Introduction

- Increased weather variability may require improved nitrogen (N) management strategies that emphasize cropping system resilience in combination with reduced opportunities for N loss.
- Nitrogen cycling relies on microbial activity yet few data exist regarding how N management and cultural factors impact soil bacterial communities.
- Critical to investigate alternative strategies that maximize plant genetic potential through incremental changes in soil health.

Objective

Determine the effect of cover crops individually and in combination with N placement and timing on temporal changes in soil health, soil and rhizosphere microbial community composition, and corn yield.

Materials and Methods

- Field studies conducted in Lansing, MI, 2014 to 2016.
- Conv. tillage following wheat.
- Split-plot RCB design with 4 replications (18 total treatments).
- Treatments are combinations of cover x N management strategy

Whole plot factor - Cover
- Sub plot factor – N strategy
  - No Cover
  - "The Buster” daikon radish
  - “Magnum” forage oats
  - Pre-plant incorporated urea or poultry manure (4-3-2; 2.2 Mg ha⁻¹) (PM) followed by V11 SD.
  - Subsurface starter (45 kg N ha⁻¹) placed 5-cm to the side and 5-cm below seed furrow (5x5) followed by V4, V11, or 50/50 V4/V11 split SD

- Total N rates equalized to maximum return to N (MRTN) rate of 179 kg N ha⁻¹.
- Corn (98-d relative maturity) was seeded in 0.76-m rows at 84,510 seeds ha⁻¹.
- Soils sampled on 4 dates from bulk soils and corn rhizospheres.
- Dual-index sequencing of soil 16S rRNA gene using Illumina MiSeq platform and MOTHUR curation pipeline.

Table 1. Cover crop quantity*, quality†, and impact on soil respiration and soil labile amino-N content (SLAN) after 74 to 81 d of growth.

Table 2. Microbial respiration and corn grain yield as affected by cover crop and N management strategy, Lansing, MI, combined across years 2015-16.

Table 3. Cover crop and N strategy effects on inverse Simpson’s diversity indices (0-10 cm) at two soil sampling zones and two timings, 2015-16.

Table 4. Pearson correlation coefficients relating Inverse Simpson’s Diversity indices to grain yield at selected observation timings and soil sampling zones.

Results and Discussion

- In both years a radish cover crop produced 68% more biomass than an oat cover crop corresponding to a 56% increase in total N uptake. Oat cover increased SLAN 12% from a no cover while cover crops increased CO₂ respiration 29 – 43% indicating biological activity (Table 1, Fig. 1).
- At autumn termination, radish and oat cover crops reduced soil nitrate levels 78% and 84%, respectively, suggesting that a portion of total N taken up by oats remained in the roots since total N uptake observed was greater with radish (Table 1, Fig. 3).
- A cover crop x N strategy interaction was observed for corn grain yield (P=0.0245). Unfertilized radish and oat covers sig. reduced grain yield 10.5 and 14.3%, respectively, and increased yield response to N 63 to 79% from the no cover x no control. This indicates fall N removed from the soil by the covers may not have been available during critical periods of rapid corn N uptake following the June Table (2, Figs. 1 to 3).
- A three-way interaction which included soil sample zone and timing occurred for inverse Simpson’s diversity index each year. Sample zone and timing had greater impact on overall community diversity than main factors. Negative correlation coefficients indicated increased community diversity often did not correspond to increased yield and inconsistent yearly trends suggest bacteria relative abundance may be more important than diversity for crop yield (Tables 3 and 4).