THE WATER QUALITY FIELD STATION (WQFS) ~ A PURDUE UNIVERSITY CORE FACILITY

A unique in-field laboratory for integrated studies of agricultural productivity and environmental impacts

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FACILITY GOAL

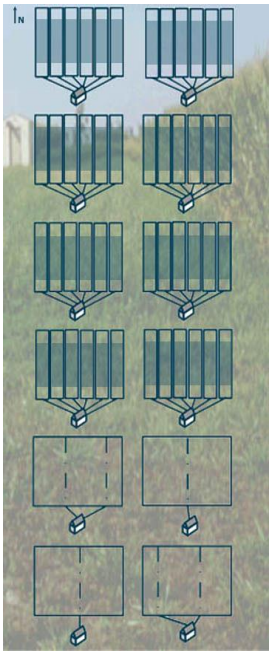
Advance the understanding of the unbreakable link between agricultural productivity and environmental stewardship. Provide an infield laboratory for studying mechanisms & processes governing productivity & environmental impacts of management technologies (e.g. ag, chemicals, nutrients, manure constituents) emphasizing quantitative assessment of soil, air & water quality.

VALUE TO R/T/E

Established field laboratory with legacy data for:

1. Comparison of productivity & environmental costs / co-benefits of emerging cropping systems w/ current systems &/ or native prairie;
2. Success evaluation of theoretically improved management strategies;
3. Educating students & the general public on critical issues of the agriculture-environment

BRIEF OVERVIEW



- Established in 1992; refurbished in 2013.
- Only fully-replicated, slurry walled, in-ground lysimeter study of this scope & magnitude in the US.
- Only facility in the humid region of the eastern cornbelt where 11 managements can be compared to a restored prairie to assess relative environmental impacts of cropping systems.
- 15+ year existing database of C/N cycling in commonly practiced production systems
- Data records for (i) hourly rainfall & tile drain volume for 54 individual tile lines, (ii) daily mass loss of NO_3-N & DOC, (iii) GHG emissions (various times), & (iv) crop productivity measures (various attributes)

EXAMPLES of PREVIOUS PROJECTS

Assessing the impacts of:

- Tile spacing on crop productivity & nutrient loss to surface water
- Land application of swine manure on movement of nutrients (N &P) & bacterial pathogens to surface water
- Precipitation & swine manure management on fate & transport of pharmaceuticals & antibiotics in soils to water
- Crop rotation, fertilizer & manure management on N use efficiency, greenhouse gas emissions & C sequestration, C/N biogeochemical cycling, & C/N losses to surface water
  Model Parameterization / Calibration / Verification ~ e.g. DRAINMOD N; SWAT, Hybrid Maize

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PURDUE UNIVERSITY

In 2007, several treatments were converted to candidate bioenergy systems. Switchgrass (upland ecotype "Shawnee") and Miscanthus (M x giganteus) were established from seed (5/2007) and 1kg transplants (5/2008), respectively. Two additional maize-based treatments were converted to annual bioenergy systems: dual purpose (grain + biomass) sorghum & no-till, continuous maize with residue removal. The native prairie was harvested instead of burned.

PREVIOUS RESEARCH HIGHLIGHTS TRADEOFFS IN GxExM & ECOSYSTEM SERVICES

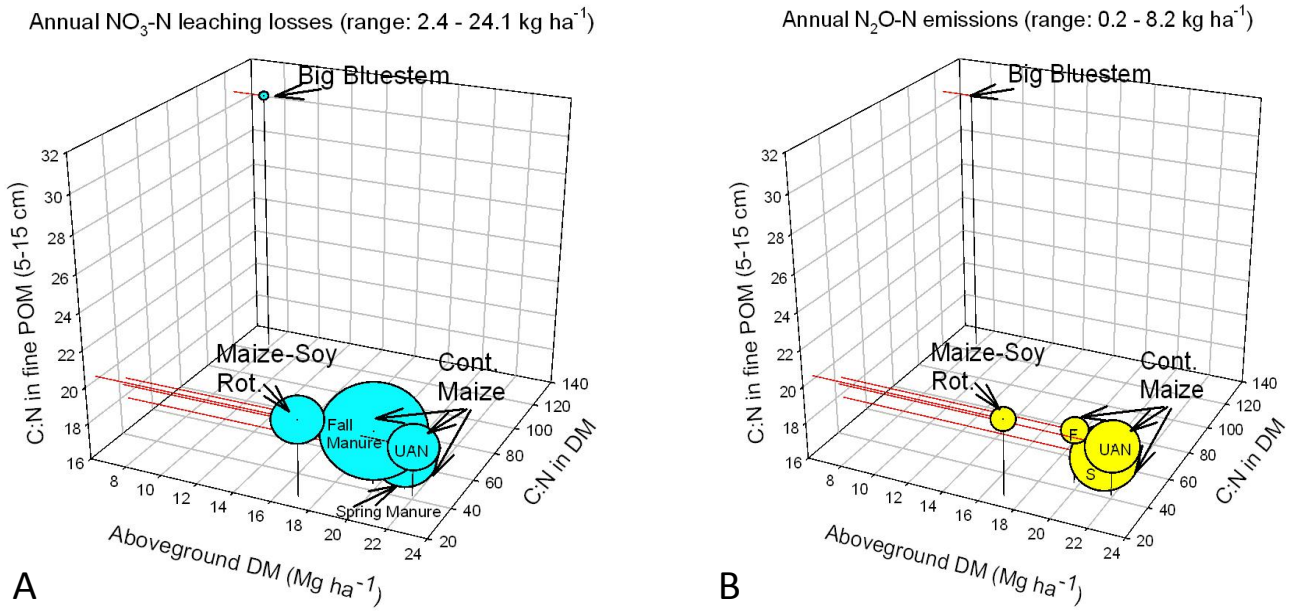

Fig.1. *Annual nitrate-N leaching losses (A) and nitrous oxide-N emissions (B) plotted as a function of total aboveground dry matter (maximum biomass), C:N ratio in the aboveground dry matter, & C:N ratio in the fine particulate organic matter in soil. The size of the bubble indicates the relative magnitude of loss among systems (kg ha^{-1} range given above each graph). Systems compared are a maize-soybean rotation (sidedress UAN at 135 kg N ha^{-1}; values averaged over both crops), continuous maize receiving N as sidedress UAN (157 kg N ha^{-1}), as fall (F) & as spring (S) manure (255 ± 24 kg N ha^{-1}), & an unfertilized, big bluestem-dominated prairie (0 N fertilizer).*

NEXT STEPS

- Analysis of WQFS bioenergy system impacts on soil, air & water quality is on-going;
- WQFS results are benchmarking on-going systems comparisons on marginal lands;
- Results from perennial systems have been used to parameterize SWAT for switchgrass & *Miscanthus*; SWAT is being used to simulate watershed-scale impacts & optimizations.

PUBLICATIONS (synthesized in figure)

Hernandez-Ramirez, G., S.M. Brouder, D.R. Smith, and G.E. Van Scoyoc. 2009. Carbon and nitrogen dynamics in an eastern corn belt soil: N Source and Rotation. Soil Sci. Soc. Am. J. 73:128-137.

Hernandez-Ramirez, G., S.M. Brouder, D.R. Smith, and G.E. Van Scoyoc. 2009b Greenhouse gas fluxes in an Eastern Corn Belt soil: Weather, N source and rotation. J. Environ. Qual. 38:841-854.

Hernandez-Ramirez, G., S.M. Brouder, D.R. Smith, G.E. Van Scoyoc and Greg Michalski. 2009c. Nitrous oxide production in an Eastern Corn Belt soil: Sources and redox range. Soil Sci. Soc. Am. J. 73:1182-1191.

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