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Livestock Manure Sampling and Testing

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Livestock manure is a valuable resource when properly and efficiently managed. On the other hand, manure that is applied at excessive rates or not applied uniformly can lead to surface and groundwater pollution. To effectively use manure, a cropland application plan is important. Furthermore, manure that has been sampled and tested for nutrients enables crop advisors and farmers to more efficiently utilize manure in preparing an application plan.

Testing for nutrients in manure

The first step in developing an effective manure application plan is to determine the amount of nutrients produced from livestock on the farm by taking a representative manure sample for laboratory analysis. A basic test consisting of total N, phosphorus, potassium (reported in lbs/ton or lbs/1000 gal), and percent solids in the manure is recommended. Other tests such as inorganic (ammonium) N and salts can be run, but are not essential for preparing a plan. A few dollars invested in laboratory fees for a manure test will yield big dividends in showing the amount of purchased fertilizer that can be replaced by manure from the farm.

Taking a representative manure sample

Most of the commercial soil testing laboratories will analyze manure. Also, most laboratories will supply testing kits on request that usually consist of a wide-mouthed plastic bottle with a tight fitting lid, a plastic bag, an information sheet, and a box for mailing.

For best results, sample the manure that is in the tank or spreader box being delivered to the field for application. Such samples will be the most representative because the liquid pit manure is likely to have been agitated in order to load the tank, and semi-solid manure scraped from the barn is moderately mixed after being loaded into a box spreader.

Collect several samples of semi-solid manure from the box spreader, mix well, and fill a laboratory container three-quarters full. With scrape-and-haul manure handling systems, periodically repeat this sampling procedure throughout the year. If liquid manure has been agitated well, one sample is sufficient to adequately determine the nutrient status of the manure in the pit. Take a sample from the tank and fill the laboratory container three-quarters full. *Caution: do not completely fill the container; leave space for gas expansion.* During this entire process the samples should be kept cool so no N is lost. When sampling is complete, freeze the sample(s) as soon as possible before sending to the laboratory.

Obtaining a representative sample from a pit under confinement housing is more difficult when the manure has not been agitated. Also, semi-solid or drier manure that is only spread once or twice a year from a feedlot or poultry house will require more sampling to accurately depict the nutrient status of the manure. These situations require continuous

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monitoring of the manure during application to determine the variation in nutrient levels.

Randomly collect samples during the application process and mix well to attain three samples that represent equal thirds of the manure that was applied. More samples can be taken if desired. However, three representative samples should adequately characterize the nutrient levels in pit manure that has not been agitated, or in semi-solid manure from a feedlot or solid manure from a poultry house. Flag or record the area where the manure has been applied and note the corresponding sample, so that the proper nutrient credit can be assigned to those areas in the field.

Variability of nutrients in manure

Nutrients in manure will vary greatly from farm to farm due to animal species, the size and number of animals, and the diet fed. Fresh manure can readily decompose and change chemically depending on various factors such as air temperature, the amount of bedding and water entering the system, and how the manure is handled and stored. Thus, the amount of nutrients ultimately delivered to the field from manure storage will vary significantly among farms and manure handling systems.

Table 1 summarizes the nutrient levels in manure samples taken from 51 farms during 1990-1992. This survey of manure handling systems was conducted cooperatively by extension educators and farmers in southeast Minnesota. Fifteen liquid and 17 semi-solid dairy manure systems were sampled along with 17 liquid swine manure and six beef manure systems. Twenty-two systems were sampled two or more times. The cooperators sampled the manure being delivered to the field for application and prepared the sample for mailing to the laboratory.

These data show the importance of determining nutrient values in manure for each farm and handling system rather than using average values found in publications. In dairy manure, the total N content varied from the low and high testing

Table 1. Variability of nutrients in dairy and swine manure in southeast Minnesota, 1990-1992

Specie	System	Nutrient	Average	Range	MWPS*
			----------lbs/1000 gal----------		
Dairy	Liquid	N	29	10-47	24
		P_2O_5	15	6-28	18
		K_2O	24	11-38	29
			----------lbs/1000 gal----------		
Dairy	Semi-solid	N	13	7-25	9
		P_2O_5	6	3-13	4
		K_2O	8	2-18	10
			----------lbs/1000 gal----------		
Swine	Liquid	N	48	7-107	36
		P_2O_5	28	3-64	27
		K_2O	21	7-51	22

**Livestock Waste Facilities Handbook,* Midwest Plan Service, March 1985

Table 2. The effect of agitating pit manure on nutrient consistency

System	Sample no.	Total N	P_2O_5	K_2O	Total solids
		----------lbs/1000 gal---------			-----%------
Dairy—	1-first load	34	16	28	8.2
metal tank	2-half full	33	18	28	8.6
storage	3-last load	30	14	27	8.0
		----------lbs/1000 gal---------			-----%------
Dairy—	1-first load	24	10	23	4.4
earthen pit	2-half full	23	10	22	6.0
storage	3-last load	27	12	23	8.7
		----------lbs/1000 gal---------			-----%------
Swine—	1-first load	45	50	15	6.9
concrete pit	2-half full	46	60	16	8.5
storage	3-last load	46	57	18	7.4

systems by 470% for liquid and by 350% for semi-solid manure. The total N content of liquid swine manure varied by an astounding 1500% from the low to high testing sites. Phosphorus and potassium levels also varied substantially when manure handling systems were compared.

Agitate liquid manure well prior to application

Another aspect of manure management that was illustrated from the survey was the relatively uniform nutrient content that can be attained by agitating liquid pit manure well. Manure that had been agitated 2-4 hours prior to application had a remarkable consistency in nutrient levels from the first tank load to the last applied. **Table 2** summarizes this factor. *Caution: all livestock should be moved prior to agitating pit manure under confinement housing. Do not attempt to agitate pit manure with animals or people in the building. Use maximum ventilation to remove hydrogen sulfide and ammonia gases.*

Regardless of how the manure is stored, relatively uniform nutrient levels can be attained by agitating the pit manure before application. This should alleviate some of the concern farmers have expressed about the lack of uniform nutrient levels in manure. The key to achieving this consistency is to agitate pit manure well prior to application.

Develop a manure application plan

The major objective of a manure management plan is to maximize the agronomic benefit of the nutrients in manure while minimizing pollution risks. Sampling and testing manure to determine nutrient values increases the accuracy and reliability of the plan. Several publications, a computer program, and videotapes have recently been produced by the Minnesota Extension Service to assist crop advisors and farmers in preparing manure application plans.

References

From the Minnesota Extension Service:

Title	Publication Number
Profit with Manure (videotape)	VH-6082
Farm-A-Syst: Farmstead Assessment System	PC-5696-S
Self Assessment Worksheet for Manure Management Plans, 1992	FO-5883-C
Fertilizing Cropland with Beef Manure, 1992	FO-5882-C
Fertilizing Cropland with Dairy Manure, 1992	FO-5880-C
Fertilizing Cropland with Poultry Manure, 1992	FO-5881-C
Fertilizing Cropland with Swine Manure, 1992	FO-5879-C
Understanding Nitrogen in Soil, 1990	FO-3770-B
Fertilizer Recommendations for Agronomic Crops in Minnesota, 1993	BU-6240-E
Manure Is a Good Source of Nitrogen, 1992	FO-5760-C

These materials are available through your county extension educator or by contacting: Minnesota Extension Service, Distribution Center, University of Minnesota, 20 Coffey Hall, 1420 Eckles Ave., St. Paul, MN 55108-6069; fax (612) 625-2207.

From the Center for Farm Financial Management, University of Minnesota:
Manure Application Planner (computer program and video)
Contact the Center for Farm Financial Management, 249 COB, 1994 Buford Ave., St. Paul, MN 55108; telephone (612) 625-1964.

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