Abstract

Intro

# Methods and Materials

## Site descriptions

Three research sites were used for this study (**Table 1**). The West and East sites were grain production fields on commercial farms, and only one phase of the maize/soybean rotation was present each year. The Central site was a large research study managed by the United States Department of Agriculture (Kaspar et al., 2007, 2012). The study included both a grain- and silage-based maize/soybean rotation. In the silage rotation, the maize phase was harvested for silage at the milk stage (R3; Abendroth et al., 2011). Both the maize and soybean phases of the rotations were present each year, but in the present study only the soybean phase was sampled due to time constraints.

All trials consisted of two treatments that had been in place for at least 10 years: (1) a maize/soybean rotation (either grain- or silage-based) with a winter rye cover crop planted in the fall following cash crop harvest and terminated in the spring, and (2) the same rotation without a cover crop. Every trial was arranged in a randomized complete block design with four (West and East) or five (Central) replicates. The plots within each trial were managed identically save for the planting of the cover crop in the fall. The exact herbicide and nutrient programs varied by site, reflective of their particular managers and contexts (**supplementary material**). More detailed accounts of agronomic management at the Central site have been published elsewhere (Moore et al., 2014). All sites had sub-surface tile drainage and were managed without tillage since initiation of the trials.

## Soil Sampling

An aluminum ring 7.62 cm in diameter and 7.62 cm tall was used to take in-tact soil samples. Sampling occurred in May of 2019 after maize (West) or soybean (East, Central-grain, Central-silage) emergence at each site. Sampling was done immediately following crop emergence to minimize the effects of live roots in the samples.

At all locations, samples were taken in the middle of the plots between planted rows. A hole 10 cm deep was dug, and soil was smoothed by hand to create a flat area approximately 30 cm square. The ring was placed on the soil surface in the center of the flat area, and a XX weight was used to evenly drive the ring into the undisturbed soil. Once the ring was fully inserted into the soil, a hole was dug around the ring. A flat sheet of metal was slid under the ring to extract it, and a knife was used to remove soil from the top and bottom of the ring using a Z-cutting motion. The ring was wrapped in aluminum foil with the soil orientation (top, bottom) marked. The foil-wrapped ring was then placed in an individual plastic container, then placed in a cooler. This process was repeated for each plot.

## Measurements

### Soil-water-retention curve

## The equipment could accommodate XX samples at a time, so each site’s samples were run together in a batch. A given batch of cores was placed in a vacuum chamber for at least 12 hours in a solution of 0.01 M CaCl2, allowing the solution to move upward to saturate the soils with minimal air entrapment. The saturated cores were weighed, then transferred to a custom-built pressure cell apparatus (Ankeny et al. 1992). The cores were drained at atmospheric pressure for 12 hours to obtain a measurement for field-capacity (Ψ = -3.8 cm H2O = −0.38 kPa). Subsequent measurements were taken at Ψ of -1, -2.5, -5, -10, -20, -50 kPa. The samples were then oven dried at 60 deg C for at least 48 hours, then weighed. Bulk densities were estimated by

### Texture

The oven-dried soil was ground and passed through a 2 mm sieve. Soil texture was measured using laser diffractometry (Miller and Schaetzel 2012) with a Malvern Mastersizer 3000 and a HydroEV attachment (Malvern Panalytical Ltd, UK).

### Organic carbon

Agsource.

## Statistical analysis

XX

Citations

Ankeny, M.D., Brown, H.J., Cruse, R.M., 1992. Means and method of soil water desorption. U.S. Patent 5,161,407.