Manure Sampling and Analysis for Nutrient Management

Nutrient Management Factsheet – No. 5 in Series

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This factsheet describes the steps to collect representative manure samples that will be analyzed for their nutrient concentration.

If manure is being used as a nutrient source, a nutrient management plan strongly recommends the collection and analysis of representative manure samples. For that reason, careful sampling is very important.

Sample Collection

Liquid Manure (slurry)

Take at least 5 manure samples of ½ to 1 litre each from around the pit. Two sampling methods are acceptable

- **Method 1: (Figure 1)** Insert a long piece of PVC pipe into the manure as deep as it will reach and cap or cover the end. Manure will be held in the pipe as it is lifted from the pit. Empty each sample into a plastic pail. There is no need to mix or agitate the manure storage facility with this method.
- **Method 2: (Figure 1 insert)** Agitate pit thoroughly to mix. Dip a small pail (1/2 litre) nailed onto a pole into the pit at 5 different spots around the pit, and empty each sample into a clean plastic pail.

Mix and subsample: Mix the contents of the pail thoroughly and pour a subsample into a ½ or 1 litre plastic screwtop container. Do not fill container more than ¾ full, particularly if samples will be frozen. Screw lid on tightly. Place the container in a plastic bag and close tightly.

Label: Write the date, time, pit name, manure type and farm name on the bottle for lab identification and your records.

Figure 1. Liquid manure sampling

Lagoon sampling: It is not necessary to agitate lagoon liquid if the pit will only be partially emptied. Use method 1 or 2 above, but sample only the liquid that is to be applied. For example, if the top 4 feet will be spread, sample to that depth using the same methodology as for manure pits.

Solid Manure

Collect 5 to 10 samples from around the pile of solid manure, digging into the pile slightly to avoid weathered and dry material on the pile surface (Figure 2). Place all the samples in a plastic pail.

Mix and subsample: Mix the samples very well, chopping if necessary to blend the material. Fill a heavy plastic freezer bag or a ½ or 1 litre plastic screw top container ¾ full with manure and tightly seal. Place the container in a plastic bag and close tightly.

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Figure 2. Solid manure sampling

Label: Write the date, time, manure type, pile location and farm name on the bottle for lab identification and your records.

Sampling Handling and Shipping

Samples must be kept cool and transferred to the lab immediately. The nutrient composition of the sample may change if the manure is stored in a warm environment for longer than a few hours.

If samples cannot be sent to the lab until the following day, refrigerate or place them in a cooler on ice. Freezing is not recommended because of the changes in nitrogen that can happen when samples thaw. If shipping manure samples by courier or bus, ensure that they will not be stranded over a weekend en route.

Frequency of Manure Sampling

Slurry storage: The concentration of nutrients in uncovered slurry storage will change throughout the year because the amount of rainwater diluting the slurry changes with the season. For this reason, manure from this storage type should ideally be sampled several times throughout the year to ensure that nutrient application rates are accurate.

The manure will be most dilute in early spring, and should be sampled shortly before the major applications onto perennial forages and annually cropped land.

During the summer months, manure will be more concentrated as rainfall is low. Resample manure two or three times throughout the summer and fall months before applying manure on grass. If these samples are all very similar in nutrient content, one annual sample from the pit during summer months should be sufficient, as well as one sample taken before application each spring.

Solid manure piles: Sample each large pile before spreading. If, over several years of sampling, it appears that the nutrient content of the solid manure does not change significantly, the average nutrient content can be used.

What Analyses are Required?

Manure samples should be analyzed for the following parameters to use the Nutrient Management Planning (NMP) software produced for the Canada-BC Environmental Farm Plan program:

- total nitrogen (N or TKN)
- ammonium or ammonia (NH_4-N)
- total phosphorus (P)
- total potassium (K)
- total solids or dry matter (TS or DM), or moisture (MC)

Most labs offer manure analysis packages which also include some secondary nutrients and micronutrients. This additional information is useful for your farm records but is not required to use the Nutrient Management Planning (NMP) software produced for the Canada-BC Environmental Farm Plan program.

Interpreting Manure Lab Analyses

Units used to express manure nutrient value: In the lab, the sample is completely dried, and the amount of moisture and solids is determined from the difference between the sample weight wet and dry. Then the analyses for nitrogen, phosphorus and potassium are done, and the amount of each nutrient is determined on a dry basis (as if all of the moisture in the sample has been removed).

The moisture content of manure can vary widely depending on rainfall, wash water etc. so it is often more meaningful to look at nutrient content on a dry basis. Some labs leave the nutrient information on a dry basis (as a percentage of dry weight), while others convert it back to wet weight (kg/tonne or lb/ton) or units of volume (kg/m^3 or lb/1000 gallons).

Substances that are found in very small quantities such as micronutrients (copper, zinc) are expressed on a gram per kg of dry manure or 'parts per million' basis (ppm, or ug/g or ug/mL). Ammonium is also expressed on a 'ppm' basis although it makes up a significant amount of the total nitrogen of manure.

To use the NMP software, manure values must be entered in units of kg/tonne of wet (or 'as produced' or 'as received) manure. All lab units can be converted to wet weight using conversion factors in **Table 1**.

Total nitrogen (N) or TKN: A typical lab analysis for nitrogen in a manure sample is total Kjeldahl nitrogen or TKN. This lab method measures the organic nitrogen and ammonium-nitrogen (NH_4-N) fractions of manure, the two fractions that make up most of the nitrogen in manure.

Ammonium-nitrogen (NH_4-N): The other typical analysis for nitrogen in a manure sample is the measure of ammonium-nitrogen. The ammonium fraction is as crop-available as fertilizer nitrogen while the rest of the nitrogen in a manure sample is mostly contained within organic matter and is not immediately available for crop uptake.

Organic nitrogen: This value is typically not measured but calculated by taking the difference between the amount of total nitrogen and the ammonium fraction.

Total phosphorus (P): This measure is the typical lab analysis for phosphorus in a manure sample. Only a portion of the total phosphorus in manure will be crop-available in the year of application; the rest is bound in organic and inorganic substances and much of it is released into crop available forms in subsequent years. About 50% of the total P is crop-available in the year of application at low to moderate soil P levels; at higher soil P levels, more of the manure P is available in the year of application.

Total potassium (K): This measure is the typical lab analysis for potassium in a manure sample. Almost all the potassium in manure is readily available to crops.

Total solids or dry matter content : In this simple lab test, all moisture is removed from the manure sample by drying. The total solids or dry matter content of the manure sample is calculated from the wet and dry weights of the sample. This lab determination is only required if the lab does not provide the manure nutrient content in kg/tonne of 'as-produced' or wet manure. See Table 1 for examples of converting nutrient contents on a dry basis to nutrient contents on a wet basis.

Manure Quick Testers

There are several manure nutrient quick testers available for on-farm use. One of the main advantages of quick testers is that once the initial investment has been made, testing is cheaper than a lab test. Another advantage is that test results are available immediately.

Nova or Agros meter: This is the most common type of quick tester. It uses a quick chemical reaction to estimate the amount of ammonium in a manure sample. It provides an accurate estimate of ammonium content if the test is performed carefully.

It is most useful when ammonium is the major component of the total nitrogen in the manure, as with liquid dairy and hog manure. However, it underestimates the total amount of nitrogen in manure because it does not measure the organic nitrogen fraction.

Ammonium quick testers are most useful when used for frequent manure testing such as before each manure application on grass.

Table 1. Equations for converting manure analysis results into units of kg/tonne (wet basis).

Conversion Equations		Conversion Examples	
Conversion	**Equation**	**Sample Manure Data**	**Sample Calculation**
lb/ton (wet basis) to kg/tonne (wet basis)	lb/ton x 0.5 = kg/tonne	Nitrogen = 5 lbs/ton	5 lbs/ton x 0.5 = 2.5 kg/tonne N
% (wet basis) to kg/tonne (wet basis)	% x 10 = kg/tonne	Nitrogen = 0.5%	0.5% x 10 = 5 kg/tonne N
mg/kg (wet basis) to kg/tonne (wet basis)	mg/kg ÷1000 = kg/tonne	Nitrogen = 5000 mg/kg	5000 ÷ 1000 = 5.0 kg/tonne N
%(dry basis) to kg/tonne (wet basis)	[(% nutrient) ÷ (% dry matter*)] x 10 = kg/tonne	Nitrogen = 2.8 % (dry matter basis) Dry matter = 6.2%	[2.8 ÷ 6.2] x 10 = [0.45] x 10 = 4.5 kg/tonne N
ppm (dry basis) to kg/tonne (wet basis)	ppm nutrient ÷ 10,000 = % nutrient (% nutrient ÷ % dry matter) x 10 = kg/tonne	Ammonium-Nitrogen (NH_4-N) = 10,300 ppm Dry matter = 6%	10,300 ÷ 10,000 = 1.03 % NH_4-N [1.03 ÷ 6] x 10 = [0.17] x 10 = 1.7 kg/tonne NH_4-N

Notes

- dry matter, DM, total solids and TS are equivalent terms
- if dry matter value is not given, assume 8.5% for dairy manure, 1.9% for pig manure
- ppm, µg/g, µg/mL, mg/kg and mg/L are approximately equivalent units for manure nutrients

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