



# Field Tests for the Nutrient Value of Manure

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*Carefully managed application of livestock manure slurries on pasture and cropland can effectively utilize plant nutrients in manure without threatening the environment. An integral part of this management is the estimation of the nutrient content and availability in slurry to determine safe and optimum application rates. Due to stratification and crusting in slurry storage, representative sampling can be very difficult and questionable without complete agitation. Slurry agitation does not take place until a day or two before field application. Taking a sample after agitation and sending it to a testing laboratory for nutrient analysis is always advisable but does not provide the results in time to be used to determine application rates. Therefore, a rapid field test to estimate nutrient content of slurries that could be conducted on site immediately prior to land application would improve the applicator's ability to manage the loading rates of livestock manure.*

*North Carolina State University researchers have spent approximately two years evaluating four such "quick-test" field methods for determining the nutrient value of manure. Two of these methods appear to offer promise and will be reported on.*

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## **HYDROMETER METHOD**

The specific gravity of manure slurries can be easily determined by using a soil hydrometer. An agitated slurry sample is taken from a storage pit or spreader and added to a 1000-ml graduated

cylinder. The slurry is mixed in the cylinder with a plunger and the soil hydrometer is put into the slurry. Specific gravity readings are taken 15 seconds later.

For accurate readings, the hydrometer must be read while floating freely in the slurry mixture. When a slurry is too viscous for accurate hydrometer readings a dilution must be made with water before mixing in the cylinder and an appropriate correction applied to the results.

Laboratory trials have resulted in a correlation between major total nutrients (N, P, K) and the specific gravity of the slurry. On-farm, the specific gravity reading from the hydrometer would be transferred to a chart or graph where a correlating total nutrient concentration could be read directly.

To estimate the plant-available percentage of the total nitrogen in the slurry, correlations between specific gravity and ammonia-nitrogen were laboratory-determined. Plant-available N could then be estimated using the rule-of-thumb stating, "all of the ammonia fraction of the nitrogen that is conserved plus one-half of the remainder (organic N) is available during the same year of application".

The equipment needed to use this method includes: 1) a soil hydrometer, 2) a 1000-ml graduated cylinder, and 3) a plunger for cylinder mixing. Total cost of this equipment is about \$30. It can be purchased at scientific or analytical testing equipment outlets.

The research conclusions stated that the hydrometer method is inexpensive and could be easily used on the farm. It was rated very good for determining the total solids (TS) content of manure slurries and fair for determining the nutrient content. The nutrient determinations would be more accurate if each individual farm collected its own data base for nutrient content and specific gravity relationships from laboratory analyses and using these farm-specific relationships for calculating slurry nutrient contents.

## **"NITROGEN METER" METHOD**

The "Nitrogen Meter" is a device introduced in Sweden in 1983 for estimating available nitrogen in manures. It consists of a stainless steel reaction chamber with a pressure gauge. Manure is mixed with a strong oxidizing agent (calcium hypochlorite, 30-37 % available chlorine). Ammonium is oxidized to nitrogen gas (N<sub>2</sub>). Urea is also oxidized, but the extent is pH-dependent according to the developer of the meter. The pressure gauge measures increased pressure due to the formation of nitrogen gas, and it is calibrated in units of nitrogen per unit of manure volume.

Measured amounts of manure and dilution water are added to the "N-meter" chamber using different size sample cups provided with the meter. A measured amount of calcium hypochlorite is added to a tipping tray in the "N-meter" chamber. The pressure gauge is then placed on the chamber forming a gas-tight seal and the tray containing the calcium hypochlorite is dumped into the manure-water mixture using a lever on the side of the chamber. Seven to ten minutes of reaction time are allowed for the pressure gauge reading to reach equilibrium.

Equipment needed for this test includes a "N-meter" test kit and reagent calcium hypochlorite. Total cost is about \$395. Specific purchase information about this test kit may be obtained from Agri-Waste Technology, Inc., 3504 Sloan Court, Raleigh, NC 27606.

Research conclusions are that this method is easy to use but at moderately high costs. It can be used to measure the ammonia nitrogen plus easily oxidized organic nitrogen in manures, thereby, giving a fairly accurate direct estimate of the plant available nitrogen. The meter had good repeatability.

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## SUMMARY

Field "quick test" methods do not eliminate the need for collecting a well-mixed sample of manure slurry and sending it to a testing laboratory for nutrient analyses. These results should be used as a check on the field test methods or should be used to calculate loading rates for the next field spreading event. Enough variability in manure slurry nutrient contents exists on-farm as well as between farms so that these field test methods should give better estimates of nutrient content than using average values. They also offer the advantages of : 1) detecting changes in manure characteristics as the storage facility is unloaded, and 2) allowing mixing of the stored manure slurry before sampling. At today's commercial fertilizer prices, an overapplication of manure with a resultant wastage of plant nutrients because of a lack of actual analyses could more than pay for one of these test methods during one manure storage unloading event.

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