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Predicting N Availability From Manure: One Attempt

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Without question, livestock manure is an important source of nutrients essential for crop production. This is especially true for nitrogen and phosphorus. It's no secret that there are many challenges when manure management is considered. In addition to the challenge of measuring the amount applied per acre, there are questions about the availability of the nutrients applied. It would be nice to have an analytical procedure that would predict the availability of nitrogen, for example. Then, soil samples could be collected and analyzed and there would be a more accurate estimate of what is available to the crop that follows application.

Several research efforts have focused on developing an analytical procedure that would predict the amount of N released from organic matter. One procedure, called the Phosphate / Borate method, showed some promise in laboratory studies. It seemed reasonable to think that this method might be appropriate to evaluate as a predictor of nitrogen released from liquid swine manure.

In order to test the possibility that this procedure might be useful, a trial was conducted in Renville County during the 2005 growing season. The field was planted to wheat in 2004. Liquid hog manure was applied in late August, or early October, or late November at rates to supply 90 lb. N per acre. The manure was analyzed for N prior to application. The manure was applied in subsurface bands that were 18 inches apart.

Soil samples were collected at depths of 0 to 12 and 12 to 24 inches in late August (before manure was applied), late September, late November and mid-April of 2005. A soil sampling scheme that would assure that soil would be collected from the band as well as between the banded manure was used. At the time of collection of the first sample, sample location was geo-referenced and subsequent samples were collected from the same location. This sampling procedure was used in an attempt to reduce variability associated with sample collection. All soil samples were analyzed for nitrate-nitrogen and nitrogen extracted by the Phosphate/Borate method.

The manure was applied in strips across the field. In mid-April, urea was broadcast at rates to supply 0, 30, 60, 90, and 120 lb. N per acre in each strip. The urea was incorporated with a field cultivator. Corn was planted on April 27 and 20 lb. N per acre was applied as 28-0-0 used as a carrier for a preemergence herbicide.

The soil samples collected in late August were taken before manure application. These values are considered to be the background levels. There was 20.0 lb. nitrate-nitrogen per acre to a depth of 2 feet prior to the application of manure (see Table 1). The amount of nitrate-nitrogen measured to 2 feet remained relatively constant through November. There was, however, a substantial increase when the mid-April sampling is compared to the fall sampling. In general, the measured nitrate-nitrogen increased from approximately 20 lb. per acre to approximately 60 lb. per acre. This increased amount of nitrogen was probably the result of mineralization of the incorporated wheat straw as well as the soil organic matter.

As would be expected, nitrate-nitrogen increased after the manure was applied. The largest increase was measured following the application of manure in August. This is a consequence of the

warm soil temperatures in September. For the mid-November sampling, there was not a large increase in nitrate-nitrogen following the application of manure in late September. This is probably a consequence of cool soil temperatures in October.

Table 1. Nitrate-nitrogen concentration at depths of 0 to 12, and 12 to 24 inches following application of swine manure on three dates in the fall of 2004.

	Sampling Date							
	late August		late September		mid November		mid April	
Manure Applied	0-12 in.	12-24 in.	0-12 in.	12-24 in.	0-12 in.	12-24 in.	0-12 in.	12-24 in.
	- - - - - - - - - - - - - - - - ppm NO_3-N - - - - - - - - - - - - - - - -							
none	3.7 a*	1.3 a	4.4 b	2.9 a	4.2 b	2.9 b	9.7 b	6.7 b
late August	--	--	14.0 a	4.2 a	10.7 a	5.1 a	9.7 b	9.3 a
late September	--	--	--	--	6.4 b	2.7 b	12.8 a	10.7 a
late November	--	--	--	--	--	--	16.4 a	7.3 b

* Treatment averages in each column followed by the same letter are not significantly different from each other.

Table 2. Nitrogen extracted by the Phosphate/Borate procedure at depths of 0 to 12, and 12 to 24 inches following application of swine manure on three dates in the fall of 2004.

	Sampling Date							
	late August		late September		mid November		mid April	
Manure Applied	0-12 in.	12-24 in.	0-12 in.	12-24 in.	0-12 in.	12-24 in.	0-12 in.	12-24 in.
	- - - - - - - - - - - - - - - - ppm N - - - - - - - - - - - - - - - -							
none	56.7 a*	22.1 a	61.6 a	30.9 a	57.9 a	25.8 a	67.2 a	34.5 a
late August	--	--	51.5 a	23.4 a	49.0 b	20.7 a	54.7 b	34.1 a
late September	--	--	--	--	62.0 a	23.3 a	64.6 a	31.2 a
late November	--	--	--	--	--	--	61.5 ab	25.8 a

* Treatment averages in each column followed by the same letter are not significantly different from each other.

The nitrate-nitrogen measured in mid-April is the result of mineralization that takes place in early spring. As might be expected, there were increases when manure was applied in either late September or late November. Considering the late August application, there was an increase from 65.6 lb. N per acre to 76.0 lb. N per acre from mid-November to mid-April. This increase was measured at the depth of 12 to 24 inches.

The amount of nitrogen extracted by the Phosphate/Borate analytical procedure remained relatively constant from late August through mid-April (Table 2). At each sampling date, there was no increase in measured nitrogen following the application of manure. The amount of nitrogen extracted by this procedure did not change as much as the amount of nitrate-nitrogen that was measured. If the amount of nitrogen extracted by this procedure was not affected by manure application, there does not appear to be a strong argument for the use of this procedure as a tool to predict the release of nitrogen from manure.

Corn yields were excellent (see Figure 1). When no manure was applied, an application of 30 lb. N per acre as urea in addition to the 20 lb. N per acre in the weed and feed program was adequate for optimum yield. The same rate of N as urea was adequate for optimum yield when the manure was applied in late August.

When the manure was applied in either late September or late November, additional N as urea was not needed for optimum yield. The 20 lb. N per acre in the weed and feed program combined with the nitrogen mineralized from the manure was apparently adequate for optimum yield.

The results of this trial illustrate the importance of measuring nitrate-nitrogen to a depth of 24 inches following the application of manure. When manure is broadcast and incorporated following

application, collection of representative samples should not be a concern. There could be a problem with sample collection when manure is applied in a band. For these situations samples should be collected perpendicular to the direction of application. Cores should be taken at distances of 6 inches from each other. The number of cores collected should represent a distance no greater than the distance between manure bands.

Manure is a valuable resource that can be used effectively to substitute for fertilizer N. The measurement of nitrate-nitrogen to a depth of 2 feet can be used as a tool to predict the N supplied by manure. More details about sampling for nitrate-nitrogen following manure application can be found in the Extension publication, "Fertilizing Corn in Minnesota" (F0-3790-C, Revised 2006).

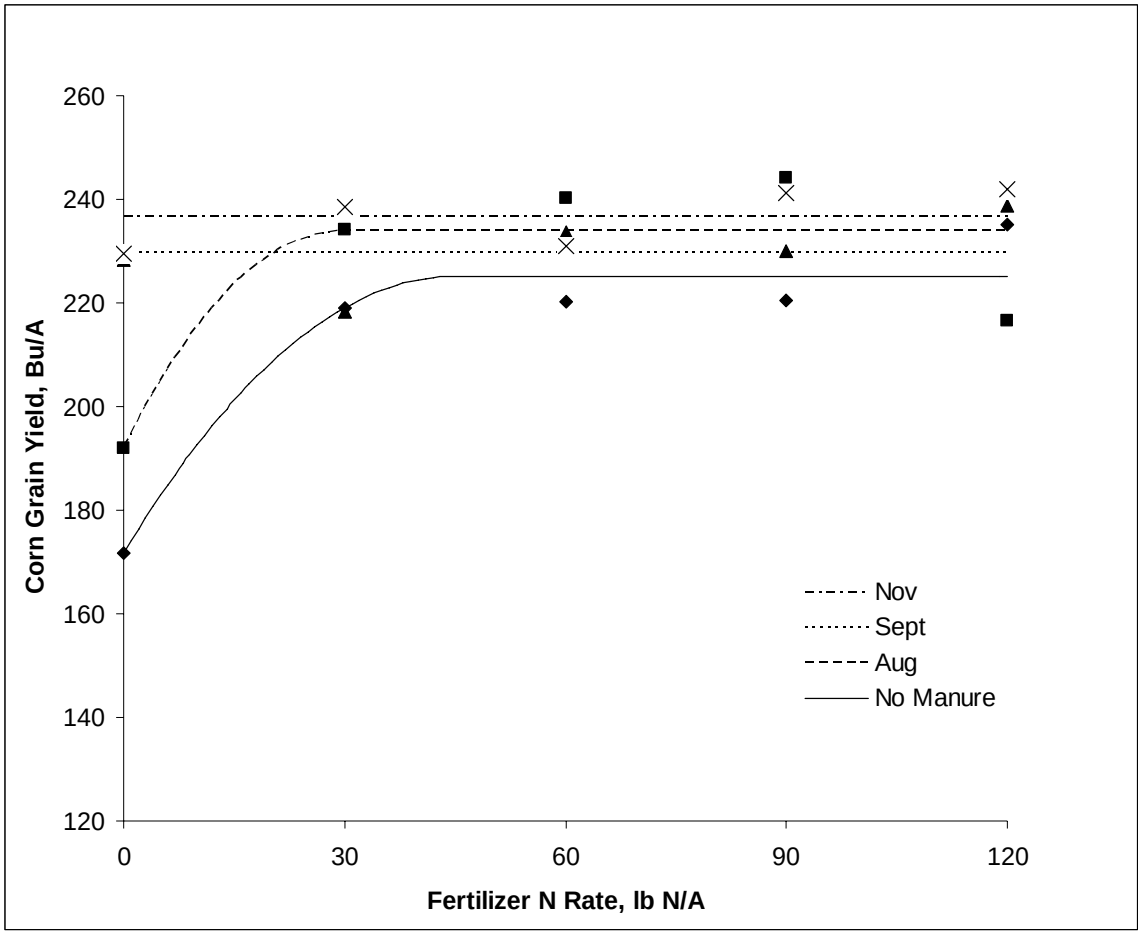

Figure 1. Corn yield as affected by rate of fertilizer N following application of swine manure on 3 dates in the fall.