Transitioning Cereal Systems to Adapt to Climate Change

November 13-14, 2015

Funded through Award #2011-68002-30191 from USDA National Institute of Food and Agriculture

Greenhouse gases: Monitoring and approaches to mitigation

Phil Robertson
Professor
Kellogg Biological Station,
Michigan State University

What are the principal gaps and opportunities for linking efforts in this area to the others covered in the breakout sessions?

- What are the knowledge gaps and priorities for moving forward?
  - Lack of N2O flux data, generally
  - For mitigation
    - » need info on perennial biofuel feedstocks, how to transition between annual/perennial phases, and better performance measures—longer term concurrent measurements
  - Lack of data for other crop types in other areas
  - What is the process in the spring thaw pulse?
  - Can you manage systems to consume N2O?
  - What is the best intensity measure for N2O (normalized by yield)?
  - Need more model development and testing
    - » Initalization of soil carbon is critical
    - » Analysis of synergistic adaptation and mitigation strategies using models
  - How can we identify environmentally optimal crop production
  - How well is agriculture represented in GHG inventory in areas throughout the world?

What sorts of short and long-term activities could promote the needed collaboration and integration?

- What are the next steps?
  - Must address denitrification and relationship to nitrogen use efficiency
  - Need to understand relative importance of nitrification and denitrification processes
  - More work on understanding wetting events, frequency of events, and resulting emissions
  - Need to understand spring thaw pulse
  - Need integrated approach to understanding emission/mitigration options
  - Looking ahead to drought and/or more extreme rainfall events --how will this affect N2O emissions
  - Comparison of EFs across regions, by soil texture, by precip, etc
  - Better low cost N2O sensors
  - Improved spatial agronomic management to reduce N2O emissions
  - Improved N fert technology and practice
  - Need new microbial probes to understand process level dynamics
  - Need to take advantage of new isotopic instrumentation

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REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE

Thank you!

University of Idaho

Washington State University

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Oregon State University OSU

CHS

Pacific Northwest Farmers Cooperative

Monsanto

GHG Monitoring and Mitigation Key Questions

- What do we know about net fluxes of GHG?
- What do we know about the management of GHG fluxes?
- How well can we model GHG fluxes?

Notes on presentations and discussion

- Mark Liebig: GHG in US Great Plains
  - 42% SOC loss due to cropping (from native grasses)
  - Now, no til, annual ~ +0.13 MgC/ha/yr SOC
  - Lack of N2O data
    - 2 to 5 g N/ha/day (can only release 1 to 3 for GHG neutrality)
  - Projected changes—more denitrification in Northern Plains and SOC reduction in Southern Plains
  - Switchgrass—large SOC accural due to large root biomass —low to moderate N2O fluxes
  - Gaps
    - Mitigation—info on perennial feedstocks, transition between annual/perennial phases, better performance measures—longer term concurrent measurements

Notes, cont.

- Reynald Lemke GHG emitted from Canadian semiarid prairies
  - Rough equilibrium, slight increase in SOC over time
  - N2O, highly variable 10 to 350 ugN/m2/hr (spring thaw pulse, after N applied in June—first soil wet-up)
  - Simple EF model using P/PE with modifiers: tillage, slope position, irrigation, soil texture
  - What is the impact of crop rotation?—oilseed-cereal or oilseed-cereal-pulse, etc.
  - 3 yr cum
    - canola-wheat = 2120 g N/ha
    - Pea-wheat and others 990 to 1440 g N/ha
    - Pea-wheat is best on a C harvested scaled basis
    - Canola-wheat is worst on a C harvested scaled basis
    - Including oilseed 'costs' on a per area or scaled basis

Notes, cont.

- Louise Barton—Australia GHG
  - Highly weathered soils
  - N2O rates 0 to 0.13 kg N/ha/yr w/w/o fert N
  - 0.2% EF factor from fert N—very low
  - Grain legumes do not increase N2O emissions
  - Increased SOC (incorporated chaff) increases N2O emissions by 10x over 2.5 yrs
    - Annual rates still low
  - Mitigation—focus on summer rainfall events
    - Liming—increase pH—see slight decrease during an event (cum 0.09 vs 0.13 kg N/ha without liming
    - Liming increases carbon footprint due to CO2 release
    - N inhibitors

Notes, cont.

- Peter Grace—adaptation and mitigation
  - GHG emissions are indicators of sustainability
  - Process level understanding of GHG emissions is missing across diverse agroecosystems
  - Need measurements
    - Increase daily sampling frequency improves annual estimate
  - Automated chamber network in Australia
    - 2 to 15 kg N/ha/hr from wheat to dairy to sugarcane sites
  - Model tests —working reasonably well for yield, not quite as good for N2O