Managing Nitrogen with Zonal Tillage: Proposed Research

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Introduction

Managing the supply of soluble nitrogen to crops is a primary challenge for organic growers. Organic growers typically use tillage to incorporate and mineralize nitrogen from crop residues, cover crops, or animal manure, but often it is difficult to synchronize the supply of nitrogen from these biological sources with plant demands.

Zonal management systems may help organic growers manage nitrogen by giving them a degree of control over when and where residues are mineralized by creating "soil functional zones" within crop rows. Our research focuses on the efficacy of zonal management systems, particularly ridge tillage, by evaluating the spatial variability of carbon and nitrogen across ridges. This study is not organically managed, but our findings could still apply in organic systems.

Background

- Ridge tillage:
  - Creation of permanent ridges in planting row space
  - Ridges are remade 1-2 times per year in early summer
- RT improves early season soil drying and drainage
- RT increases soil C and SOM-N over the long-term, especially at surface depths
- Carbon “profile” can strongly influence N cycling and availability
  - N immobilization
  - Presence of labile C leads to more rapid immobilization
- How concentration and availability of nitrogen supplied from residues in RT changes over the season is poorly understood

Objectives

- Examine the spatial distribution of soluble N across ridges throughout time
- Examine how ridge tillage affects nitrogen use efficiency
- Determine how changes in the carbon profile of soil under ridge till will affect N cycling

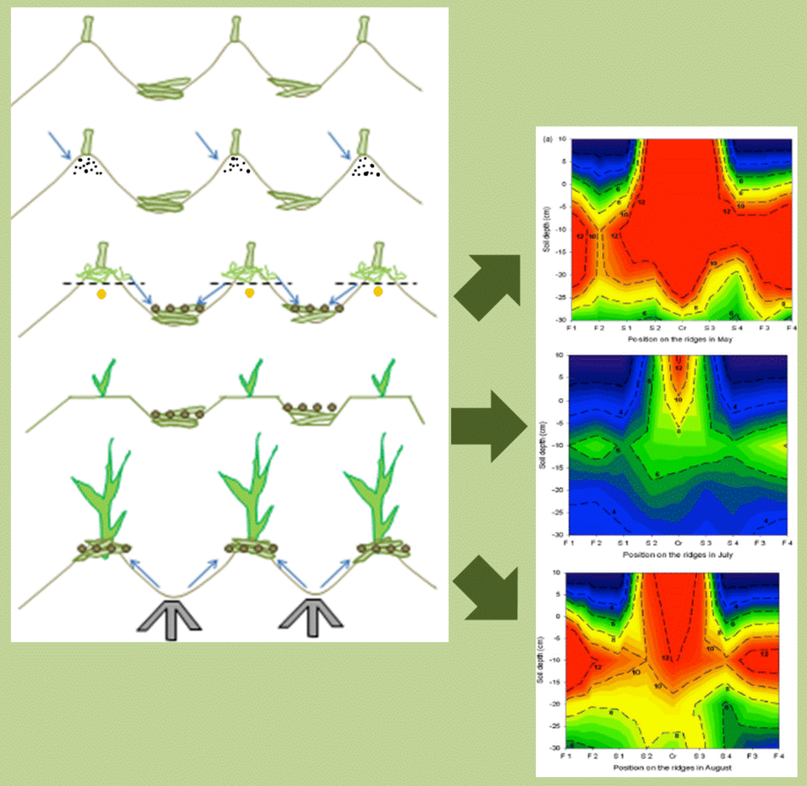
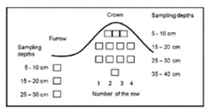


Figure 1.

The spatial distribution of N across ridges will change over the course of the season following each field operation. Image credit: Adam Davis and Muller, E.. Soil & Tillage Research 105 (2009) 88–95..

Proposed methods

- Anion exchange strips
  - allows for intensive sampling at several times across season
- Potentially mineralizable nitrogen (PMN)
- Incubation with N-15 stable isotope to measure immobilization
- Nitrogen use efficiency



Expected results

- Ridge tillage will create gradients in N and PMN over time.
- Relocating crop and cover crop residues away from planting zone into furrow will reduce early season N immobilization in planting zone as compared to conventional tillage
- Residues will be sufficiently decomposed by ridging, and nitrogen will be redistributed to planting zone in mineralized forms or forms that can be potentially mineralized.
- Ridging will result in an initial immobilization event due to increased activity, followed by an increase in N and PMN
- Nitrogen use efficiency will be higher in RT than in CT

Conclusions/Implications

- Managing residues and the supply of organic N is a challenge for both organic and conventional growers
- If RT can effectively immobilize N outside planting zone it could reduce early season losses, while minimizing impacts on seedlings
- Leaving residues unprocessed until mid-season allows farmers to utilize residues as a nitrogen source later in the season and exercise a degree control over the supply of nitrogen to plants
- Zonal management could improve N synchrony
- Improving N synchrony could enhance yield sustainability

Interested in participating?

We’re looking for growers using zonal tillage to collect on-farm soil samples. If you use ridge tillage, strip tillage, or any other form of zonal tillage with any cropping system or know someone who does, let us know!

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