NM1259 (Revised January 2021)

Solid Manure Sampling for Nutrient Management Planning


1


2


3


4

NDSU | EXTENSION

North Dakota State University
Fargo, North Dakota

Mary A. Keena
Livestock Environmental Management Extension Specialist
Carrington Research Extension Center

Photos by the author

On the cover

1. Collect 10 quart-sized subsamples from various depths and locations in the manure pile and place them together in a bucket.
2. Mix the subsamples together thoroughly.
3. Place one pint-sized sample into a sampling container.
4. Place the labeled sample in a cooler and transfer to a freezer if you are not delivering it to the lab on the day it is collected.

Why sample manure?

Manure is highly variable in composition and nutrient availability, compared with commercial fertilizer, which has a guaranteed analysis. As reported in NM2007, "Nutrient Characteristics of Solid Beef Manure in North Dakota," the nitrogen in solid beef manure in North Dakota ranges from 4 pounds per ton to 32 pounds per ton. Manure nutrient values depend on many things, including:

- Manure type
- Animal source
- Animal size
- Animal diet
- Bedding used
- Weather conditions
- Manure handling practices
- Storage systems

Accurate sampling and laboratory testing provides actual manure nutrient information. This information allows crop producers to strategize for maximum crop yields and minimal manure nutrient impact to the environment.

How should solid manure be sampled?

Contacting the laboratory you wish to send your sample to, before taking samples, is best. This is because each lab may have its own preferences for sample size, packaging and delivery. Some labs will furnish sample containers and mailers free of charge. Your local Extension agent can help you find a lab that is right for your needs.

If you have manure storage sites (stockpiles, compost, etc.) from multiple animal sources, take care to collect samples from these sites. Samples should be taken from each manure storage site that represents a different animal source, type, size, age, diet, management practice and type of storage structure or other factor that could affect nutrient values.

To start the sampling process, collect 10 to 15 quart-sized subsamples using a spade or shovel from various locations and depths in the pile. Avoid sampling the dry top crust or other parts of the stockpile that may not be representative. Mix subsamples thoroughly in a bucket. Collect 1 to 2 pints and place in a sealable plastic bag or a plastic bottle with a lid, or use the sampling containers the lab has provided you.

This sampling procedure is consistent with analysis criteria stated in the USDA-NRCS North Dakota 590 Nutrient Management Standard.

How should manure samples be handled?

Samples must be labeled before sending to the lab for analysis. Labeling with date, species and location is a good practice (for example, fall 2019 beef stockpile). If collected during warm weather, the sample should be placed on ice, in a cooler, and delivered to the lab as soon as possible. If samples are going to be mailed, freeze immediately after collection. Send samples early in the week to avoid weekend layovers.

Manure is changing constantly in physical, chemical and biological characteristics. Keeping samples cool slows the process of change and gives you a better snapshot of what is happening in the stockpiled manure.

What to analyze?

When a manure sample is submitted for analysis, you will need to tell the lab what nutrients you want analyzed. You can request almost any nutrient, as well as organic matter, pH and electrical conductivity (salts).

Total nitrogen (N), inorganic N, phosphorus (P) as P_2O_5, and potassium (K) as K_2O are the main nutrients you need to know for nutrient planning. Other nutrients such as sulfur and zinc also may be important for nutrient planning purposes. Total salt analysis may be useful if salts are a concern in the soil to which manure is to be applied.

How should results be reported?

Manure test results should be reported "as is" or "as received" because that is the way manure will be land applied. If results are on a dry-matter basis, values can be multiplied by the manure dry-matter percentage (expressed as a decimal) to obtain the equivalent wet weight.

Example:

If total N = 2% dry basis and the sample is 60% dry matter, then N = 2 x 0.6 = 1.2% as is.

How do I read my manure report?

Sample Fall 2020 beef stockpile

Type Solid manure

Source Beef

Storage Stockpile

Lab number LN652

- **"Sample"** is what you have named the sample to remember where it was taken from (for example, bull pen vs. finishing steers vs. stockpile).
- **"Type"** and **"source"** describe what kind of manure and the species from which it was taken.
- **"Storage"** describes how the manure was stored when the sample was taken (for example, stockpiled vs. composted vs. not piled).
- **"Lab number"** is assigned by the lab and used if you ever have any questions about your manure report. You can call the lab that did the analysis and receive information by using this number.

Moisture **46**
Dry matter **54**

- These numbers are expressed as percentages. The moisture is the percent of water that was in the sample when it arrived at the lab. The dry matter (DM) is the percent of everything left (solids) after the sample is dried.

	Dry Basis	As Received	lbs/ton
Total nitrogen (N)		1.00%	20
Ammonium nitrogen		0.0053%	0.11
Nitrate nitrogen		0.052%	1.00
Inorganic nitrogen		0.057%	1.1
Organic nitrogen		0.94%	19
Phosphate (P_2O_5)	0.73%	0.39%	7.9
Potash (K_2O)	0.78%	0.42%	8.4

- **"Dry Basis"** is the percent of each element present in the manure sample; it's calculated after removal of moisture from the sample.
- **"As Received"** is the percent of each element present in the manure sample; it's calculated with no manipulation (drying) of the sample.
- **"Lbs/ton"** is the total pounds of each element that is present in 1 ton (2,000 pounds) of manure.

The nutrient content of the manure should be in the same units used in calibrating the land application equipment. For solid manure, typically pounds per ton is used. For solid manure spreader calibration procedures, see NDSU Extension publication "Manure Spreader Calibration for Nutrient Management Planning" (NM1418).

Phosphorus should be reported as P_2O_5 because this is the value used in fertilizer application planning. If results are in elemental P, the conversion formula is: P x 2.29 = P_2O_5.

Potassium should be reported as K_2O because this is the value used in fertilizer application planning. If results are in elemental K, the conversion formula is: K x 1.20 = K_2O.

If results are given in percents, the following conversion factor can be used to get results in a more usable form: percent x 20 = pounds per ton. For example, in the table at left, total N is 1.00 as received x 20 = 20 lbs/ton or K_2O is 0.42 as received x 20 = 8.4 lbs/ton.

How can manure analyses be used?

Using **Tables 1 and 2 (Page 4)**, the crop-available portion of manure nutrients can be estimated. Manure nutrient analyses, combined with soil tests, previous crop credits and crop nutrient requirements, can be used to determine the proper application rate for manure. Determine crop nutrient requirements using NDSU Extension publication "North Dakota Fertilizer Recommendation Tables and Equations" (SF882).

Table 1. Nitrogen Availability and Loss as Affected by Method of Manure Application for Beef.

	Broadcast Incorporation Time[2]		
Year Available[1]	**> 96 hrs.**	**12-96 hrs.**	**< 12 hrs.**
	— Percent of Total Nitrogen Available Per Year —		
Year 1 (first crop)	25	45	60
Year 2 (second crop)	25	25	25
Lost	40	20	5

Adapted from: Calculating Manure Application Rates. Table 1: Nitrogen availability and loss as affected by method of manure application and animal type. University of Minnesota Extension. 2019. Accessed *May 2020. https://extension.umn.edu/manure-land-application/calculating-manure-application-rates#step-3%3A-divide-the-answer-from-step-1-by-step-2-1124362*

[1] Third year available N is not listed but can be computed by adding first and second year and lost percentages and subtracting this sum from 100.

[2] Timing categories refer to the length of time between manure application and incorporation.

Table 2. Phosphorus and Potassium Crop Availability for Beef Manure.

Nutrient	Percent of Total P and K Available in Year One
Phosphorus	80%
Potassium	90%

From: Manure Characteristics. Figure 4. Calculations for determining plant-available phosphorus and plant-available potassium. University of Minnesota Extension. 2018. Accessed May 2020. *https://extension.umn.edu/manure-land-application/manure-characteristics#phosphorus-and-potassium-817861*

Example

Using the North Dakota Corn N Calculator, you can determine that for corn grown in Foster County under conventional tillage methods of medium-texture soils with historic yields greater than 160 bushels/acre with 45 pounds/acre soil test N and soybean as the previous crop, you need 137 pounds of N/acre. Knowing you have 20 pounds of N/ton from the manure analysis and that approximately 50% of the total N is available for crop production during year one, you would need to apply the manure at a rate of 13.7 tons/acre.

Using NDSU SF882, we know that if our soil test P is in the medium range (8 to 11 ppm), we need to add 52 pounds of P_20_5/acre, and if soil test K is in the high range (121 to 160), then we need to add 60 pounds of K_2O/acre. We know from our sample above that we have 7.9 pounds/ton of P_2O_5 and 8.4 pounds/ton of K_2O in the manure.

Remember, 80% of the P and 90% of the K are available the first year for plant growth. So, if you're spreading 13.7 tons/acre, then you are applying 87 pounds of P/acre and 104 pounds of K/acre. Applying the manure from the sample above at a rate of 13.7 tons/acre meets/exceeds the necessary crop requirements.

Need more assistance?

If you have questions about manure analysis or nutrient management planning, please contact your local Extension office.

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under number 69-3A75-17-17. USDA is an equal opportunity provider and employer. Any opinions, findings, conclusions, or recommendation expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.

Reviewers: Leslie Johnson, University of Nebraska-Lincoln Extension; Penny Nester, NDSU Extension Agent, Kidder County; Angie Johnson, NDSU Extension Agent, Steele County.

The current author extends appreciation to the previous authors for their contributions.

For more information on this and other topics, see www.ag.ndsu.edu

250-3-04; 1M-12-07; 500-1-21; rev-3-21