Introduction:
- Management and landscape position interact to affect soil processes
- To accurately map soil processes, we must understand these interactions
- Soil respiration measures CO$_2$ as an indicator of the metabolic activity of the microbial community
- Soil respiration indexes the microbial community’s ability to mineralize, store, and transform nutrients, use amendments, and develop good structure

Objectives:
- Optimize assessments for soil respiration
- Understand relationships between land-use, topographic position, and soil respiration

Sampling Site:
- Long-term rye cover crop research plots in Boone, IA (figure 1) established in 2003
- Eight crop systems with odd year crop in parentheses:
  1. Soybeans (corn) – no rye
  2. Soybeans (corn) – rye
  3. Soybeans (sillage) – no rye
  4. Soybeans (sillage) – rye
  5. Corn (soybeans) – no rye
  6. Corn (soybeans) – rye
  7. Silage corn (soybeans) – no rye
  8. Silage corn (soybeans) – rye
- 350 soil samples taken 0-15 cm during soybean V1.5 and corn V4.5 growth stages in June 2016
- Modified stratified sampling design based on crop management and landscape position
- Landscape position determined by digital hillslope position model (DHP) using GRASS GIS 7.0.2 and ArcGIS 10.3.1
- Four landscape positions analyzed at this site:
  - Summit
  - Shoulder
  - Footslope
  - Toe slope

Soil Respiration:
- Soil respiration (CO$_2$ burst) measured using modified methods from Cornell and Haney soil health tests$^{1,5}$
- 10 g air-dried and 2 mm sieved soil weighed into 150 ml Wheaton jars
- Soil rewetted with 3.5 ml deionized water to assume imbibed water content
- Wheaton jars immediately sealed upon rewetting and incubated at ambient temperature for 96-hours
- CO$_2$ concentration determined by infrared gas analysis using a LICOR 7000 CO$_2$ analyzer

Statistical Methods:
- SAS 9.4 used to calculate unbalanced analysis of variance and Least Significant Difference tests with GLM procedure$^3$
- Following comparisons without absent data:
  - Crop rotations 1, 2, 3, 4, 4 at landscape positions 1, 2, 4 (figures 2, 3, 4)
  - Crop rotations 5, 6, 7, 8 at landscape positions 4, 5 (figures 5, 6, 7)

Results & Discussion:
- Both cover crops and landscape position effect soil respiration with landscape position more consistently having a significant effect (figures 4, 7)
- In the corn(soybean) rotations, there was not a significant difference between rye and no cover crop (figure 6)
- Summit and toeslope positions, relatively flat locations, show highest soil respiration (figures 2, 3, 8)

Conclusions:
- Landscape position has a greater effect on soil respiration than crop rotation and management
- Cover crop benefits are most readily observed during soybean rotation compared to corn and silage rotations
- Future analyses on second research plots site and on-farm samples are needed to corroborate results

Figure 1 (right): Iowa State University’s Boyd Farm plots. This site is characterized by Clarion (138) – Nicollet (55) soil series association.