Soil Sampling Study

Mark Schaffner, Precision Ag Specialist

Dairyland Labs is always trying to conduct useful research while providing great service to our customers. Two common questions that we receive at the lab are “How many cores should be collected for each sample?” and “Does sampling depth have an influence on soil test data?” This spring, we conducted a 2-part soil sampling study that helps answer those questions. The first part was to take 20 sample cores around a standard grid circle to illustrate variability in soil test data depending on the number of cores taken at a given grid point. The second was to take 5-acre grid samples across an entire field at varying depths in the same holes. Samples were taken from 0-2 inches, 2-6 inches and 6-10 inches.

Background: The Field

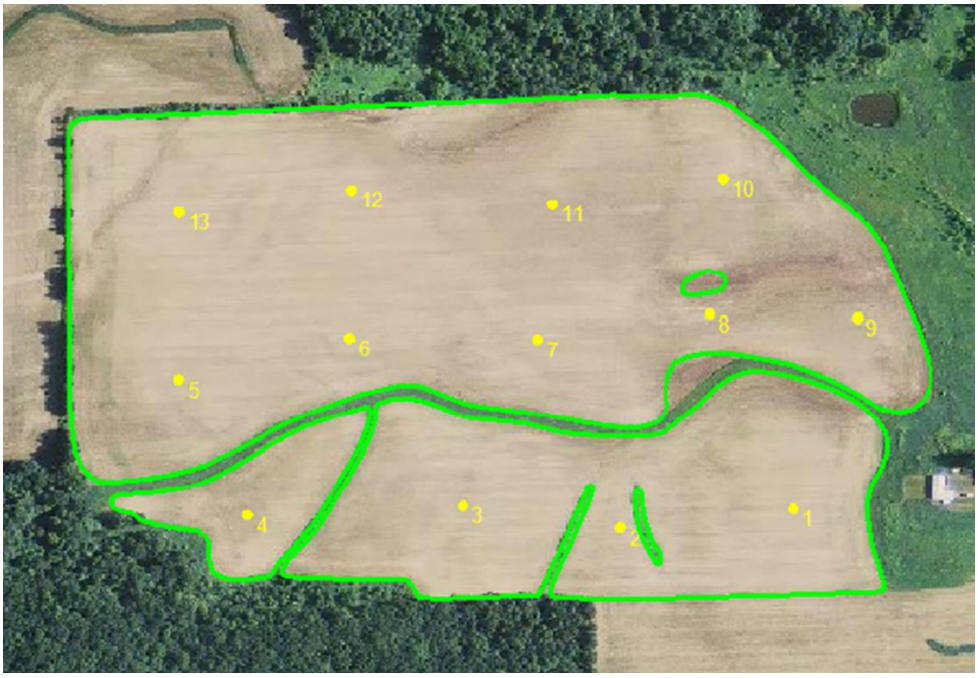

Figure 1. Map of the field used in the research study showing the grid sample locations.

The selected field was an odd shaped 55-acre field (Figure 1). The field has been historically no-till with several waterways present. The field is in a corn to soybean rotation, has somewhat rolling hills, and also has a wet spot near sample #8. No fertilizer or manure was spread prior to sampling this spring.

Part 1: Number of Soil Cores per Sample

For this study, one grid point was randomly selected from the field. Cores were taken at 20 random points around the grid circle (approximately 10 meters). These 20 samples were then analyzed at the lab for Bray-1 P and K, soil pH, and soil organic matter.

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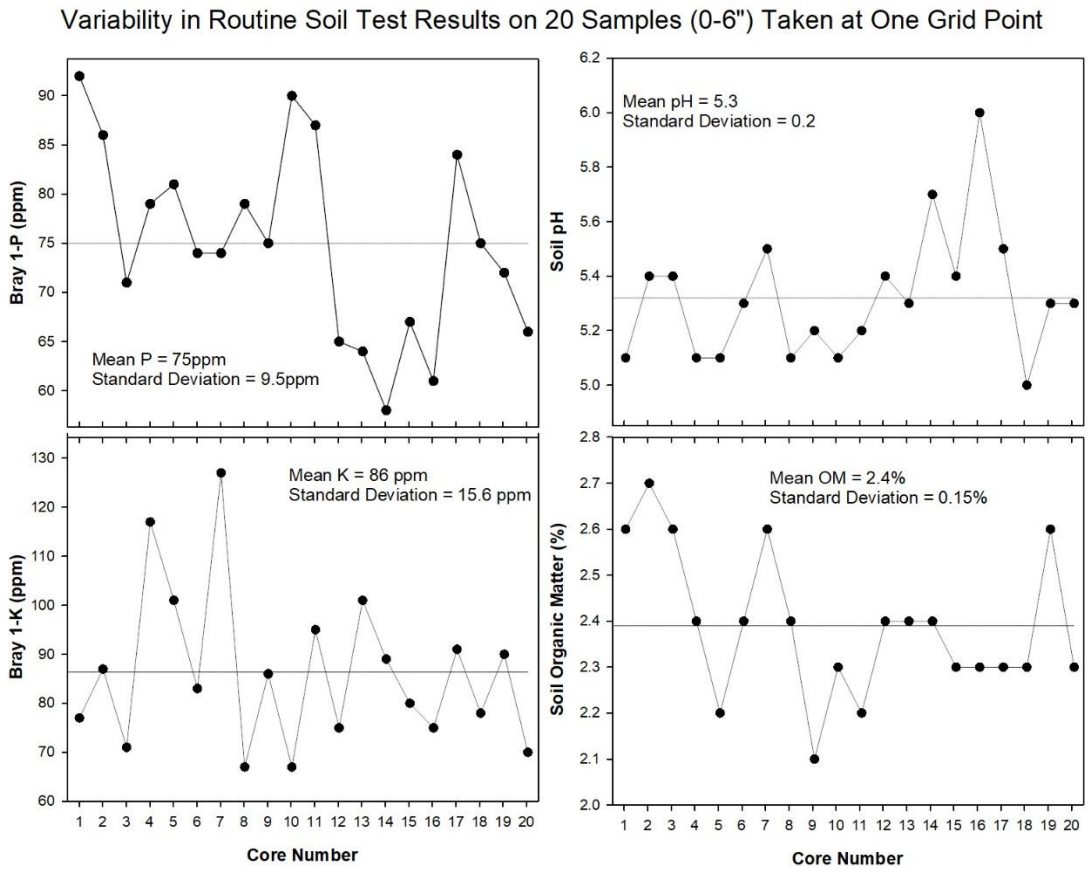

Figure 2. Routine soil test data for 20 individual cores (0-6" depth) collected around one grid point location.

As seen in Figure 2, routine soil test results varied greatly across the 20 soil cores that were collected around 1 grid point location. For example, the mean pH for these 20 cores was 5.3, but pH in the area these cores were taken ranged from 5.0 to 6.0. This data demonstrates how variable soil test data can be even in a small area within a no-till field. This further supports the concept of taking an adequate number of cores to make a composite sample, to accurately represent the variability that exists within the field.

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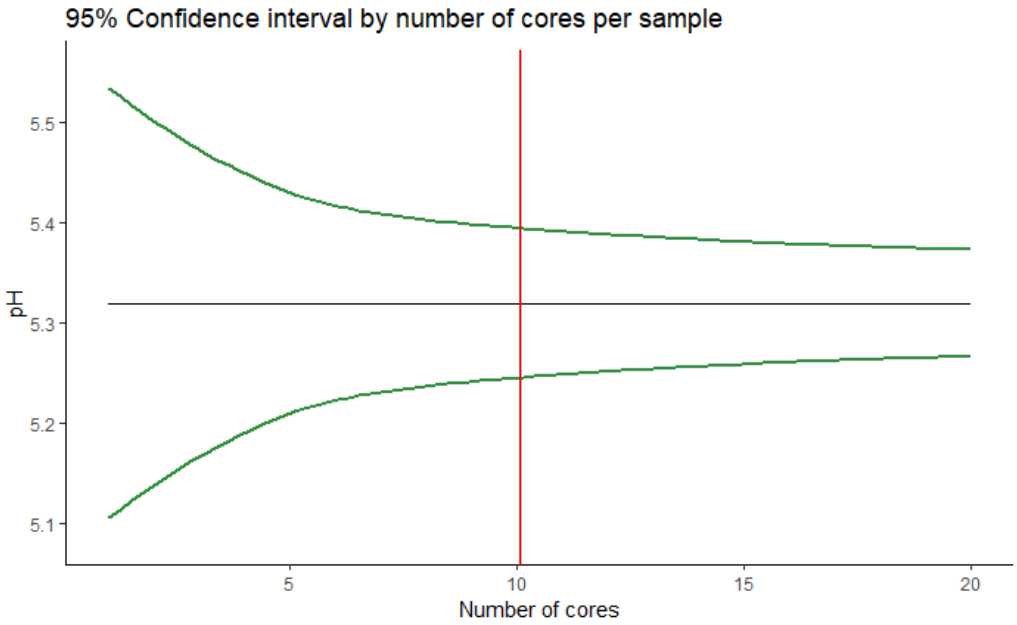

Figure 3. Variability in measured soil pH by number of cores included in a composite sample from one grid point location.

In figure 3 above, the black line represents the average soil pH of all 20 cores, which can be assumed to be the most representative result. The green lines are the 95% confidence intervals for soil pH when 1 through 20 cores were included in making the composite sample. The confidence intervals show that when very few cores were taken to make the composite sample, the pH value could range from 5.1 to just over 5.5 (the true value being just over 5.3). Conversely, when more cores were collected in making the composite sample, the pH ranged from just under and just over 5.3. Other soil test results such as P, K, and OM showed the same conclusion (data not shown). This data suggests that taking 10 cores adequately encompasses the variability in routine soil test data at a given grid point. Taking more than 10 cores per composite sample does not seem to result in additional benefit when thinking about minimizing soil test data variability at a grid point. This finding compares well with the University of Wisconsin's recommended number of cores per sample, being 10 (A2809, 2012).

Part 2: Sampling Depth Study on 5 acre grids

The field had a 5-acre grid overlay done first. This was done to avoid waterways, eroded knolls, etc. At each sample point, 10 cores were taken at a depth of 0-2 inches. The 0-2 inch cores were mixed and put into a sample bag to make one sample. This was repeated in the same holes for depths of 2-6 and 6-10 inches.

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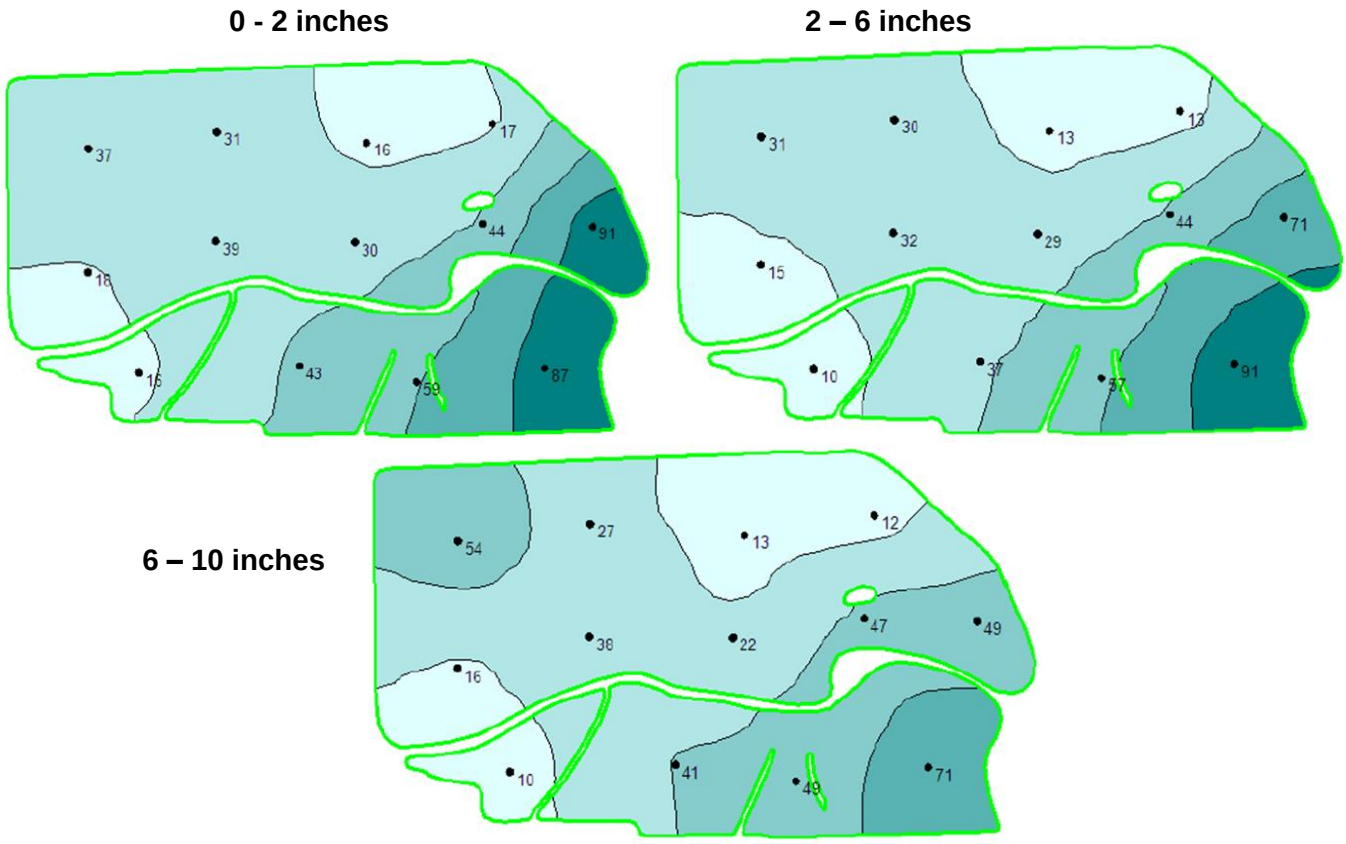

	0-2 inches	2-6 inches	6-10 inches
Minimum	14.90	10.33	10.44
Average	39.95	35.86	34.72
Maximum	94.24	90.97	70.32

Figure 4. Soil test Phosphorus by Depth at each grid point location within the field.

As seen in Figure 4, soil test phosphorus tended to decrease with depth, being highest in the 0-2 inch samples and lowest in the 6-10 inch samples. This trend was even more evident with soil test potassium (Figure 5). Organic Matter was another test that exhibited a similar trend, with higher OM at the surface and a less OM at greater depth.

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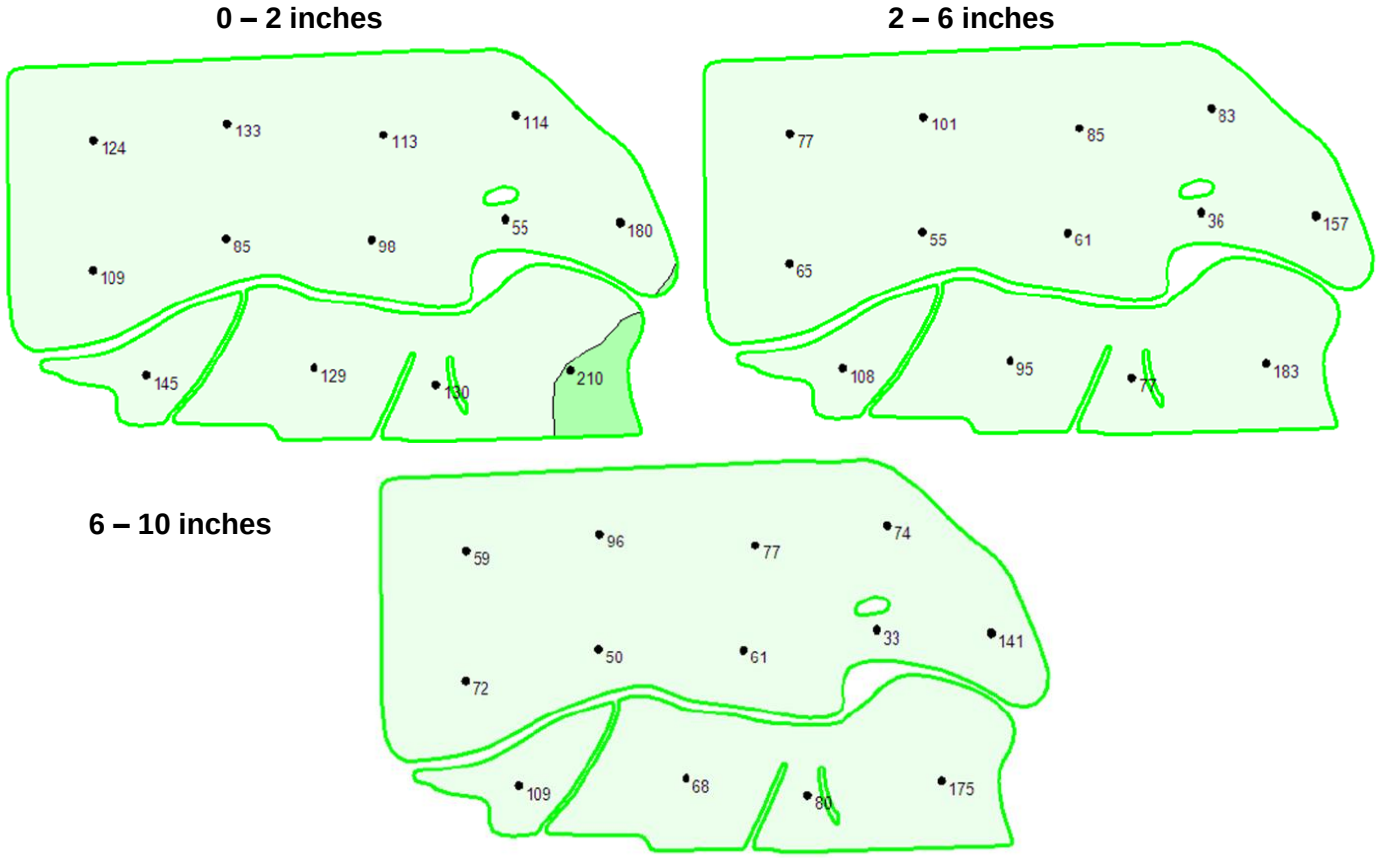

		0-2 inches	2-6 inches	6-10 inches
Minimum		59.26	36.49	39.93
Average		125.97	84.33	91.34
Maximum		217.56	179.45	189.30

Figure 5. Soil test Potassium by Depth at each grid point location within the field

Soil pH data followed an expected trend, with an average pH at 0-2 inches of 5.5, 5.7 at 2-6 inches, and 5.7 at 6-10 inches. This demonstrates the ability for a relatively acidic layer to form near the surface in no-till fields. Calcium and Magnesium increased slightly with increasing depth. Boron, Sulfur, and Manganese concentrations showed little difference between the 0-2 inch and 6-10 inch depths, while Zinc concentrations slightly decreased with increasing depth.

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Takeaway Message

Overall, this study showed that both the number of cores collected to make a composite sample and soil sampling depth have a large impact on soil test results. Taking an adequate number of cores per sample (approximately 10) will greatly reduce the potential variability in the soil test results. Collecting soil cores at the same depth within and between sampling times is also very important for getting representative soil test data that can be tracked over time.

Future Research

In the future, we would like to repeat this study on additional no-till fields to see if the same trends and relationships are observed on different soil types that are potentially managed in different ways. Additionally, we would like to conduct this study on multiple conventionally tilled fields, as we expect different trends on the effects of core number and sampling depth on soil test results. We would also find value in evaluating the effects of wet or seasonally wet areas on soil test levels.