How to Interpret Your Manure Analysis

Introduction

Manure analysis is a critical component of proper nutrient management planning. Table or book values of manure nutrient concentrations can serve as a starting point for planning purposes, but actual manure sample analysis provides a better indication of manure nutrient concentrations and will help better define application rates. Utilizing manure testing will help achieve the potential as a crop nutrient source, and result in reduced chance for misapplication that could lead to lower crop productivity or increased environmental risk.

Sampling Frequency and History

Collecting manure samples for nutrient analysis should not be a one-time event. Manure samples should be taken at least yearly, near the same time every year to account for any seasonal changes, and preferably near or during land application. Once samples have been collected for at least three years, and with no significant changes due to feed inputs, management or storage, then sampling frequency can be reduced. If feed inputs, management, storage or land application frequency change frequently, samples should continue on a yearly basis.

Sampling strategies can be found in PM 1558, ***How to Sample Manure for Nutrient Analysis***. One recommendation is to collect samples as the manure is being land applied. Sampling during land application will prevent you from having a nutrient analysis available to determine application rates, but this method ensures you have a well mixed sample and you will know what nutrients were applied (along with the known application rate). By sampling yearly, you will build a history of analyses allowing you to determine application rates. You can further refine your nutrient applications by using the results of samples collected at application and adjusting rates with fertilizers if needed.

Information for your Manure Analysis

When collecting and submitting a sample it is important you provide as much information about the sample as possible. In addition to your name, address, phone number, (and email if available), you also need to provide a sample identification name or number so you can remember where and when the sample was taken. It is also recommended that you record the species of animal, how the manure is stored, if there is bedding, the type of bedding, and how the manure is land-applied.

Nutrient Analysis

As a minimum, all manure samples should be analyzed for total nitrogen (N), total phosphorus (P), total potassium (K), and moisture content (or dry matter). You may choose to have your sample analyzed for ammonium-N as well. Other tests may include micronutrients and total salts.

Total N is often reported as TN or TKN. TKN is Total Kjeldahl Nitrogen. Kjeldahl refers to a specific analytical method. Total N is a measure of all N contained in the sample and represents both organic and inorganic N fractions. Because organic N is not immediately available to plants, the total N value does not, necessarily, represent plant available N, nor does it represent any losses that may occur due to volatilization, denitrification, or leaching after application.

Ammonium-N (NH_4-N) represents the inorganic N fraction commonly occurring in manure. Typically there is no or little inorganic nitrate-N (NO_3-N). Ammonium-N is plant available. Subtracting the ammonium concentration from total N provides the estimate of organic N in the manure sample.

Total P may be expressed as P or P_2O_5 in the lab analysis report. If reported as P, it can be converted to P_2O_5 so as to be consistent with commercial fertilizer analyses and application recommendations. To convert from P to P_2O_5, multiply P by 2.29.

Total K may be reported as K or K_2O in the lab analysis report. If reported as K, it can be converted to K_2O to be consistent with commercial fertilizer analyses and nutrient application recommendations. To convert from K to K_20, multiply K by 1.2.

Secondary and Micronutrients

Manure sources contain all secondary and micronutrients necessary for growing crops. Having manure analyzed for secondary and micronutrients is not necessary unless you think you are experiencing a specific deficiency. This analysis will help you determine how much of that nutrient you are applying.

Moisture Content (as is) or Dry Matter Content

All manure analyses should include either the moisture or dry matter content, and are usually expressed as a percentage. Dry weight analyses are useful for comparing nutrient levels without the dilution effect of water. However, since most producers need to account for the entire volume or weight of

IOWA STATE UNIVERSITY
Extension and Outreach

PM 3014 September 2011

manure (including water) when determining application rates, ask the laboratory to also report the nutrient analysis values on an "as-is" basis which accounts for the moisture content.

pH/Electrical Conductivity/Carbon: Nitrogen Ratio

Most laboratories do not report the pH of manure samples as part of the standard test package. However, if manure is to be surface applied, then knowing the pH can be beneficial as high pH can increase the proportion of ammonium-N as ammonia-N and therefore result in increased volatilization during or after application.

Electrical conductivity (EC) is an indication of soluble salts. The units of measure are either millimhos per centimeter (mmho/cm) or deciSiemens per meter (dS/m). Soluble salts include all ions that are contained in manure liquids. This measurement can be used to help determine salt addition and potential salinity. Generally, salt build-up in Iowa soils from manure application is not a concern because of adequate rainfall that leaches salts out of the root zone. A measure of EC may be important when irrigating liquid manure or effluent onto standing crops so as to avoid potential leaf burn.

Example Manure Analyses

EXAMPLE: Basic Analysis

Cyclone Laboratories, LLC.
1000 Easy Street
Cyclone Nation, IA 12345

Joe Farmer
239840 Trail Ridge Lane
Our Town, IA 54321

Account Number: 50010
Sample Type: Beef Manure
Description: Barn A

Sample Submitted Date: 11/30/09
Received Date: 12/1/09
Report Date: 12/4/09

Test	Analysis as received (%)	Nutrients lbs/ton
Total Nitrogen (N)	0.82%	16.4
Phosphorus (P_2O_5)	0.62%	12.5
Potassium (K_2O)	0.91%	18.3
Total Solids	47.2%	

Comments:

1. These are reported on an as-is basis.
2. The analysis is total nutrient content. When crediting manure as a nutrient source, the nutrients are considered only partially available the first year of application because some of them are in the organic form.

EXAMPLE: Analysis with Micronutrients

Cyclone Laboratories, LLC.
1000 Easy Street
Cyclone Nation, IA 12345

Joe Farmer
239840 Trail Ridge Lane
Our Town, IA 54321

Account Number: 50010
Sample Type: Liquid Swine Manure
Description: Barn A-Johnson Farm/Finisher

Sample Date: 10/17/11
Received Date: 10/19/11
Report Date: 10/20/11

Test	Analysis as received	Nutrients lbs/ 1,000 gal	Est. 1st year availability lbs/1,000 gal
Ammonium Nitrogen (NH_4-N)	0.47%	39.2	36.0
Organic Nitrogen (N)	0.10%	8.3	7.0
Total Nitrogen (N)	0.57%	47.5	44.0
Phosphorus (P_2O_5)	0.48%	40.0	31.0
Potassium (K_2O)	0.14%	11.7	10.0
Sulfur (S)	0.25%	20.8	9.0
Calcium (Ca)	0.36%	30.0	22.0
Magnesium (Mg)	0.25%	20.8	15.0
Sodium (Na)	0.23%	19.2	14.0
Copper (Cu)	136 ppm	1.13	0.80
Iron (Fe)	104 ppm	0.87	0.62
Manganese (Mn)	532 ppm	4.43	3.15
Zinc (Zn)	145 ppm	1.20	0.86
Moisture	97.7%		
Total Solids	2.3%		
Soluble Salts (EC)		4 mmho/cm	
pH	8.8		

Comments:

1. These are reported on an as-is basis.
2. The analysis is total nutrient content. When crediting manure as a nutrient source, the nutrients are considered only partially available the first year of application because some of them are in the organic form.

The carbon (C) to N ratio (C:N) is a ratio of the total N and C analyses and is primarily measured in compost or manures containing large amounts of bedding or litter. The C:N ratio gives a general indication of whether the manure will be an immediate source of plant available N, or if microbial decomposition of the manure will make N plant unavailable (i.e. tie up or immobilize N) after application.

Nutrient Availability

Some laboratories provide an estimate of nutrient availability. This estimate is based on livestock species, manure type, if the manure contains bedding, storage, handling and land application methods.

These estimates may or may not be based on research from land-grant universities and in some cases do not match what state regulatory agencies may require for nutrient management planning.

Caution is urged when using these values as reported on the manure analysis. In Iowa, manure nutrient availability values are published in PMR1003, ***Using Manure Nutrients for Crop Production***.

Using your Results in a Manure/Nutrient Management Plan

Once you have your manure test analyses back from the lab, you can use them in your manure plan to determine application rates or to determine the amount of nutrients applied from the manure. Application rates are primarily based on N or P needs for crop production. In Iowa, required nutrient management plans must use the Iowa P-Index to determine if rates will be based on N or P.

Using Example Analyses

Using the example manure nutrient analyses provided in this fact sheet, the nutrient concentrations from your swine finisher building are:

Total N: 47.5 lb N/1,000 gal

Total P: 40.0 lb P_2O_5/1,000 gal

Total K: 11.7 lb K_2O/1,000 gal

Your Iowa P-Index Score is 1.8, which allows you to apply manure at a N rate. You are applying manure to corn in a corn-soybean rotation. You are planning nutrient applications for 200 bu/acre corn yield. Your soybean yield average is 60 bu/acre. Your ***soil test*** is 19 ppm Bray P_1 (Optimum category) and 165 ppm Ammonium Acetate K (Optimum category). You will inject the liquid manure.

The N rate based on corn fertilization need for the rotation is 133 lb N/acre (Maximum Return to N, MRTN) based on the ***Corn N Rate Calculator*** and a price ratio (N price to corn price) of 0.10. An alternate rate could be based on a lower price ratio, 0.05, where the value of N in the manure is discounted. That MRTN rate is 153 lb N/acre. (NOTE: DNR manure plans still allow you to use a yield goal multiplied by a N factor to determine N application rates).

For the two year rotation, the ***removal rate*** (based on harvested grain since the soil test is in the Optimum category) for P_2O_5 is 123 lb/acre (75 lb/acre for corn + 48 lb/acre for soybean). The ***removal rate*** for K_2O is 150 lb/acre (60 lb/acre for corn + 90 lb/acre for soybean).

The manure is injected in late fall and the crop ***nutrient availability*** is 100% for N, P, and K.

The manure ***N volatilization correction factor*** is 0.98 for injected manure.

The manure application rate based on N is:
133 lb N/acre ÷ 47.5 lb N/1,000 gal x 0.98 (volatilization correction factor) x 1.00 (availability factor) = 2,800 gal/acre.

At this N application rate you have supplied:

2,800 gal/acre x 40 lb P_2O_5/1,000 gal x 1.00 (availability) = 112 lb P_2O_5/acre

2,800 gal/acre x 11.7 lb K_2O/1,000 gal x 1.0 (availability) = 32 lb K_2O/acre

The N based rate allows P to be met for the corn crop (75 lb P_2O_5/acre) and part of the soybean crop need, but supplemental P will need to be applied for the following soybean crop. The N based rate does not meet the K needs for either crop. Supplemental K will need to be applied.

If you receive a manure analysis lab report with odd numbers or concentrations that seem really high or low you should consider asking the lab to re-analyze the sample again. This should be done as quickly as possible since most labs only keep samples for a short period of time.

Conversion Factors

To switch from	Multiply by	To get
mg/l	1.0	ppm
ppm	0.0001	percent
ppm	0.00834	lb/1,000 gal
ppm	0.002	lb/ton
ppm	0.2265	lb/acre-inch
lb/1,000 gal	0.012	percent
lb/ton	0.05	percent
percent	83.4	lb/1,000 gal
percent	20	lb/ton
percent	10,000	ppm
percent	2,265	lb/acre-inch
ton	2,000	lb
acre-inch	27,200	gallons
P (elemental)	2.29	P_2O_5
K (elemental)	1.2	K_2O

Useful Equations:

Converting dry weight analysis to "as-is" or wet weight:

lb/ton = (% solids/100) x (% dry weight/100) x 2,000 lb/ton

lb/1,000 gal = (% solids/100) x (% dry weight/100) x (density in lb/gal x 1,000)

Resources

A3769, ***Recommended Methods of Manure Analysis*** (University of Wisconsin)

Corn Nitrogen Rate Calculator

MWPS-18, ***Livestock Waste Facilities Handbook, Third Edition*** (Midwest Plan Service)

MWPS-18-S1, ***Manure Characteristics: Section 1*** (Midwest Plan Service)

PM 287, ***Take a Good Sample to Help Make Good Decisions***

PM 1584, ***Cornstalk Testing to Evaluate Nitrogen Management***

PM 1588, ***How to Sample Manure for Nutrient Analysis***

PM 1688, ***A General Guide for Crop Nutrient and Limestone Recommendations in Iowa***

PM 1714, ***Nitrogen Fertilizer Recommendations for Corn in Iowa***

PM 2015, ***Concepts and Rationale for Regional Nitrogen Rate Guidelines for Corn***

PM 2026, ***Sensing Nitrogen Stress in Corn***

PMR 1003, ***Using Manure Nutrients for Crop Production***

Authors: Angela Rieck-Hinz, extension program specialist; Thomas G. Miller, project planning specialist-Ag; John E. Sawyer, professor of agronomy and extension soil fertility specialist. Reviewers: L.G. Brenneman and Joel DeJong, extension field specialists; Mark Garrison and Eric Hurley, Iowa NRCS.

This publication is made available with partial support from the Iowa USDA-NRCS through cooperative agreement number 68-6114-10-2; and funds from the Smithfield Settlement with the State of Iowa.

This publication is available from the ISU Extension Online Store in printed format and as a downloadable PDF. Visit the store at ***https://store.extension.iastate.edu/*** or call the distribution center at 515-294-5247.