ADVANCES IN AGRICULTURAL PRACTICES TO ADDRESS GHG MITIGATION AND CARBON SEQUESTRATION

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CALIFORNIA-NETHERLANDS WEBINAR

CLIMATE SMART AGRICULTURE: SOIL MANAGEMENT

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Objectives

- Mitigating N_2O emissions in agriculture thru micro irrigation practices
  - Subsurface drip reduces N_2O emissions
    - Tomatoes
    - Dairy
- Assessment and potential for soil carbon sequestration opportunities
  - Sequestration rates optimistic
  - Where would the nitrogen come from to sequester soil carbon?

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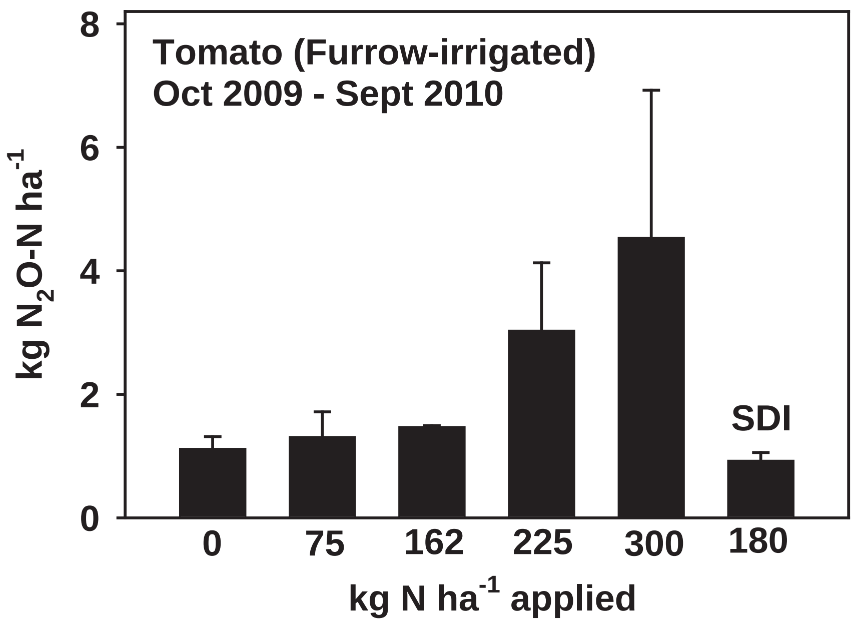
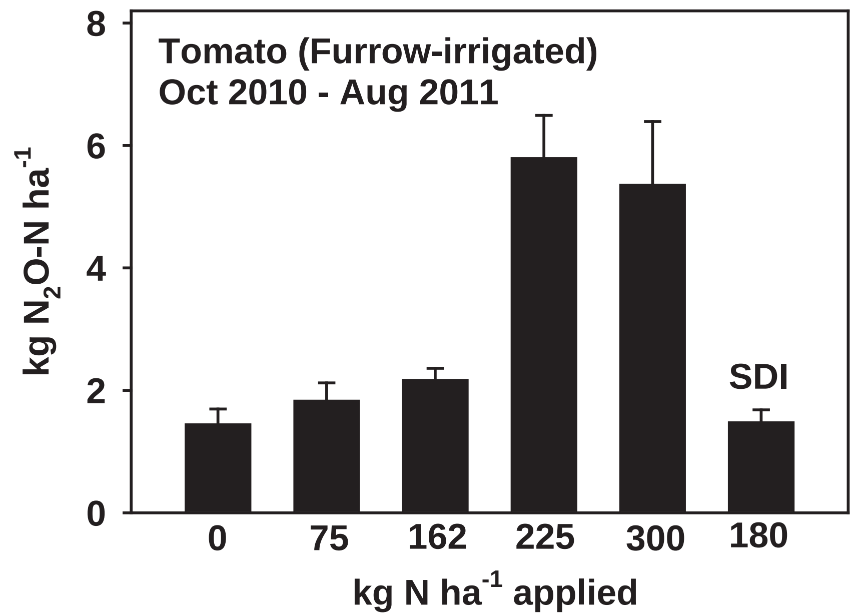
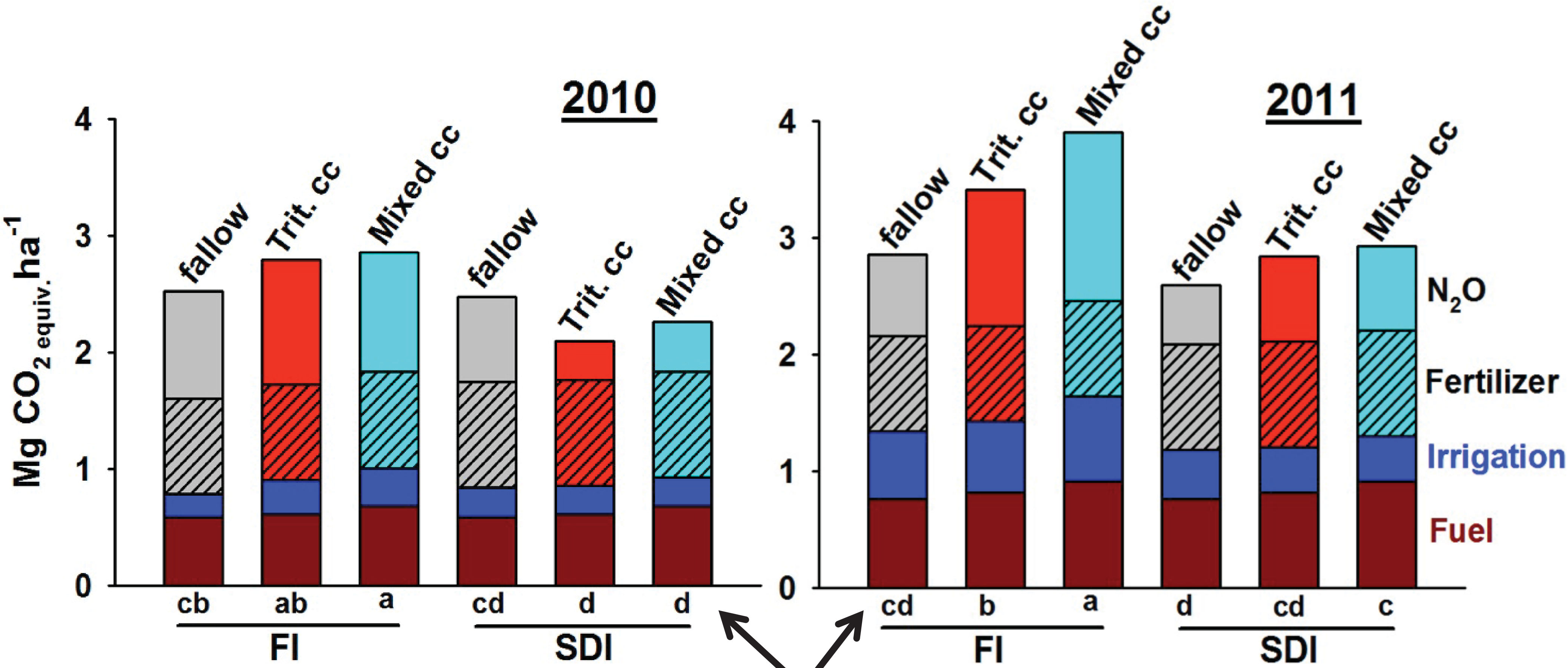
Processing Tomatoes: Annual N_2O Emissions Fertilizer Rate & Irrigation Effects





Crop N off-take: 150 to 230 kg N ha^{-1}

GWP in tomatoes as a function of cover crops and irrigation practice



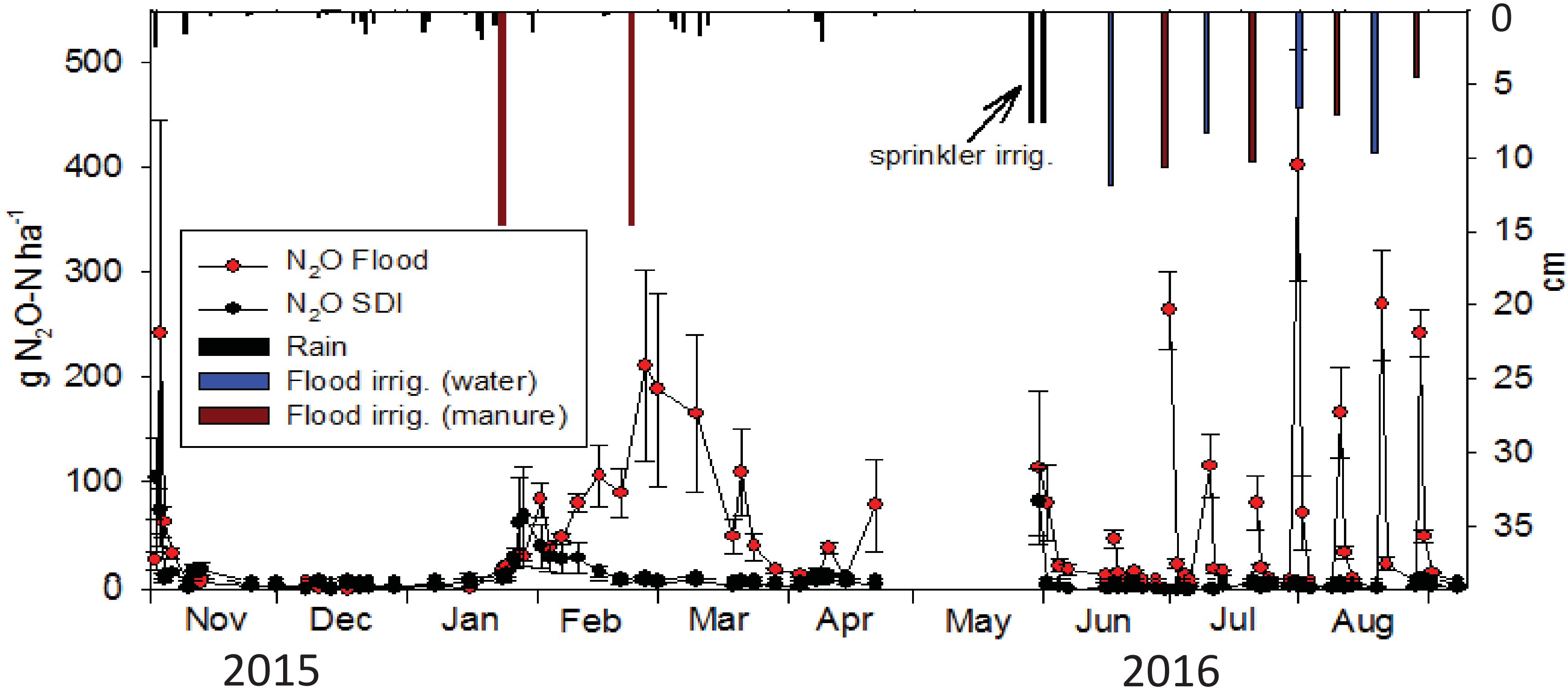
Statistical significance

FI= Furrow Irrigation
SDI=Subsurface drip irrigation
Fallow= No cover crop
Trit=Triticale
Mixed=Legume/grass

- N_2O emission < 1/3 total

Unpublished data; do not cite

Applying Dairy Manure Through Subsurface Drip versus Flood Irrigation Reduces N_2O Emissions in Forage Production Systems



System	Soil	Irrigation		Total
	N_20	Electricity	Diesel	
	kg CO_2 eq. ha^{-1}			
SDI wheat	847	95	190	1130 (±260)
SDI corn	180	575	190	942 (±50)
Flood wheat	3530	99	190	3810 (±1520)
Flood corn	1700	75	190	1960 (±280)

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Potential of US Soils to Sequester C and Mitigate Climate Change

Ecosystem	Land area* (Mha)	Rate (Mg C ha-1 y-1)	Total Potential (Tg C y-1)	Reference
Cropland	**156.9**	**0.3-0.5**	**45-98**	**Lal et al. (1998)**
Grazing land	336.0	0.04-0.21	13-70	Follett et al. (2001)
Forest land	236.1	0.11-0.43	25-102	Kimble et al. (2002)
Land conversion	16.8	0.125-0.46	21-77	Lal et al. (2003)
Soil restoration	498.4	0.05-0.12	25-60	Lal et al. (2003)
Other land use	166.0	0.09-0.15	12-25	Lal et al. (2003)
Total			144-432 (288)	Lal et al. (2003)

4 per Thousand Initiative
COP21

Global Soil Organic Carbon Pool 0-40cm Depth

Total Pool = 825 Gt *.... Batjes (1996)*

= 850×0.4%= 3.6 Gt C/yr

What is possible on agricultural land:

Soil C sequestration potential (t ha^{-1} 10 y^{-1})	Gt soil carbon (globally 10 y^{-1})
1	2.7
3	8.0
5	13.4
10	26.8
15	40.2
20	53.6

Likely outcome

4 per thousand

in 10 years

is 36 Gt C/ 10 yr

Assume:

- 2,682 million hectares agricultural land globally in 2030 (FAO)
- assume consistent indefinite management to sequester soil C
- Including rangeland/pastures (5x ag area and plantation forests 20% of ag area) would help in achieving goal

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SUMMARY

- Irrigation technologies: sub-surface drip irrigation improves yield, reduces N_2O emissions and reduces GWP.
- Soil carbon sequestration to meet 4 per mille goal is optimistic
  - Requires additional nitrogen input
  - Climate warming could increase soil carbon priming and GHG
- Regardless of goal, any increase in soil carbon would be beneficial

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Thank you!

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