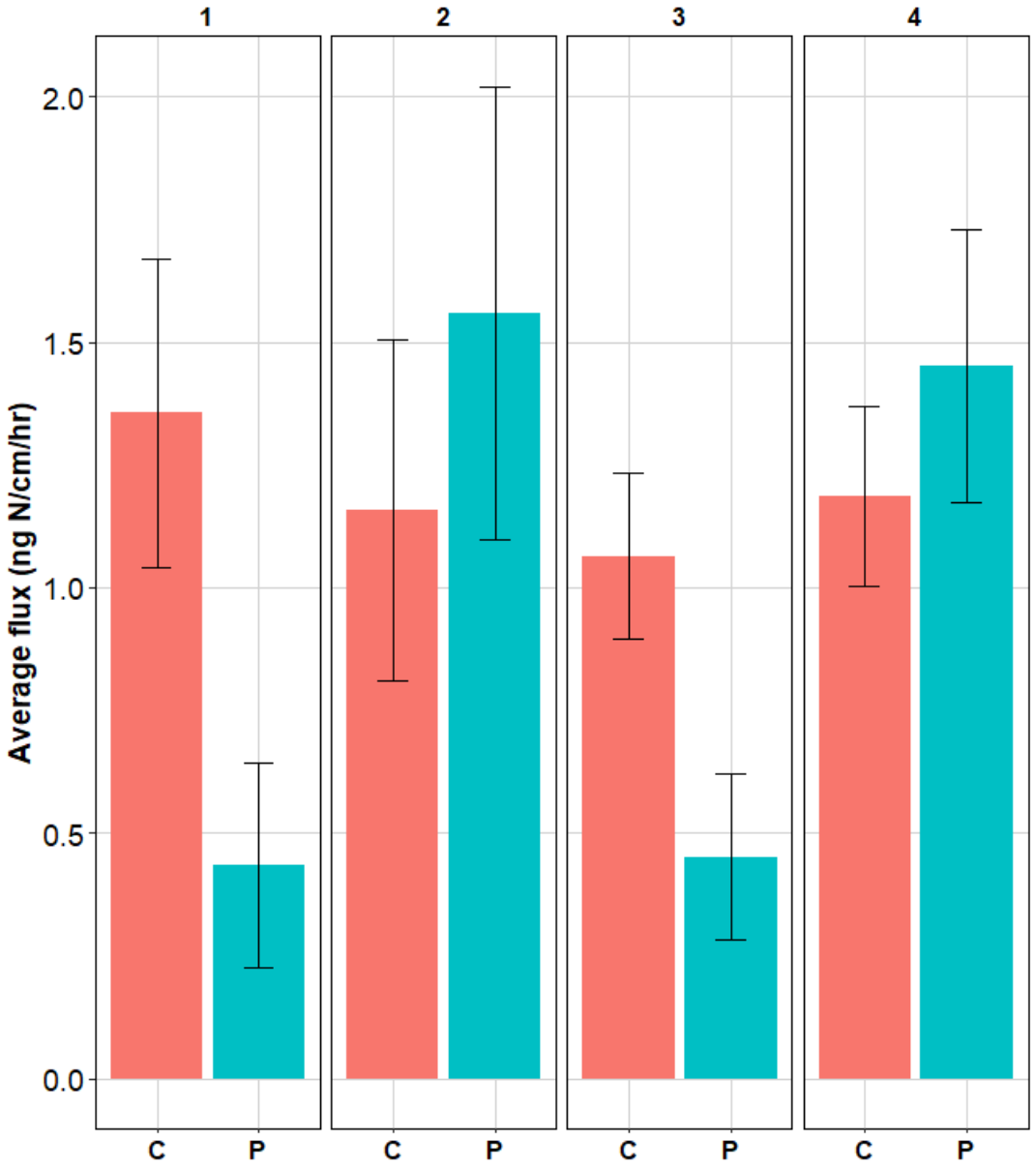
Year 1 nitrate (NO_3^-) in groundwater over time



- Low NO_3^- concentrations in two fields
- Variable and high NO_3^- concentrations in two fields
  - Up to 30-40 ppm N in individual lysimeters
- No clear pattern related to fertilizer treatment

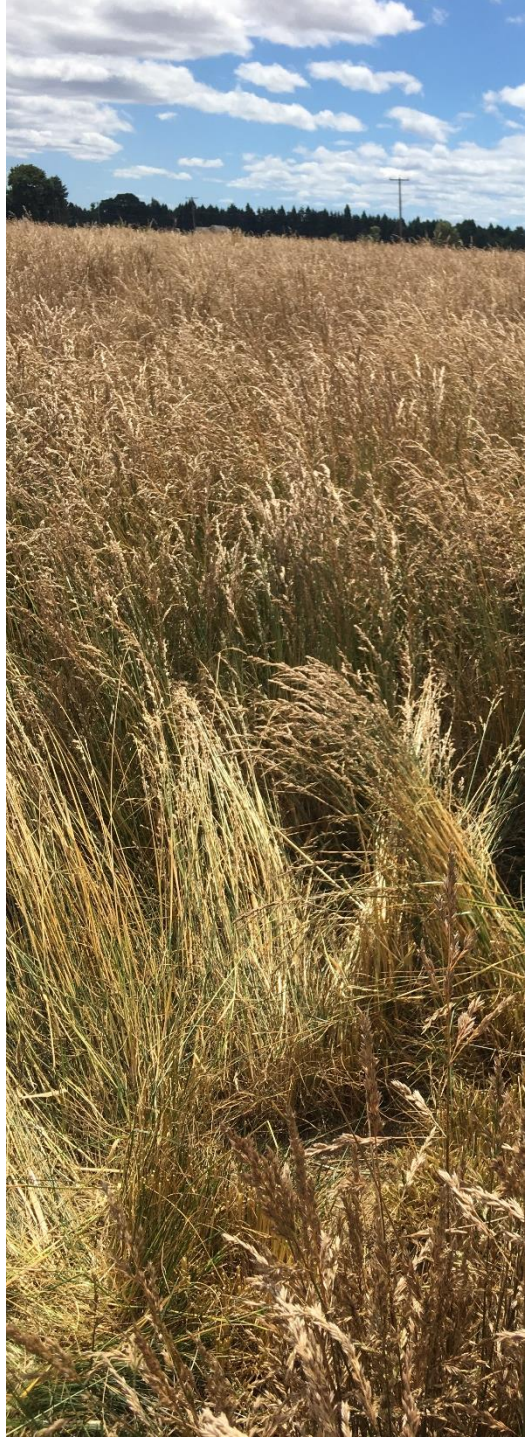
*No data prior to March 2018
*not yet volume-weighted

Year 1 average nitrous oxide (N_2O) flux



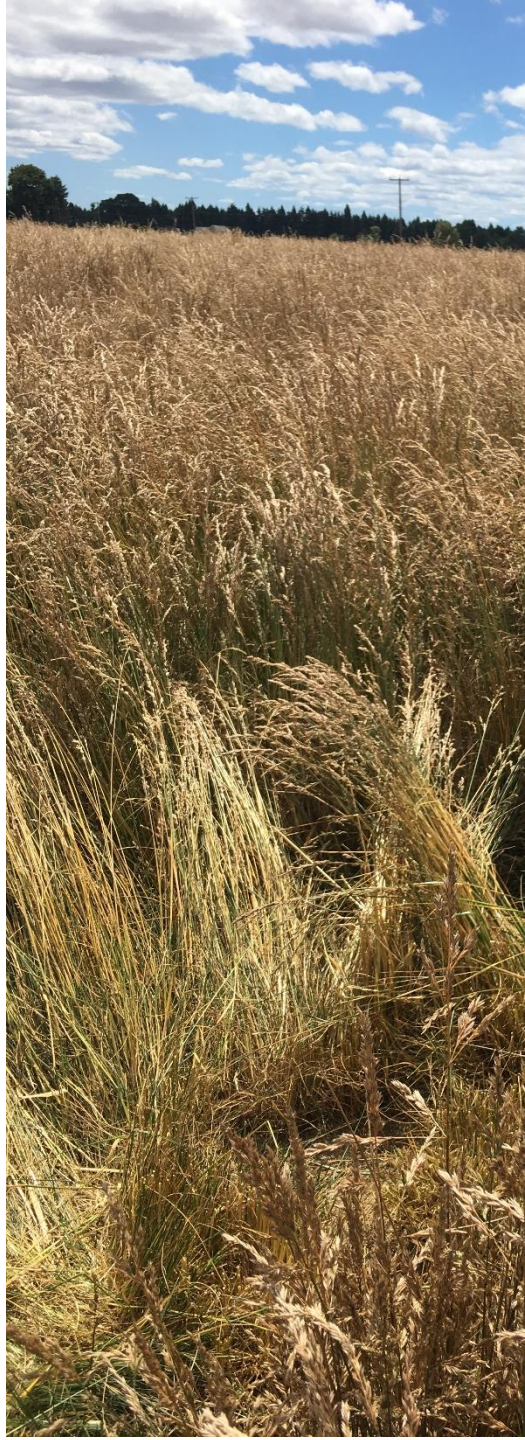
- No robust pattern across all fields
- Two fields had higher emissions under conventional fertilizer
- Two fields had no significant difference between treatments

Treatment
Conventional
Slow-release

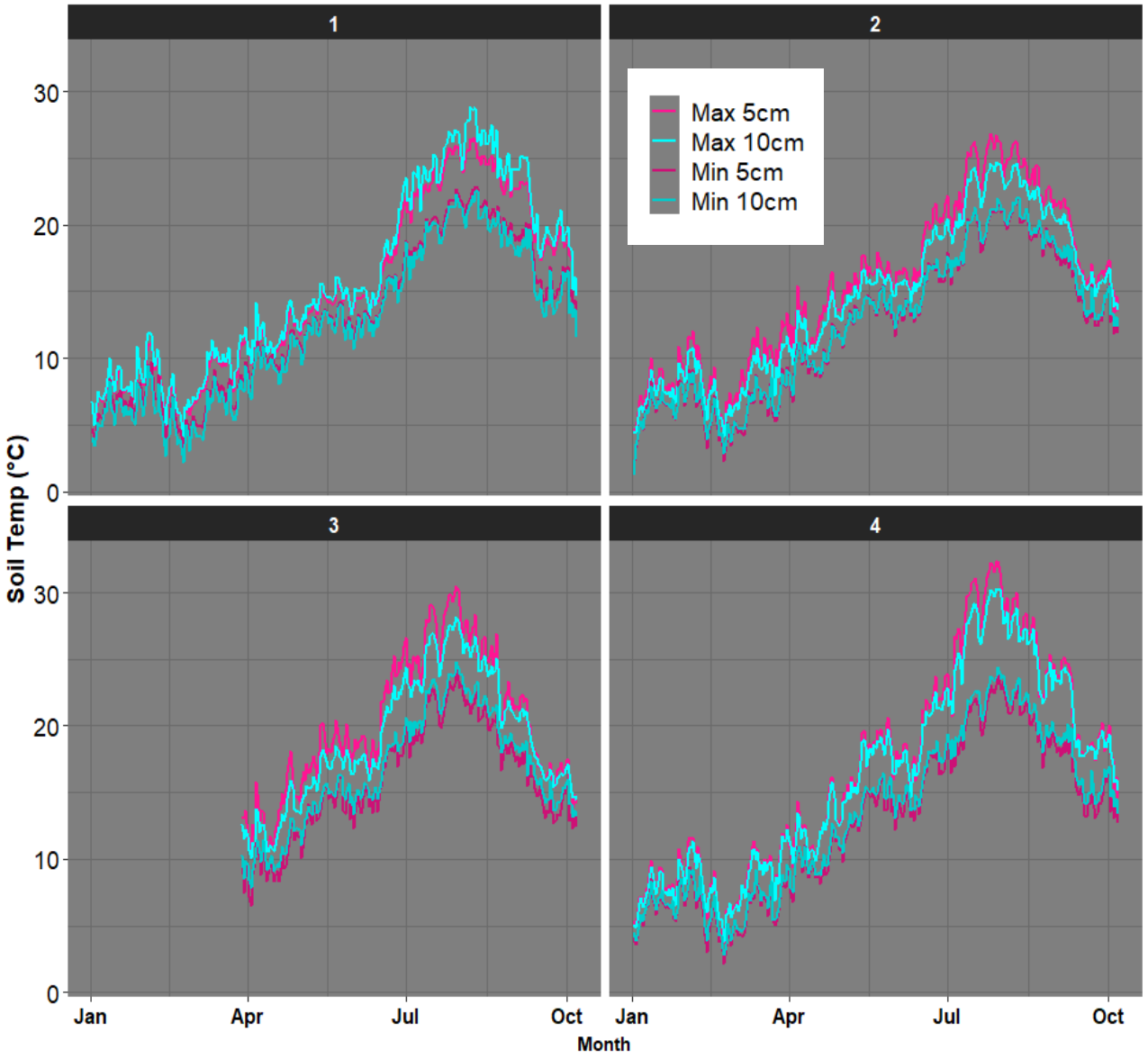


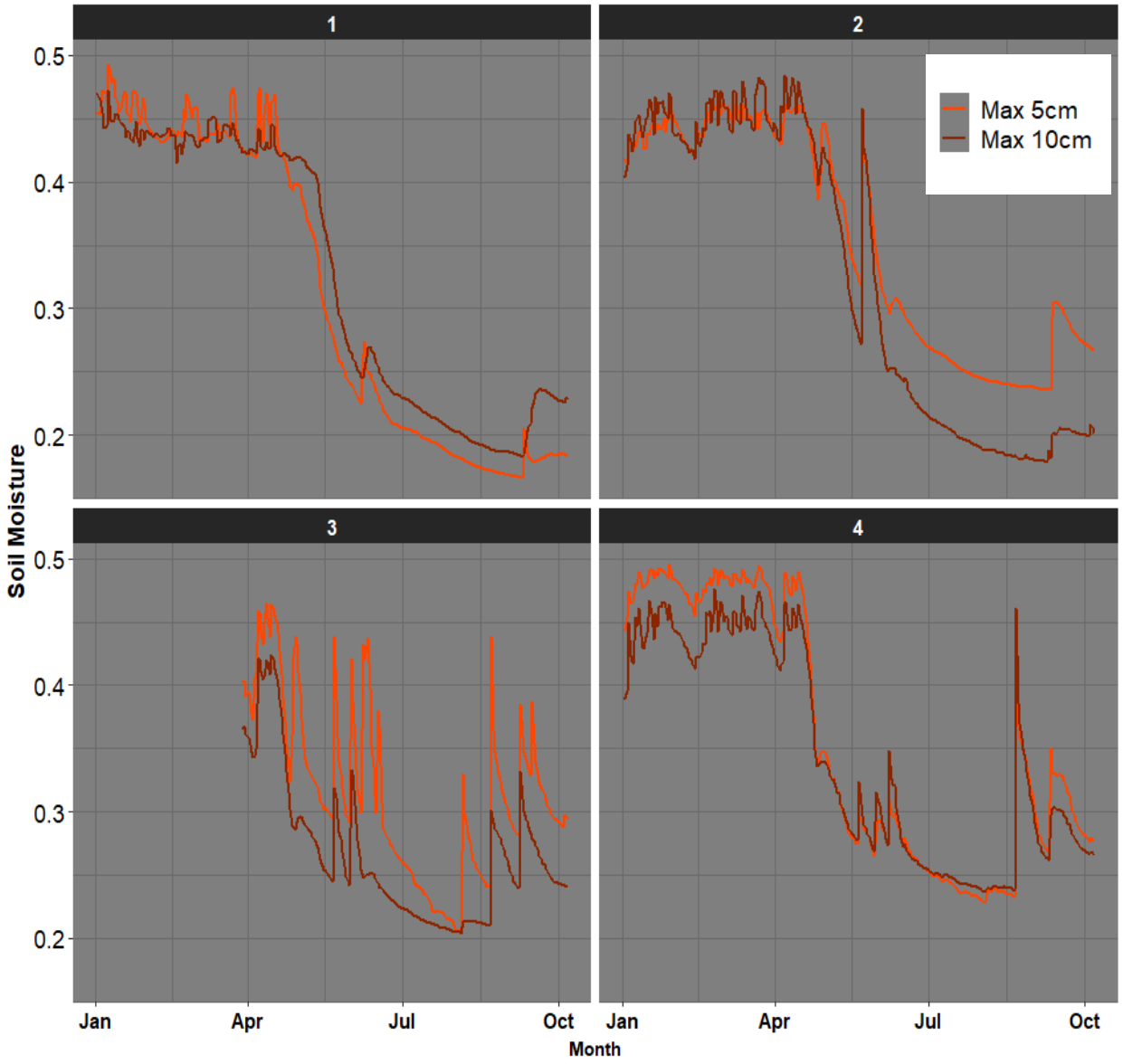
Year 1 average nitrous oxide (N_2O) flux over time

- No clear differences between treatments
- Fluxes were higher under warming/ drying conditions in spring



Year 1 soil temperature and soil moisture





Conclusions:

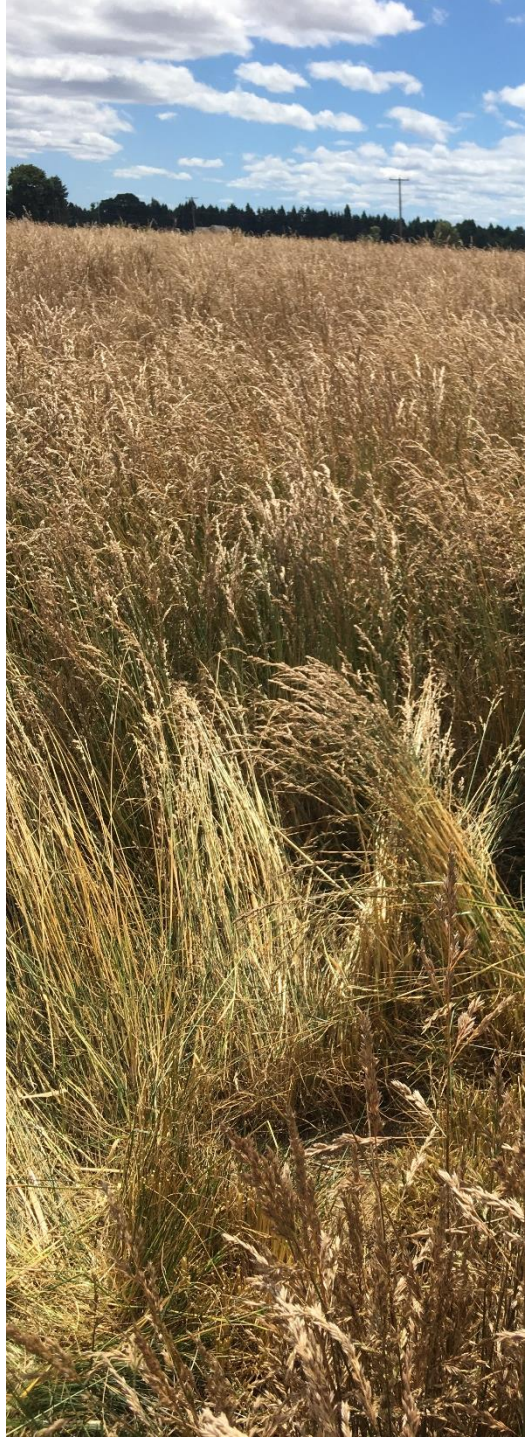
- Inherent differences in soils between different fields
- Different fertilizer practices (amount, timing, form) between different fields

→ Inconsistent responses to fertilizer treatments across all fields

  → This is useful! We didn't set out to exactly replicate the treatments in four farm fields, we intentionally chose different sites to see the range of responses to these treatments across the GWMA

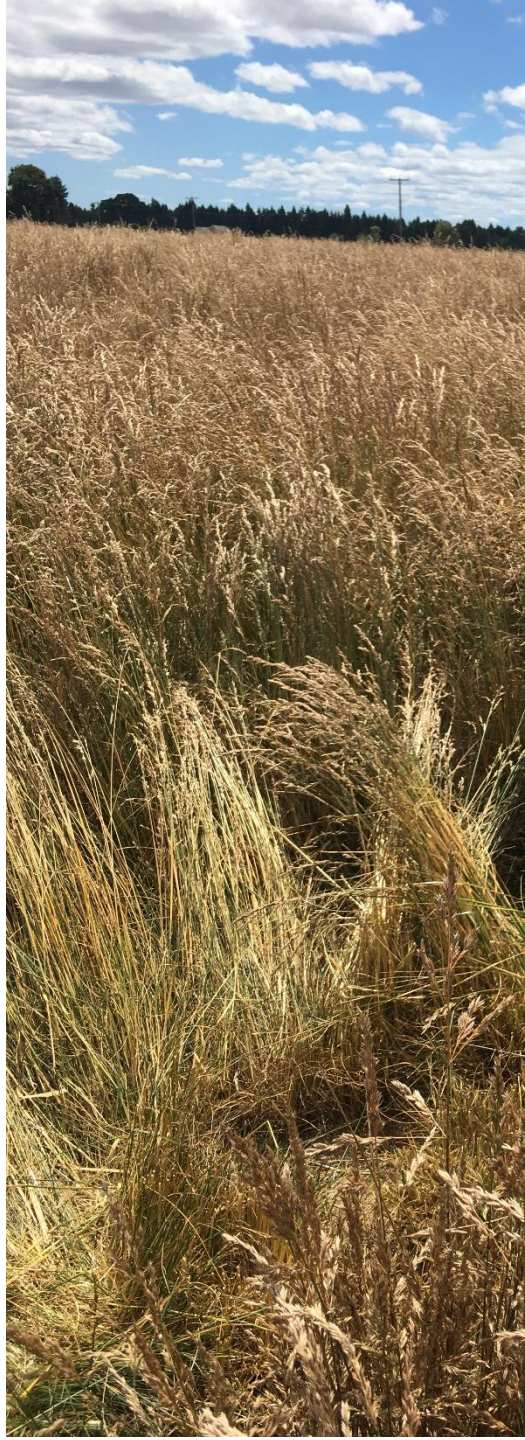
→ Same amount of N in conventional and EF fertilizer treatments:

  → Maybe any differences in NO_3^- leaching or N_2O emissions will be more pronounced in year 2 of experiment?



Next steps:

- Continue sampling groundwater and gases every two weeks
- Continue to build a statistical model incorporating environmental data to determine effects of soil moisture and temperature on nitrate leaching and nitrous oxide emissions
- Use soil moisture and rainfall data to determine the water budget for each field
- Compile harvested biomass data and create a system nitrogen budget to account for all nitrogen fates



Thank you:

- Growers and field crews, business partners and operators
- PSU, OSU and EPA field and lab technicians, volunteers, and project partners

Project partners

GWMA GROUND WATER MANAGEMENT AREA

Oregon State UNIVERSITY Extension Service

DEQ State of Oregon Department of Environmental Quality

USDA

Portland State UNIVERSITY

BENTON SOIL AND WATER CONSERVATION DISTRICT

Oregon Department of Agriculture

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