ALABAMA A&M AND AUBURN UNIVERSITIES

ALABAMA COOPERATIVE Extension SYSTEM

ANR-790-4.6.5

Animal Waste Management To Protect Water Quality

Analyzing Nutrient Value Of Animal Wastes

By determining the nutrient value of animal wastes, producers can prevent environmental problems, meet crop fertility needs, and save on commercial fertilizer costs. Manure nutrient analysis should be made just prior to land application so that nitrogen and phosphorus contents can be matched with crop requirements. Nutrient value of lagoon wastes and manure piles can be determined by measuring electrical conductivity, estimating, or sampling followed by laboratory or field testing.

Measuring Electrical Conductivity

In the absence of a more complete analysis, electrical conductivity of liquids and slurries can be used to estimate both nitrogen content and salinity. For manure in liquid or slurry form, electrical conductivity (EC) as an estimate of soluble salts can be measured quickly in the field.

"Solu-bridges" or other conductivity meters are relatively inexpensive and maintenance free. A county Extension office can purchase a pocket-size model for around $50 or pay more than $250 for a portable, digital lab model. Conductivity meters are also used to check dissolved solids (salts) in fish ponds, greenhouse and nursery soils, and irrigation water. Electrical conductivity should be measured in several samples after the lagoon is agitated.

Calculating Nitrogen Content. Table 1 shows the relationship between electrical conductivity measured in millimhos per centimeter (mmhos/cm) and total nitrogen in pounds per 1,000 gallons.

Most of the time EC readings will not be in the increments listed in Table 1. If this is the case, N content must be calculated. For example, assume an agitated lagoon has an electrical conductivity reading of 13,335 micromhos per centimeter. This would be 13.3 mmhos/cm (13,335 / 1,000 = 13.3). The 13.3 mmhos/cm reading is about two-thirds of the difference between 10 and 15 mmhos in Table 1, and would be equivalent to two-thirds of the difference between 12 and 18, or about 16 pounds of N per 1,000 gallons.

Table 1. Relationship Between Electrical Conductivity (Soluble Salts) And Total N In Lagoon Wastes.

Electrical Conductivity, EC (mmhos/cm)[a]	Estimated Total Nitrogen (Pounds/1,000 Gallons)
5	5
10	12
15	18
20	24
25	30
30	36
35	42
40	47

[a]Some meters read in micromhos per centimeter. If this is the case, convert micromhos to millimhos by dividing the micromhos by 1,000.

Source: Chapman, 1984.

Estimating

Sometimes, the best a producer can do is to estimate the nutrient content of solid manure or lagoon waste, apply it based on this estimate, and follow up with a laboratory analysis to determine exactly what was applied. Since nutrient content of animal manures varies widely, estimates based on the values in Tables 2, 3, and 4 may be helpful. However, values in Tables 2, 3, and 4 are for illustrative purposes. Animal wastes should be analyzed and land-applied at rates based on laboratory tests and local data when available.

Nutrient content of animal manure may change substantially from the time it is generated to the time it is land applied because of storage and handling. Lagoons, for example, reduce the nitrogen content of manures by as much as 50 percent through dilution with water and through losses as ammonia gas and from denitrification. Table 2 gives the range and average values of samples taken from twelve lagoons in Arkansas.

Nutrient content of animal manures can also change substantially over time because of animal species and diet and rate of decomposition. Tables 3 and 4 give estimated quantities and nutrient values of manures available at the time of land application.

Sampling

The most accurate method to determine nutrient levels in land-applied manure is to have a sample analyzed by a reputable lab just prior to application. In Alabama, samples can be sent to Auburn University's Soil Testing Laboratory or any other laboratory that offers a manure analysis program. The cost for such an analysis is around $30 but can be cost-shared under certain USDA Consolidated Farm Service (CFSA) programs.

Taking a manure sample is much like taking a good soil sample: the manure sample should be representative of the entire material being sampled. The procedure is as follows:

• Collect small amounts of manure in a clean bucket from several areas within the stack or pile.

For the dry forms of manure, such as poultry, horse, or dairy cow manure, a shovel or trowel works well in obtaining the sample since a soil probe will most likely present some problems. If you have a manure pile 50 feet long, pull ten samples from the top, bottom and middle of the pile.

For liquid manure, such as lagoon wastes, you can make a scoop from a tin can attached to a pole or stick and sample from the top, bottom, and middle of the storage facility. Liquid manures should be agitated and thoroughly mixed prior to sampling. Ideally a lagoon could be sampled a week or so before pumping and a laboratory could do a complete analysis. However, since lagoons are not usually agitated until just before pumping, timely sampling is difficult.

• Thoroughly mix the large composite sample, and place a small subsample in a container to send to an area lab for analysis. A 1-gallon heavy duty "zip lock" plastic bag works well for the dry forms of manure such as broiler litter. A wide-mouth, 1-quart plastic bottle works well for the liquid forms of hog or cattle manure. **Do not ship liquid manure in glass jars.** Glass jars can break, or they can explode when left in warm, sunny areas.

Table 2. Amount Of Nutrient Components From Animal Waste Lagoons.

Component	Range In Pounds Per 1,000 Gal	Average Pounds Per 1,000 Gal
Nitrogen (N)	1 to 58	16
Phosphorus (P_2O_5)	< 1 to 30	10
Potassium (K_2O)	< 1 to 42	12

Source: Chapman, 1984.

Table 3. Some Estimated Total Solids And Nitrogen Values Of Livestock And Poultry Manure At The Time Available For Land Application.

Source Of Manure	Total Solids (Percent)	N[a] (Percent)	N Range[a] (Percent)
Dairy, stored	18.0	2.0	1.5 to 3.9
Dairy, removed daily	13.0	3.2	
Dairy runoff	0.1	0.015	0.001 to 0.86
Beef	52.0	2.1	0.6 to 4.9
Beef runoff	0.1	0.1	0.001 to 0.86
Swine	18.0	2.8	2.0 to 7.5
Swine lagoon	1.0	0.024	0.01 to 0.15
Sheep	28.0	4.0	0.9 to 5.4
Hen	45.0	5.0	3.0 to 11.0
Hen litter	75.0	2.8	1.2 to 5.0
Broiler litter	75.0	3.9	1.21 to 5.0

[a]Nitrogen and nitrogen range for solid manures are on a dry-weight basis; these values for liquid manures (dairy runoff, beef runoff, and swine lagoon water) are on a wet-weight basis.

Source: Extracted from USDA and U.S. EPA, 1979.

Table 4. Some Estimated Nutrient Values Of Livestock And Poultry Manures At The Time Available For Land Application.[a]

Source Of Manure	Element (Percent)[a]				
	P[b]	K[c]	Ca	Mg	Na
Dairy, stored	0.6	2.4	2.3	0.7	0.4
Dairy, removed daily	0.6	2.4	2.3	0.6	0.3
Dairy runoff[c]	0.005	0.085	0.016	0.011	0.053
Beef	0.8	2.3	2.0	0.7	0.7
Beef runoff	0.01	0.01	0.02	0.01	0.06
Swine	0.6	1.5	2.3	2.4	0.6
Swine lagoon	0.005	0.025	0.005	0.006	0.06
Sheep	0.6	2.9	1.7	0.5	0.7
Hen	1.8	1.4	3.4	0.5	0.7
Hen litter	1.9	1.9	3.5	0.5	0.7
Broiler litter	1.5	2.0	1.9	0.5	0.7

[a]Nutrient levels for solid manures are on a dry-weight basis; these values for liquid manures (daily runoff, beef runoff, and swine lagoon water) are on a wet-weight basis.

[b]Multiply by 2.29 to convert to P_2O_5.

[c]Multiply by 1.2 to convert to K_2O

Source: Extracted from USDA, 1954 and USDA and U.S. EPA, 1979.

• Submit the manure sample to an area lab and request an analysis for N, P, K, and NH4+ (ammonium). This analysis will provide the available nutrients in pounds per ton in the manure. The Auburn lab can also estimate soluble salts in irrigation or lagoon water using electrical conductivity measured in millimhos per centimeter (mmhos/cm).

An example report on manure analysis from the Auburn lab is presented in Figure 1. Fertilizer value is reported as pounds per ton based on the moisture content of the sample that arrives at the lab. From the information in Figure 1, the N value is calculated by multiplying 0.0142 (percent N) times 2,000 (pounds per ton) to get 28 pounds of N per ton of manure containing 40 percent moisture. For liquid manure fertilizer, values are reported as pounds per 1,000 gallons as sampled.

MANURE ANALYSIS REPORT
-For use as Fertilizer-

Type of Sample: Manure

Note: All results are reported on the sample as it was received by the laboratory before drying.

		-- Sample Identification --
		Manure
		-- % --
MOISTURE		40
ASH		47
NUTRIENTS		
Nitrogen	N	1.42
Phosphorus	P_2O_2	1.19
Potassium	K_2O	0.98
Calcium	Ca	0.67
Magnesium	Mg	0.14
Sulfur	S	----
		-- ppm --
Copper	Cu	22
Zinc	Zn	85

FERTILIZER VALUE AS SAMPLED (lb./Ton)

	MANURE
N - P_2O_5 - K_2O	28-24-20

Figure 1. Example report on manure analysis from the Auburn University Soil Testing Laboratory.

References

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This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist*, assisted by Leigh Stribling, *Technical Writer.*

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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UPS, **New June 1995,** Water Quality 4.6.5

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ANR-790-4.6.5