Nitrous Oxide Emissions from Cover Crop Systems:

Comparisons between Conventional and Organic Management During an Establishment Phase

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CHALLENGE

- Reduce reactive nitrogen (N) in the environment without compromising productivity
- Implement practices that minimize N inputs and maximize N conservation, i.e., increase nitrogen-use efficiency (NUE)

OVERVIEW

- Nitrous oxide (N_2O) is the largest contributor to the Greenhouse Gas (GHG) burden of cropping systems
- Very few studies have directly compared N dynamics in Certified Organic and Conventional management systems
- There is a shortage of N_2O emissions data from agricultural systems that include cover crops in their rotation
- Cropland N_2O emissions are primarily due to soil management activities, particularly N inputs
- Quantifying N_2O emissions is important for:
  - Improving accuracy of inventories of agricultural GHG emissions;
  - Evaluating potential for GHG and N pollution mitigation strategies

HYPOTHESIS

With effective management, cover crop use can: Decrease N_2O emissions; Improve NUE; and, Increase soil C accumulation

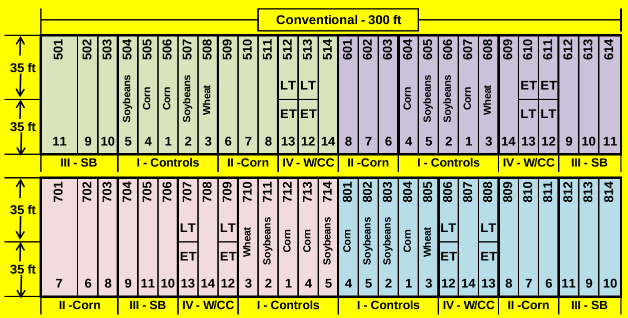

Figure 1. Experimental design in Conv. Management system at KBS

Figure 2. Management practices at the experimental site.

METHODS & MANAGEMENT

Design: Randomized split-split-block; 4 replications; Corn-soybean-wheat rotation; Conventional and Certified Organic management (Figure 1).

Treatments:

Corn - Cereal rye, No cover crop/no-till, No cover crop.

Soybeans - Wheat cover/cash crop, No cover crop/no-till, No cover crop. *Wheat* - Red clover, Oilseed radish, Annual ryegrass, No cover crop.

Management: Independent according to common practice in Michigan using timing based on growing season (Figure 5).

Organic: Organic certified or non-GMO seed, organic fertilizers and rotary hoe/cultivation for weed control.

Conventional: GMO seed, synthetic fertilizers and herbicides for weed control (Figure 2).

Sampling and Analysis: Simultaneous at both sites - Determined by management; GHG, Plant/Soil C:N, Fiber, Lignin (Figures 3 and 4).

Figure 3. Sampling at the experimental site.

Figure 4. Sample analysis techniques.

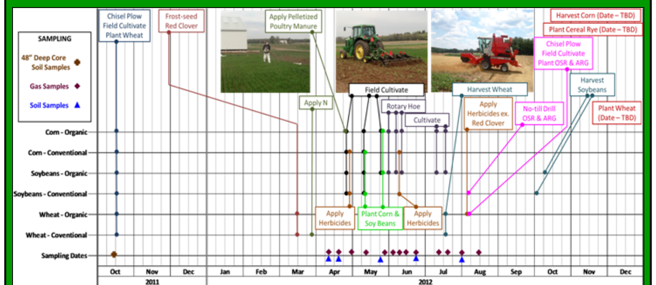

Figure 5. Year 1-2 management practices, timing and sampling dates.

During establishment phase, preliminary results compare:

- Management (Organic vs. Conventional)
- Fertilization (UAN vs. Poultry Manure)
- Tillage (Conventional till vs. No-till)

RESULTS

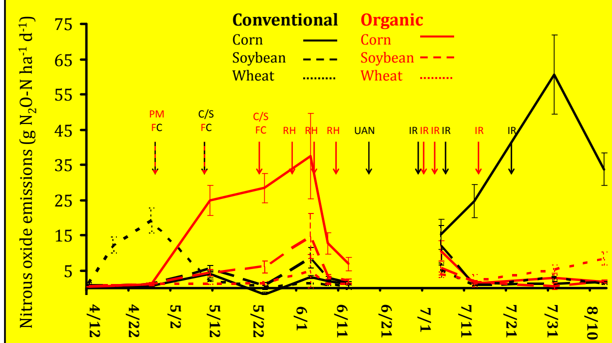

Figure 6. Daily N_2O emissions during 2012 growing season.

Figure 7. Average daily N_2O emissions in corn, soybean, and wheat.

Figure 8 (inset). Average daily N_2O emissions in no-till / tilled corn.

CONCLUSIONS

- N_2O emissions greatest under Org. management in May-June, and under Conv. management in July-Aug. (Figure 6).
- N_2O emissions increase following input of org. N (poultry manure) and synthetic N (UAN) fertilizers (Figure 6).
- N_2O emissions influenced by irrigation and field cultivation
- N_2O emissions highest in the corn treatments (Figure 7).
- N_2O emissions are lower under no-till corn (Figure 8).

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