Manure Analysis Reference Guide

TABLE 1: NUTRIENT REMOVAL BY CROP

Crop	Unit	N	P_2O_5	K_2O
CORN				
Grain	bu.	1.00	0.37	0.26
Stover		0.75	0.15	1.06
Total Removed:		1.75	0.52	1.32
COTTON				
Lint & Seeds	lb.	0.08	0.04	0.03
Stalk,etc.		0.06	0.02	0.05
Total Removed:		0.14	0.06	0.08
BARLEY				
Grain	bu.	1.00	0.40	0.30
Straw		0.40	0.10	1.10
Total Removed:		1.40	0.50	1.40
OATS				
Grain	bu.	0.70	0.25	0.20
Straw		0.30	0.15	1.25
Total Removed:		1.00	0.40	1.45
PEANUTS				
Nuts	lb.	0.03	0.01	0.01
Vines		0.02	0.01	0.03
Total Removed:		0.05	0.02	0.04
RICE				
Grain	bu.	0.50	0.24	0.14
Straw		0.30	0.11	0.85
Total Removed:		0.80	0.35	0.99
GRAIN SORGHUM				
Grain	bu.	0.83	0.41	0.21
Stover		0.94	0.18	1.06
Total Removed:		1.77	0.59	1.27
SOYBEANS				
Beans	bu.	4.00	0.80	1.40
Stover		1.15	0.27	0.96
Total Removed:		5.15	1.07	2.36
TOBACCO				
Leaf	lb.	0.03	0.01	0.05
Stalk		0.01	0.01	0.03
Total Removed:		0.04	0.02	0.08
WHEAT				
Grain	bu.	1.25	0.62	0.37
Straw		0.57	0.15	0.90
Total Removed:		1.82	0.77	1.27

INTRODUCTION

Manure is a co-product of animal agriculture. Depending on the point of view, it is either a resource for crop production or it is a waste product of the livestock enterprise. No matter what the point of view, it must be removed to continue the livestock operation. Soils normally benefit from the application of organic material and animal manure is an excellent source. This organic material acts as a source of nutrients and as a soil conditioner. Therefore, it makes sense to use manure to recycle nutrients and improve the soil.

It is difficult to place a dollar value on the improvements in physical properties of the soil from the addition of manure, but the value can be considerable when evaluated on a long term basis.

The main value of manure is its supply of nitrogen, phosphorus, and potassium. Micronutrients will also be available, but the amounts will vary greatly depending on type of livestock and their diet.

About half of the nitrogen is in the inorganic or ammonium form, the form that is immediately available for plant intake. The inorganic forms of nitrogen are subject to being lost through leaching out of the root zone or volatilization into the atmosphere. Volatilization is minimized by injection or tillage into the soil.

Proper application rates and methods must be utilized to ensure environmentally sound results and cost effective application. Excessive manure application rates or improper application methods can result in surface or ground water contamination and reduced crop yields.

Much of the yield reduction is thought to be caused by germination damage and growth reductions due to high concentrations of ammonium and soluble salts including sodium, potassium, magnesium, calcium, and chloride, which can limit water uptake by the plants.

High salt level can also cause injury to plant root hairs which will result in reduced nutrient and water uptake. Also, improper balance between sodium in relation to calcium and magnesium will cause soil aggregates to break down or disperse. The dispersed clay particles will move down into the soil profile, blocking soil pores, reducing the rate of water infiltration.

NUTRIENT REQUIREMENTS

Before manure is applied, the nutrient requirement of the crop should be determined. Soil testing is a reliable method to determine nutrient levels in the soil. With this information, and knowledge of the nutrient levels of the manure, economically and environmentally sound application rates for both manure and fertilizer can be determined.

Manure application rates are usually based on crop nitrogen requirements. Manure application rates should never exceed the crop nitrogen requirement. However, after long term application, the phosphorus level in the soil will probably build up to a level that will prohibit continued manure applications. All manure application sites should be monitored with a soil testing pro-gram. To prevent the build up of soil phosphorus and potassium levels to a very high range, it would be best to calculate a manure application rate on basis of crop phosphorus or potassium removal (do not exceed crop N requirements). Table 1 provides a list of estimated nutrient removal per unit of yield for many crops. Actual removal will be site specific and may be determined by a laboratory analysis of a representative sample of the plant material removed from the field.

NUTRIENT AVAILABILITY

The nutrients contained in animal manures, composts, or other organic materials are less readily available to plants than the nutrients of most inorganic fertilizers. The nutrient content of these materials is highly variable (Table 2) and a laboratory analysis should be used to determine the actual nutrient content of manure materials.

NITROGEN:

Manure would be classified as a slow release nitrogen fertilizer. Approximate manure nitrogen availability percentages are listed in Table 3. They vary according to the type of material, storage, and application method. When incorporated, most of the ammonium nitrogen is available during the first year. Nitrogen availability percentages listed in Table 3 are total N and account for ammonium nitrogen content. The figures in Table 3 are based on availability of total N during the first year following a spring application.

ORGANIC N:

(Total N minus ammonium N, or assume 60 to 75 percent of the Total N as organic) will supply nitrogen to the cropping system for several years. To estimate residual N use the availability factors listed in Table 4.

PHOSPHORUS AND POTASSIUM:

About 70 percent of the total P applied in manure will become available in the year of application. Of the total potassium, 100 percent will be available the year of application.

DETERMINING NUTRIENT AND FERTILIZER NEEDS

Nitrogen is usually selected as the priority nutrient and total crop nutrients are determined by soil test and crop removal. When soil test results are high or very high in phosphorus or potassium it may be best to use these nutrients to determine the manure application rate. Also, if the manure tests low in nitrogen, basing the application rate on phosphorus or potassium may be best. In any situation, manure application rate should never exceed the crop's nitrogen requirement.

Amounts of nutrients that can be added from manure without greatly increasing soil test levels are estimated on the basis of expected crop removal. Values in Table 1 may be used to estimate crop removal expected per unit of yield for various crops.

Manure sampling, manure analysis, and spreader calibration are part of a comprehensive nutrient management plan. Manure with greater than 20 percent solids is classified as dry manure and is handled as a solid. Manure with 4 to 20 percent solids is classified as semisolid and can be handled as a liquid. Semi-solid manure usually requires thorough agitation before pumping and sampling. Manure with less than 4 percent solids is classified a liquid manure and is handled with pumps, tank wagons, and irrigation equipment.

A representative sample is needed to provide an accurate manure analysis. One of the many factors affecting the nutrient content of manure is how the manure is handled and stored. Each handling system results in different types of nutrient losses. The most important thing in collecting a manure sample is to obtain it in a similar way to the methods used in developing the standard nutrient values.

Table 2. Approximate Manure Nutrients Remaining at time of application

Species	System	Solids %	Lb/Ton			Lb/1000 gal		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O
Dairy Cattle	Daily Spread	15	8	5	10	—	—	—
	Anaerobic Pit	8	—	—	—	24	18	29
	Earthen Storage	10	—	—	—	32	14	28
	Anaerobic Lagoon	1	—	—	—	4	5	5
	Above Ground Storage	12	—	—	—	46	18	40
	Covered Stack	18	10	9	12	—	—	—
Swine	Anaerobic Pit	4	—	—	—	36	27	19
	Anaerobic Lagoon	1	—	—	—	4	2	4
Beef	Open Feedlot	15	10	7	10	—	—	—
Poultry	Liquid Pit	13	—	—	—	80	37	96
	Dry Pit (dry)	85	100	70	40	—	—	—
	Dry Pit (Crumbly)	70	60	55	30	—	—	—
	Dry Pit (moist)	50	40	40	20	—	—	—
	Dry Pit (fresh)	25	30	20	10	—	—	—
	Compost	54	44	66	48	—	—	—
Sheep	Dry Pit	25	23	8	20	—	—	—
Horse	Dry Pit	20	12	5	9	—	—	—
Composted Poultry Materials	Dry Pit	54	44	66	48	—	—	—

Table 3. Nitrogen Availability Coefficients for Manure Total Nitrogen Content

Type of Manure	Method of Incorporation			
	Broadcast, No Incorporation	Broadcast, Incorporated within 12 hours	Injected	Irrigated, No Incorporation
Dairy (semi-solid)	0.40	0.60	—	—
Dairy (slurry)	0.45	0.60	0.70	0.45
Beef	0.40	0.60	—	—
Swine (slurry)	0.40	0.60	0.70	0.40
Swine Lagoon	0.50	0.80	0.85	0.50
Poultry	0.50	0.50	0.50	—
Municipal sludge	0.50	0.50	0.50	—
Composted Materials	0.20	0.20	—	—

Table 4. Residual Availability of Organic N in Manure and Compost

Material Applied	Organic N Availability Coefficients
Last Year	0.13
2 Years Ago	0.05
3 Years Ago	0.02