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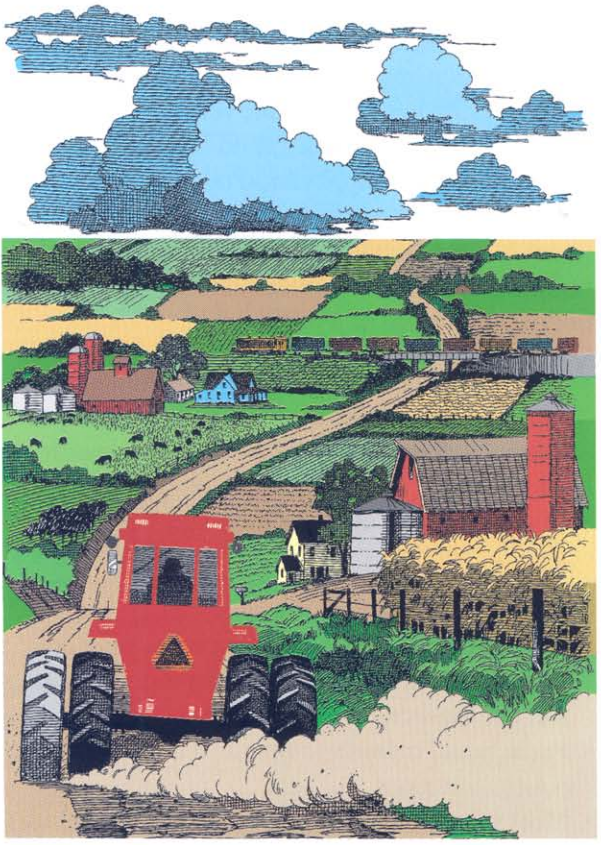
Best Environmental Management Practices

Farm Animal Production

Land Application Records and Sampling

Don Jones and Alan Sutton, Purdue University and Bruce MacKellar, Michigan State University



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Proper land applications of manure saves money by using manure as a plant nutrient resource. This requires testing of both manure and soil. Nutrient concentration, especially nitrogen (N), varies widely in manure. For example, available N values range from 0.03 to 617 pounds per 1,000 gallons in swine lagoons, from 0.1 to 250 pounds per 1,000 gallons in dairy slurry, and from 4 to 140 pounds per ton of nonstockpiled broiler litter. Average nutrient estimates are suitable for the purpose of developing a manure utilization plan but not for calculating proper application rates. Manure samples should be taken as near application time as possible. Certified labs that analyze manure samples can make recommendations regarding the use of the manure as a fertilizer.

Manure Sampling

Proper sampling is the key to reliable manure analysis. Seal and mark the litter samples with the farm name and address, date and location of collection, and an identification number and/or code.

Liquid Manure

- Liquid manure should be sampled after it is thoroughly mixed; take several random samples and composites.
- Place liquid manure sample in a sealed, clean plastic container.
- Most labs require at least 1 pint of material for analysis.
- Leave at least 1 inch of air space in the container to allow for expansion caused by the release of gas.
- Refrigerate or freeze samples that cannot be shipped on the day they are collected.

One pint of material should be taken from at least eight sites around the lagoon and then mixed in the larger clean, plastic container. Effluent should be collected at least 6 feet from the lagoon's edge at a depth of about a foot. Avoid floating debris and scum.

Galvanized containers should not be used due to the risk of contamination from metals like zinc in the container.

Solid Manure

Solid manure samples should be representative of the manure's average moisture content. Stockpiled manure and surface-scraped materials should be sampled at a depth of at least 18 inches at six or more locations and combined to make a composite sample. Approximately 1 quart of the mixed sample should be placed in a durable plastic bag, sealed, and shipped directly to the lab with dry ice. Samples to be stored for more than two days should be refrigerated.

Poultry cake litter samples should be taken at the depth of cake removal.

What Does the Manure Analysis Tell Me?

Lab results are presented in a number of ways. The easiest to use is a wet, "as-is" basis in pounds of plant-available nutrient (nitrogen (N), ammonium N (NH_4), phosphorous (P), or potassium (K)) per ton if solid, per 1,000 gallons if liquid, or per acre-inch if irrigated. *In Michigan, ammonia levels will also be neded to estimate field losses.* If a lab reports results on a dry basis, you must know the moisture content of the manure to convert the results back to a wet basis. Some labs give results as a concentration (parts per million (ppm) or milligrams per liter (mg/l)). If P and K are given as elemental P and K, convert them to the fertilizer basis of P_2O_5 or K_2O.

The most useful information is estimated nutrients available for the first crop. Nutrient availability is predicted based on estimates of manure breakdown and nutrient loss according to application method. Nutrients listed in the report or calculated as "available for the first crop" should be used to determine the actual application rate.

Review the analysis to see if it is within the expected range for your manure. Manure analyses can vary between seasons, due to excess rainfall, drought, or changes in management practices. Compare it to previous reports to ensure that it is reasonable. If significantly different from expected values, resample the manure. The original sample may have been mislabeled, improperly collected, or not representative of the manure.

Soil Sampling

Soil testing is the most reasonable means of assessing soil pH and plant-available nutrients, determining the need for lime and nutrients, and minimizing environmental damage from over application of manure. Soil samples submitted for testing should consist of about 15 to 20 cores taken throughout the field. Pulverize the cores and mix them thoroughly in a clean plastic bucket (Figure 1). Fill the container about two-thirds full with this mixture. Each sample should represent only one general soil type or condition (Figure 2). If the field contains areas that are different in slope, color, drainage, or texture, submit a separate sample for those areas.

When collecting samples, avoid small areas where the soil conditions are obviously different from those in the rest of the field, for example, wet spots, old manure and urine spots, places where woodpiles have been burned, severely eroded areas, old building sites, fence rows, spoil banks, etc., because samples taken from these locations are not typical of the rest of the field.

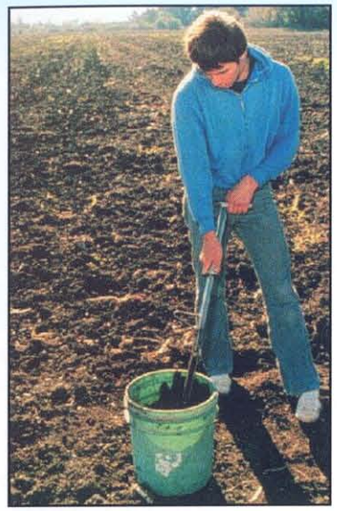

Figure 1. *Soil cores should be pulverized and mixed thoroughly in a clean plastic bucket.*

Using a Soil Test to Adjust and Monitor Manure Application

Most manure application rates are based on supplying crop N needs, although P will likely be used in the future (as is currently the case in Michigan). N should not be applied at rates greater than the crop can use because the nitrate form of N can leach through the soil to the groundwater. Other nutrients may be stored in the soil just as one stores money in a bank and will generally remain in the soil until used by plants or until the soil becomes saturated with the nutrients.

Ranking Fields for Manure Applications

Nutrient concentrations in a soil test may be reported as index values. Index values are used to predict soil fertility levels or potential heavy metal toxicities. They are also used to relate soil fertility levels to the likelihood of an increase in crop yield resulting from a fertilizer application (Table 1). When the index value is high or very high, no additional plant nutrients are needed. When index values are less than these critical

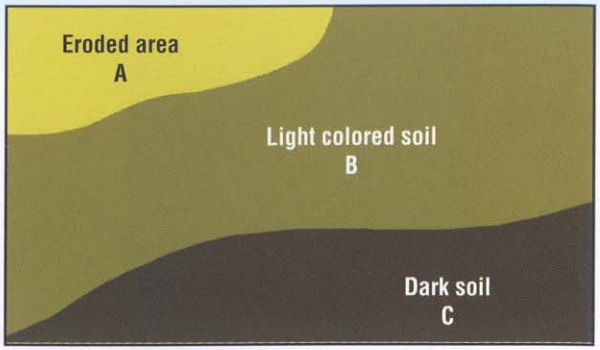

Figure 2. Within each field, collect a separate sample from each area that has a different type of soil or different management history.

levels (low or medium, depending on the nutrient), the soil test report will indicate the amount of nutrient to apply for optimum plant growth in the "Recommendations" section of the report.

Note: Soil test index values above 100 indicate excessive nutrient levels are present. Some labs use a concentration level (e.g., ppm) in the soil as the basis for the index system.

By monitoring soil test index values for various nutrients, nutrient buildup to undesirable levels can be avoided. In general, if the soil index for P or micronutrients is high or very high, other fields should be used for manure application. The long-range goal of nutrient management is to maintain good soil fertility levels in all fields and avoid nutrient buildup and runoff that can contaminate surface waters. ***A good rule is to select the application field based on soil test for P and determine application rate based on manure test for N.***

Table 1. Example relationship between soil test index and crop response.

(Note: These ratings may not be relevant in your state.)

Soil Test Index	Expected Crop Response to Nutrient Application			
Range	Rating	P+*	Zinc	Copper
0 to 25	Low	High	High	High
26 to 50	Medium	Low	None	None
51 to 100	High	None	None	None
100+	Very high	None	None	None

+ For organic soils, the range for P ratings are Low (0 to 16), Medium (16 to 30), and High (30+).

* Phosphate recommendations above the 50 index are designed to replenish nutrients removed by crops and for building purposes.

Application Records

Application records provide evidence that you are managing manure applications properly and not exceeding agronomic rates.

The following application records should be kept on the farm:

1) Records that indicate how much of what type of manure was applied, the date of application, and the date of incorporation.
2) Map of farm fields including manure application fields and acreage of each field.
3) Calculations showing how the application rate was determined to meet crop needs.
4) Manure sample analysis (best if taken just before application).
5) Regular soil analysis for each field receiving manure applications (should be taken at least every three years).

These records should be maintained for five years (or for the period required by state rules), and made available to regulatory personnel if requested.

Useful Conversions

$P \times 2.29 = P_2O_5$

$K \times 1.2 = K_2O$

Lb/1000 gal = PPM/120

Lb/ton = PPM/500

About this Publication

The material discussed here presents general sampling and record-keeping guidance; you should become familiar with sampling and record-keeping recommendations and requirements in your area or state to properly manage your manure and ensure compliance with state regulations.

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