Quantifying Nitrogen Mineralization and Plant Available Nitrogen Concentrations in the Soil Following Crop, Cover Crop Residue and Manure Incorporation Across An Organic Vegetable Rotation

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Introduction

- Adequate nitrogen fertilizer and synchronizing nitrogen availability with crop nitrogen demands are great concerns in organic vegetable production.
- Net nitrogen mineralization quantity and rate varies with cover crop residue and organic amendment chemical composition.
- Our goal was to determine in-situ nitrogen mineralization and plant available nitrogen pools as affected by previous crop, cover crop and fertilizer residues alone and in combination within the soil.

Objectives:

1) Quantify nitrogen mineralized in soils following crop residue, cover crop residue, organic fertilizer incorporation.

2) To determine plant available nitrogen concentrations within the soil, throughout a sweet corn crop growing under four organic fertility management systems.

Materials and Methods

Field Methods

- 2 year study at Arlington, WI from 2009-2010 within a sweet corn cropping system
- Plano silt loam soil (Typic Argiudolls)
- Randomized complete block design-3 blocks- 2 columns/block
- Four organic fertility management systems.
  - *Control*- no inputs
  - *Manure*- manure applied in spring prior to planting, no cover crops- no fertilizer
  - *Plant based*- Field pea and mustard cover crops- no fertilizer
  - *Integrated annual cover crop/manure*- field pea and mustard cover crops, manure applied the previous year

In-situ column methods

- 10.16 cm dia. x 30 cm deep PVC columns with in-tact soil core
- Amendments added and installed at the time of cover crop incorporation
  - Initial soil sample (1cm x 8 cm core from within column)
  - 2 resin ion/anion bags placed at base of column
- Repeated soil sampling and resin bag extraction at time of significant crop growth stages
  - Emergence, V5, VT, VS, Harvest

Data Analysis

- A Levene's test for homogeneity of variances across years was conducted followed by repeated measures ANOVA methods.

Results

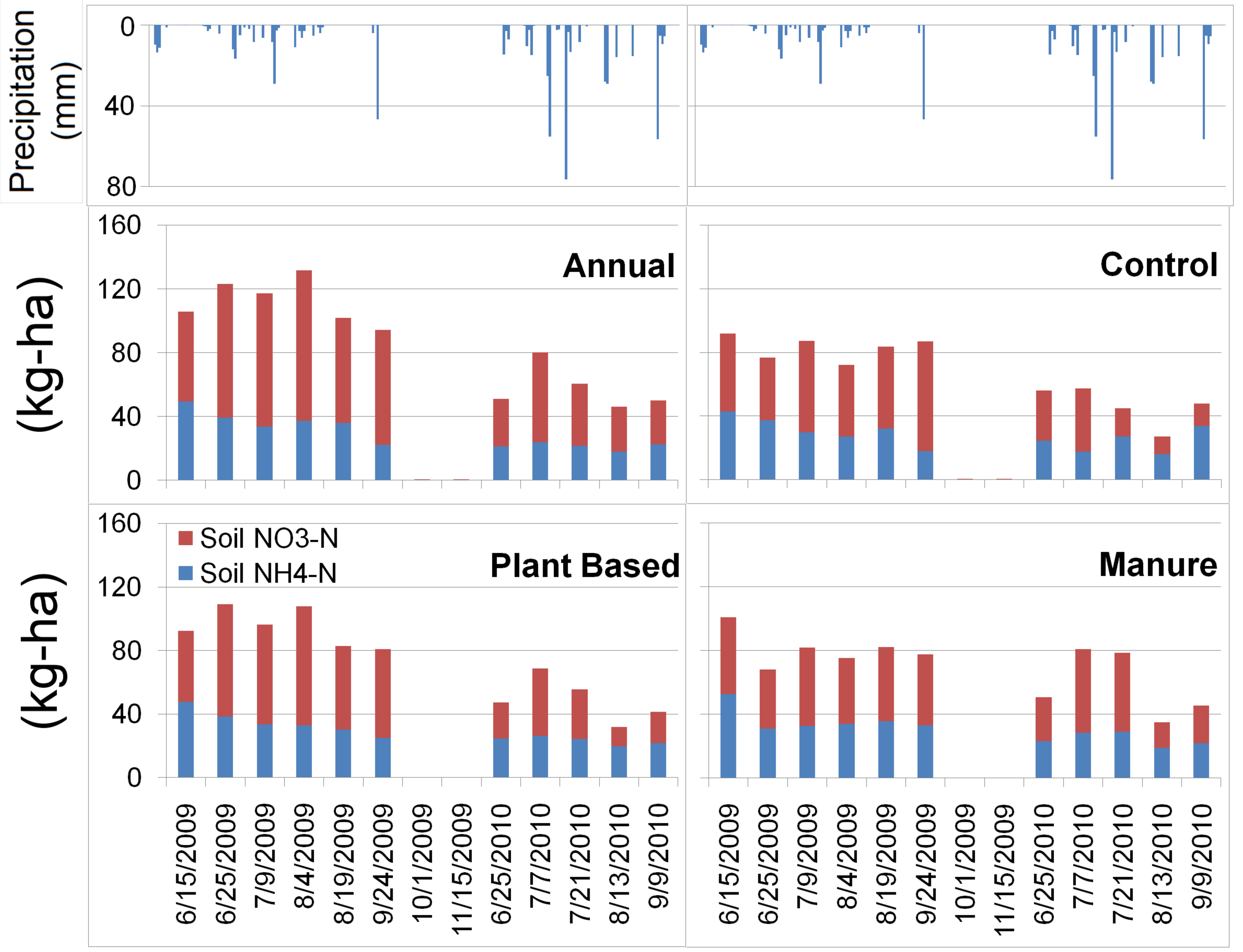

Figure 1: Soil NH_4-N, NO_3-N,throughout 2009 and 2010 by organic fertility management system.

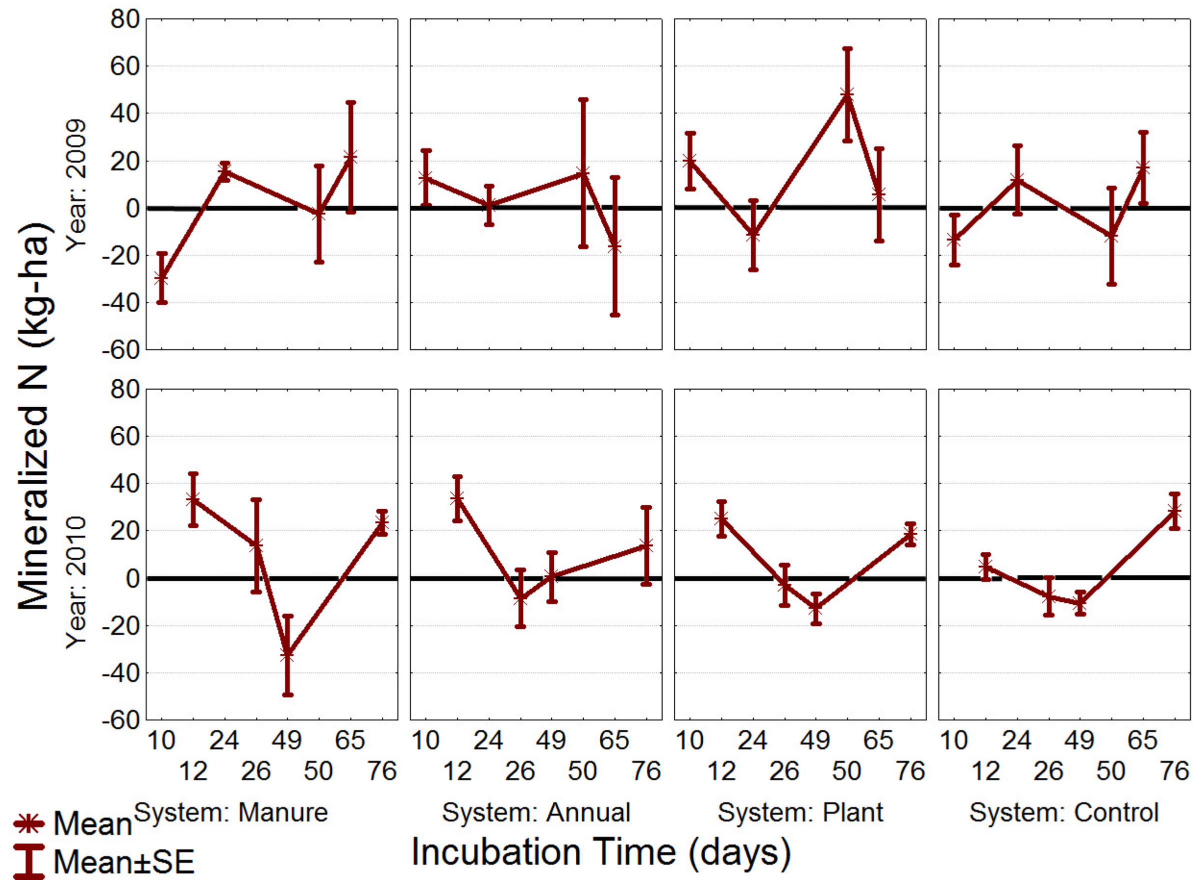

Figure 2: Within season accumulated mineralized NO_3-N, incubation time, year and organic fertility management system.

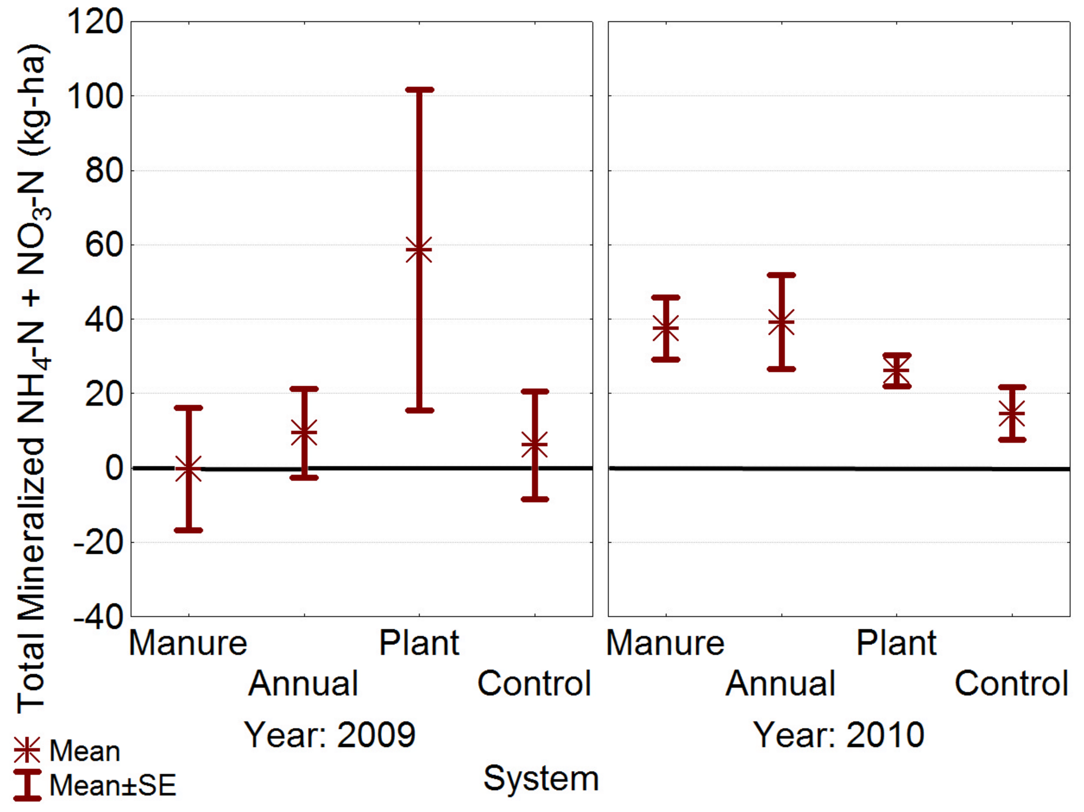

Figure 3: Total mineralized NO_3-N by year and organic fertility management system.

Table 1: Summary of comparable mineralization studies in similar systems. (Adapted from Brye et al. 2003)

Ecosystem	Soil Type	Time Period	N-min Estimate	Reference
Dryland Fallow	Loam	April 30-July 22	33.7	Kolberg et al. 1997
	Clay loam	April 30-July 15	26.5	
Fertilized corn	Sandy silt	Aug. 10- Sep. 26	82	Hubner et al. 1991
Wheat-fallow rotation	Sandy loam	2 Weeks	13-19	Qian and Schoenau 1995
Minimum tillage agroecosystem			17-20	
Uncultivated sugarcane	Muck	Annual	149-348	Hanlon et al. 1997
Cultivated sugarcane			13-221	
Sod			63-234	
Cultivated sweet corn			18-123	
Cultivated winter wheat		30 days	153	Ajwa et al. 1998
Wheat-corn-millet rotation	Loam	30 days	32-52	Wood et al. 1990
	Loam clay		39-73	
Cultivated field corn	Silt loam	1 Month	-167 - 58.5	Brye et al. 2002
Our Study	**Silt loam**	**76-100 days**	**4-82**	

- Soil NO_3-N and NH_4-N values varied by system, incubation time and year.
- Within season mineralized NO_3-N varied by system and year.
- Total growing season mineralized NO_3-N did not vary by system or year
- Net mineralized N values from this study were within published values typical of cultivated systems.

Conclusions

- We were able to quantify nitrogen mineralization within and across a growing season, and while our values were within previously published ranges, the quantities of nitrogen available for plant uptake were insufficient for sweet corn crop growth.
- Soil NO_3-N and NH_4-N and mineralized NO_3-N after amendment additions can vary and be synchronized with crop growth by adjusting time of incorporation.
- Supplemental nitrogen is needed for organic sweet corn production using these fertility management systems.