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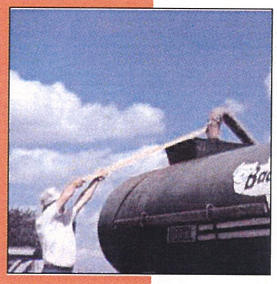
Recommended Methods of Manure Analysis



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Introduction

The benefits of applying livestock manure to crops have been recognized for centuries. Nutrient composition of manure varies with a number of factors, including animal type, bedding, ration, storage/handling, environmental conditions, field application method, and age of manure. These factors certainly present sampling and analysis challenges. In addition, the chemical form and amount of each nutrient varies between fecal and urine fractions.

Nutrient values can be assigned by using estimated "book" or average available N, P_2O_5 and K_2O contents. However, testing manure may better indicate how animal management and other factors actually affect nutrient content. In fact, many state nutrient management programs now require manure testing as part of farm nutrient management.

Using good sampling technique is critical for having confidence in manure nutrient analysis results. Appropriate sample handling and laboratory methods are also important to ensure producers have confidence in test results. However, quantifying the nutrient value of applied manure remains a complex challenge. This information is needed to better manage manure as a nutrient asset.

Work on the development of this multi-regional publication began in 1996 following a joint meeting of regional soil testing workgroups in Raleigh, North Carolina. Earlier in that year, a sample exchange was conducted with NCR-13, SERA-6 and NEC-67 laboratories. Results from that sample exchange were presented at the Raleigh meetings and sparked interest in joining efforts to develop a manure testing manual, which could be used in all regions. This document is the result of the work of this multi-regional committee in developing a reference document for sampling and testing livestock manure.

—John Peters

Note: Reference to commercial products or manufacturers' names throughout this publication does not constitute an endorsement by the authors. When this type of information is listed, it is only done to give the reader an indication of the relative type of equipment, chemicals and supplies that are required.

The authors wish to thank the following individuals for their assistance in developing this manual:

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Unit I **Sampling Livestock Waste for Analysis**

John Peters and Sherry Combs

1. Introduction

There are essential pieces of information required to determine the proper application rate and nutrient credits for livestock waste to meet crop needs. These include the acreage of the field, capacity of the spreader and nutrient concentration of the manure. Nutrient concentration can be assigned by using estimated "book" or average available N, P_2O_5 and K_2O concentrations. However, testing manure may better indicate how factors such as animal and manure management affect manure nutrient content. Using good sampling technique is critical for maintaining confidence in manure nutrient analysis results. Appropriate sample handling and laboratory methods are also important to ensure accurate results.

2. Sampling livestock waste

Data in the livestock waste facilities handbook (MWPS-18, 2000) provides "typical" or average nutrient contents for manure from several types of animals. These values probably give an acceptable estimate for "typical" producers, especially if current sampling methods used do not represent the pit, pack or gutter adequately. However, an analysis of a well-sampled system may give a better estimate of manure nutrient concentrations for individual farms than book values, especially if herd and manure management are not "typical." The MWPS total nutrient estimates are compared in table 1 to actual manure analysis of 51 farms in Minnesota (Wagar et al., 1994) and from 1959 manure samples submitted to the University of Wisconsin Soil and Forage Analysis Laboratory between 1998–2001 (Combs, 1991). On average, the actual farm values compare

Table 1.
Comparison of analyzed manure total nutrient concentrations to "typical" nutrient concentrations

Animal Type	System	Nutrient	Minnesota*		Wisconsin**			MWPS***
			Avg.	Range	Avg.	s.d.	Range	Avg.
					lbs/1000 gal			
Dairy	Liquid	N	29	10-47	22	9	1-73	31
		P_2O_5	15	6-28	9	7	1-118	15
		K_2O	24	11-38	20	11	1-114	22
					lbs/t			
Dairy	Solid	N	13	7-25	12	10	2-97	9
		P_2O_5	6	3-13	6	7	1-78	4
		K_2O	8	2-18	8	7	1-60	7
					lbs/1000 gal			
Swine	Liquid	N	48	7-107	34	20	1-91	28
		P_2O_5	28	3-64	16	12	1-60	24
		K_2O	21	7-51	20	12	2-70	23

*Nutrient levels in manure samples taken from 51 farms.

**Nutrient levels in 799 solid/semi-solid dairy, 746 dairy liquid and 414 liquid swine manure samples submitted to the University of Wisconsin Soil and Forage Analysis Lab, 1998-2001.

****Livestock Waste Facilities Handbook* (MWPS-18, 2000)

well to the MWPS estimates. Note, however, that the actual analysis values range widely from the MWPS estimates, indicating poor sampling, management or other on-farm differences. Lindley et al. (1988) also found actual manure analysis values to be highly variable and ranged from 50 to 100% of published values.

2.1 Technique

In virtually any type of agricultural analytical work the results are greatly influenced by sampling. For solid manure, it is generally recommended to sample from loaded spreaders rather than from the actual manure pack. A Wisconsin study (Peters and Combs, 1998) showed that even when well-trained professionals sampled dairy manure, variability was much higher when samples were collected directly from the barnyard and pack compared to those collected from the loaded spreader. The data also indicated that taking several samples would help minimize potential variability.

In this same study, several samples of liquid manure were taken from a thoroughly agitated lagoon while being pumped into a spreader tank. The results of multiple samples taken by different individuals from a well-agitated liquid dairy manure lagoon indicate that variability is much lower than in the solid manure/barnyard system.

Variability can exist among different samplings even when they are taken by the same individual under ideal conditions. This occurred when samples of liquid and semi-solid dairy manure were collected. Five-gallon samples were mixed as thoroughly as possible before being split into twenty-four subsamples. The results indicate that the variability between liquid samples was quite low, but higher with semi-solid dairy samples. This was particularly apparent with total N and dry matter measurements (Peters and Combs, 1998).

2.2 Time

An evaluation of long-term sampling of solid/semi-solid manure showed little variability occurred in nutrient concentration over a three-year period at the University of Wisconsin Arlington Agricultural Research Station (Combs, 1991). Sampling a stanchion barn periodically for three years showed that all samples had similar total nutrient values. The least variation occurred for N while most variation was associated with K. These results seem to indicate that with good representative sampling and no significant change in herd management, consistent results, even for solid manure, are possible.

On the other hand, results from sampling solid manure in a poultry-laying barn at the University of Wisconsin Arlington Agricultural Research Station indicated inconsistent results over time (Peters and Combs, 1998). These poultry manure samples taken from the same barn approximately five months apart show a significant difference in all parameters measured. This could be partially a result of seasonal changes in the feed ration, feed contamination or differences in individual sampling technique. Commonly, five to six batches of birds are grown out before the litter is removed. Poultry houses are normally sampled when the last batch of birds is removed from the house, since the nutrient content in poultry litter will change over time. Therefore, sampling earlier is not recommended.

Due to these variations over time, manure nutrient concentration values used to determine field nutrient credits should ideally be based on long-term farm averages, assuming herd and manure management practices have not changed significantly. If an established baseline level does not exist for a farm, manure testing needs to be done frequently and consistently to develop a historic record that spans at least two–three years. Preferably, manure sampling and analysis should be done just prior to land application, with the time of year noted to monitor potential seasonal variability.

2.3 Storage management

The segregation of manure that occurs in liquid storage requires that special care be taken to ensure that a homogeneous mix is sampled. In a Minnesota study, manure agitated for 2–4 hours before application had highly consistent results for total N, P, K concentrations and percent solids when individual tanks (first to last) were analyzed (Wagar et al., 1994). Samples taken at various stages during the storage system emptying process at Wisconsin also showed very little variability providing the material was thoroughly agitated (Peters and Combs, 1998).

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实验室信息

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客户要求分析项目

For: M7
EXAMPLE REPORT

实验室信息2

Report Number: F76006-6007
Acount Number: 54321
Lab Number: 72866

重要日期

Date Sampled: 7/11/2014
Date Received: 7/15/2014
Date Reported: 7/17/2014

Sample ID: 1
Manure Type: TURKEY, SOLID WITH LITTER (14)

样品信息及描述

MANURE ANALYSIS

Parameter 分析指标	Unit 单位	Analysis Result (As Received) 分析结果(%)	Pounds Per Ton 磅/美吨	First Year Availability@ Pounds Per Ton 第一年作物可用量
Moisture	%	30.50	610	
Solids	%	69.50	1390	
Ash @ 550 C	%	14.13	282.6	
Organic Matter (LOI @ 550 C)	%	55.37	1107.4	
Organic Carbon (LOI @ 550 C)	%	32.12	642.3	
Carbon:Nitrogen Ratio (C:N)	-	9.1:1		
Nitrogen, Total (TKN)	%	3.534	70.7	49.3 *
Nitrogen, Ammonium (NH_4-N)	%	0.863	17.3	17.3 *
Nitrogen, Organic (N)	%	2.671	53.4	32.0 *
Phosphorus (P)	%	1.548	70.9 (as P_2O_5)	70.9 (as P_2O_5)
Potassium (K)	%	1.724	41.4 (as K_2O)	41.4 (as K_2O)
Sulfur (S)	%	0.54	10.7	5.9 #
Magnesium (Mg)	%	0.55	10.9	6.1 #
Calcium (Ca)	%	2.74	54.8	30.1 #
Sodium (Na)	%	0.32	6.4	
Aluminum (Al)	ppm	537	1.1	
Copper (Cu)	ppm	255	0.5	0.3 #

@ Estimate of first-year availability does not account for incorporation losses. Consult MWPS-18, "Livestock Waste Facilities Handbook" for additional information.
* Source: MWPS-18, Livestock Waste Facilities Handbook, 1993
# Source: A3411, "Manure Nutrient Credit Worksheet", University of Wisconsin