Successful Nutrient Management Begins with Soil Sampling

Soil testing is a vital first step toward successful manure nutrient and environmental management. The information a soil test provides is critical for determining current soil fertility levels. Collecting value requires using the information to make good nutrient management decisions.

Variability is one of the most prominent features of biological systems. In the case of soil sampling, minimal amounts of soil (1 pound) are collected for samples that are intended to represent large field areas (2,500 tons of earth, assuming 2.5 acres). Collecting representative samples is the only means to control and manage this variation. In particular, laboratory techniques for nutrient analysis are estimated to contribute only 2 to 5% of nutrient concentration uncertainty. The remaining 95-98% is from spatiotemporal variability and sample collection.

You can soil sample in either the fall after harvest, before fertilizer application, or the spring before fertilizer application. Subsequent sampling should try to occur at approximately the same time of the year to minimize variation from timing effects. For more information on soil sampling, Take a Good Soil Sample

Two example soil phosphorus profiles are used to illustrate this impact. One of the soils, Soil 1, shows a high testing, highly stratified soil. The other, Soil 2, demonstrates a soil where manure phosphorus was injected. For these two examples, shallow sampling, two inches lower than the suggested 6-inch depth, would have resulted in 40 and 20% higher soil samples than the actual result. Probing deeper than

<table>
<thead>
<tr>
<th>Sampling Depth</th>
<th>Soil 1</th>
<th>Soil 2</th>
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</thead>
<tbody>
<tr>
<td>4-inches</td>
<td>97</td>
<td>16</td>
</tr>
<tr>
<td>6-inches</td>
<td>68</td>
<td>13</td>
</tr>
<tr>
<td>8-inches</td>
<td>53</td>
<td>12</td>
</tr>
</tbody>
</table>

Figure 1. Phosphorus concentrations for the 0-2, 2-4, 4-6, and 6-8 inch depths.

Interpretation of Soil Test Results (PM 1310).
recommended resulted in 30 and 15% lower than the actual result. The impact is more pronounced in soils with higher phosphorus concentrations and where phosphorus concentrations in the soil are more stratified.

From an environmental perspective, the phosphorus in the top two inches of soil impacts phosphorus concentrations in runoff water. Injection or incorporation to reduce phosphorus stratification can help mitigate this concern. However, field and weather conditions should be carefully considered, as the tillage event can lead to more significant erosion and particulate phosphorus transport.

**Manure Sampling**

Using the previous manure sample’s average result has long been accepted as the best estimate for the current manure’s nutrient concentrations for setting the upcoming application rate. Any particular sample requires taking a relatively small volume from large storage and assuming it represents the storage manure. Taking multiple manure samples allows us to better estimate the manure’s nutrient concentration in a particular year as it reduces sampling error, but does this make the previous manure sample’s average a better estimate of nutrient content than any single sample taken in a given year?

One method to test this is to compare the standard deviation of sample results from a particular application event against the "error" that would have occurred if the "average" of all previous sampling events was used to estimate the manure nutrient characteristics. Effectively, this compares how far any particular sample would be from our best estimate of the actual manure nutrient content (the yearly average) against the error generated by assuming it is similar to previous years.

I performed this analysis for five farms. There was no statistical difference between using a sample to represent that year’s manure or using previous years’ averages for two farms. For the other three farms, the manure’s phosphorus concentration was better estimated by the average of prior years than from any particular sample. Presumably, this is because phosphorus is strongly correlated with solids in manure. As a result, it is subject to more significant sampling variability than predominately dissolved nutrients, mainly when the sample was collected during manure removal and how it correlates to manure solids content.

Table 2 provides a summary of the performance of both methods. Lower average values would indicate less error in using that method to estimate nutrient concentration. A lower standard deviation would indicate less magnitude to the degree to which the method estimated incorrectly. Ideally, both the average and standard deviation would be low.

**Table 2. Summary of error from an individual sample compared to the previous year’s average.**

<table>
<thead>
<tr>
<th></th>
<th>Single Sample</th>
<th>Previous Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Average</td>
<td>3.53</td>
<td>6.60</td>
</tr>
<tr>
<td>St Dev</td>
<td>1.85</td>
<td>3.20</td>
</tr>
</tbody>
</table>

There was no statistical difference between the single sample and the previous average in terms of their ability to predict the manure’s nutrient concentration (p = 0.979, 0.533, 0.887). Particularly, both nitrogen and potassium, nutrients that tend to be primarily in the dissolved form, showed no difference in the average error between the two methods. While not estimated differently, phosphorus tended to show lower error by using the average of the previous years’ analysis.

In summary, using the average of the previous samples often provided the best approximation of the manure’s nutrient content. This occurred more often for phosphorus. Its propensity to be associated with solids had more sample-to-sample variability and made collecting a representative sample more challenging.
Spring Manure Sampling Resources

Collecting a sample for manure analysis helps to ensure you are getting the most value from the manure. While average nutrient values do exist for manure, those values can vary by 50 percent or more. The animals’ feed ration, water usage, and management, as well as other factors, can contribute to variation in manure nutrient content. This makes sampling on a regular basis an important part of your nutrient management plan and allows you to adjust your application rate as necessary.

To fully utilize the available nutrients, while protecting the environment, check out the resources listed below:

- AE 3550 How to Sample for Manure Nutrient Analysis
- AE 3601A Calibrating Liquid Tank Manure Applicators
- AE 3607 Manure: A Valuable Commodity
- PM 1941 Calibration and Uniformity of Solid Manure Spreaders
- PM 3014 How To Interpret Your Manure Nutrient Analysis
- PMR 1003 Using Manure Nutrients for Crop Production

Manure Scoop: The Value of Real Time Nutrient Sensing

In this month’s manure scoop we take a look at the value real-time manure application would offer. Head on over and give it a read.

Engineering Your Farm Podcast

This podcast is produced and hosted by the Iowa State University Extension and Outreach Field Agricultural Engineering Team. We are a group of agricultural engineers that work with farmers and agribusiness professionals to help improve the efficiency, profitability, and environmental outcomes on farms. This podcast will feature information and interviews with ISU Extension field ag engineers and others with expertise in engineering and environmental issues in agriculture. We will cover a variety of topics including grain drying, handling and storage issues, livestock facility design and ventilation, soil and water management, manure management, machinery management, composting, farm safety, and more. We will also discuss solutions to common problems with homes and farmsteads, including energy efficiency improvements, indoor air quality, and well water quality. You can find our episodes on many of your favorite podcast players. Please subscribe to the Engineering Your Farm podcast and stay tuned for new episodes.

https://engineeringyourfarm.buzzsprout.com/

Manure Monday

Join us at noon on Monday to hear about dragline manure application. Challenges, opportunities, and applicator perspectives. Sign up and join the conversation.
Events

March – April 2021

Manure Mondays: A Virtual Conversation About Manure
March 22: Utilizing Dragline Systems
April 5: Working with Solid Manures
April 19: Soil Health Impacts

April 14, 2021
Dairy Technology Field Day

April 16, 2021
Livestock and Poultry Environmental Learning Community Webinar
Aerobic Digestion

June 24, 2021
Iowa Swine Day