Effects of Agricultural Management with and without Cover Crops on Soil Nitrate in Different Topographical Positions

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INTRODUCTION: It is critical for any agricultural managements to provide optimal levels of nitrate for plants in different stages of the growth. Adding cover crops to rotations has been shown to provide substantial soil conservation and carbon sequestration benefits. While influence of cover crop on soil nitrate levels has been studied intensively in small experimental plots less has been done on larger scales and under diverse topography.

OBJECTIVES: Assess the interactive effects of management practices and topography on soil nitrate levels.

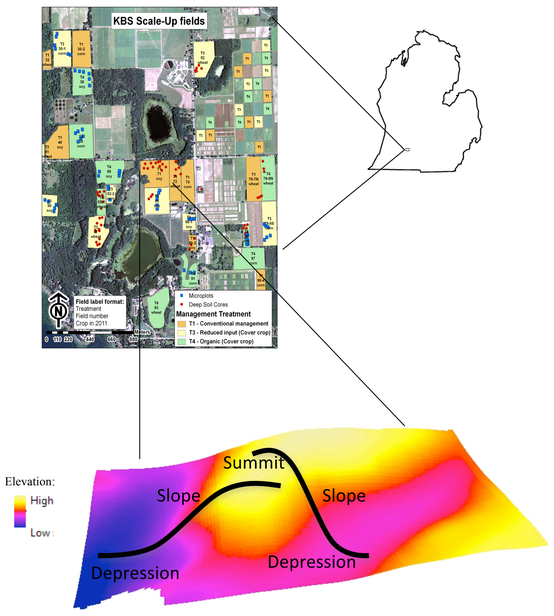

Figure 1. The study area and a schematic representation of two transects on the elevation map of one of the studied fields.

MATERIALS AND METHODS

Study location: LTER Scale-Up experiment at Kellogg Biological Station, southwest Michigan.

Experimental design: RCBD with 3 replicated field per treatment and multiple sub-samples (topographical transects) per field.

Agricultural management practices:

- **conventional:** conventional nitrogen inputs,
- **low input:** low nitrogen fertilizer inputs with red clover and rye cover crops , and
- **organic:** certified organic with red clover and rye cover crops.

Topographical positions:

- **depression,**
- **slope and**
- **summit.**

Soil samples were collected monthly during the growing seasons of 2010 and 2011.

Statistical analysis: PROC MIXED in SAS 9.3.

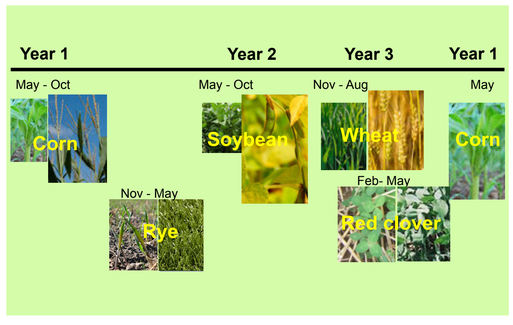

Figure 2. Rotation of the low input and certified organic management systems with cover crops.

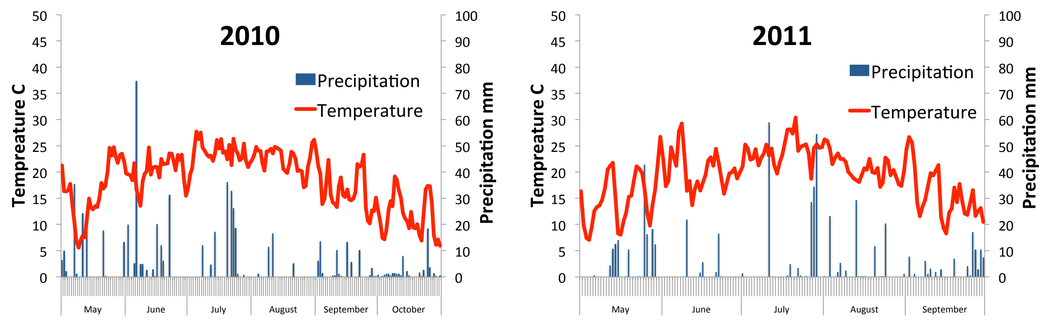

Figure 3. Weather patterns for 2010 and 2011 growing seasons.

RESULTS:

-The effect of time was statistically significant in both 2010 and 2011; effect of topography in 2011; effect of management was not significant in both years ($P<0.05$).

-High nitrate levels in July are related to fertilizer application and to nitrate accumulation prior to plant absorption.

-Highest rates of nitrate in depressions followed by summits and slopes are related to nitrate redictribution across terrain.

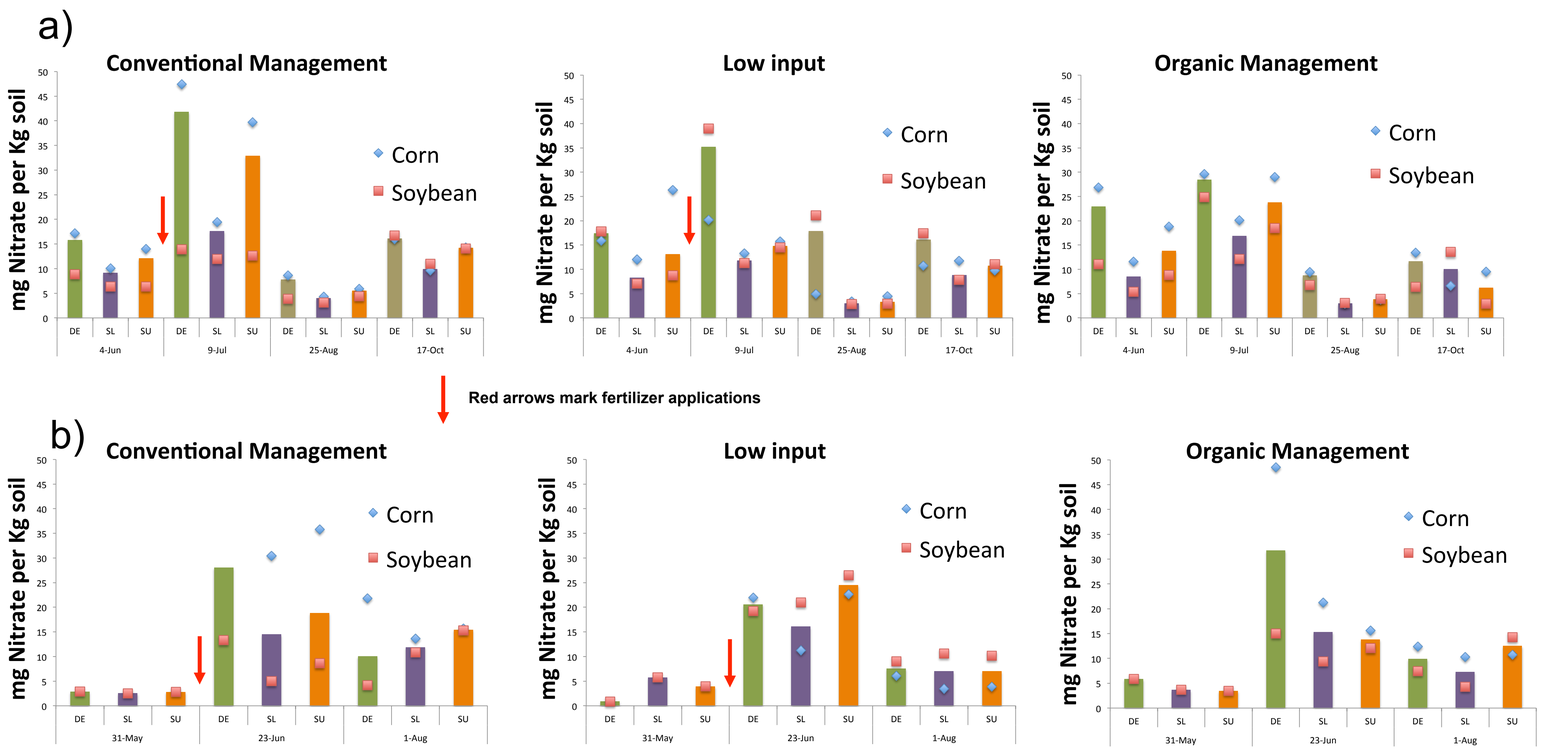

Figure 4. Nitrate levels in a) 2010 and b) 2011 in corn and soybean fields under studied agricultural managements, topographical positions and growing season months (DE: depression, SL: slope and SU: summit)

CONCLUSIONS:

- The amounts of nitrate in Organic and Low input managements were comparable to those of the Conventional management.

-Nitrate levels were higher in depressions as compared to slope and summit topographical positions.

-Time was the largest source of variability in nitrate levels, followed by space (topographical effects) and then by management practice. Temporal variations were less pronounced in Organic management as compared to Low input and Conventional management practices.

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LTER

USDA United States Department of Agriculture National Institute of Food and Agriculture

MICHIGAN STATE UNIVERSITY

MICHIGAN AGRICULTURAL EXPERIMENT STATION

GLBRC Great Lakes Bioenergy Research Center