NITROGEN AVAILABILITY FROM COMPOSTED MANURE[1]

Douglas Beegle and Randy Bowersox[2]

INTRODUCTION

Composting of manure has been proposed to play a role in manure management programs designed to protect water quality. It is known that the biological activity involved in composting changes the nutrient availability of the material and in some cases will reduce the nutrient content. The major role of composting in alleviating some of the on-farm manure nutrient excess problems is by facilitating manure movement from a farm with an excess to a farm with a deficit of nutrients. There are several concerns that compost can address in this situation. Composting reduces the amount of material to be transported. This is critical because one of the main limitations to moving manure is the high cost of moving the low analysis bulky material. Composting reduces the hazards from weeds and diseases because of the high temperatures involved in the composting process. Odors are usually reduced by composting. Finally, composting improves the perception that the public has about the material. There is much greater public acceptance of compost than raw manure, regardless of the properties of either material. In fact, composted manure is a marketable product in some cases that can result in significant farm income. Thus, composting manure could play a role in dealing with the potential environmental problems related to manure nutrients. However, there are questions related to use of composted manure for crop production. The main question is: What is the availability of the nutrients in composted manure?

OBJECTIVE

Determine the availability of the nitrogen in composted manure for corn production under field conditions.

PROCEDURES

Field plots were established with farmer cooperators in Centre Co., Montour Co., Columbia Co., and Lancaster Co. over the three years of the research. In Centre, Montour, and Columbia Co. the manure was dairy. At Lancaster Co. the manure was poultry. At each location manure and compost made from that exact same manure were applied at rates to supply equal amounts of total N (approximately 200 lb/A) regardless of the source. All plots were planted to field corn following the cultural practices used by the individual farmers. At the Lancaster and Montour locations there were severe weed control problems which limited yields at these locations. Also, in 1995 there was a severe drought which limited yields. Pre-sidedress soil nitrate tests (PSNT) were run at each location. All plots were sampled after harvest and analyzed for residual nitrate-nitrogen. After the initial year, only the fertilizer treatments were repeated in subsequent years. No additional manure or compost was applied at these locations. This enabled us to look at residual effects of the manure and compost.

---

[1] Presented at the 26th North Central Extension-Industry Soil Fertility Workshop, November 20-21, 1996, St. Louis, MO

[2] Professor of Agronomy and Research Technician, Department of Agronomy, Penn State University, University Park, PA 16802

RESULTS AND DISCUSSION

In a greenhouse incubation study with poultry manure and compost there was a significant difference in nitrogen availability as indicated by analysis for soil nitrate-nitrogen levels (Figures 1). Under these conditions there was an increase in nitrogen mineralization from the manure treatments but the compost treatments were similar to the untreated soils.

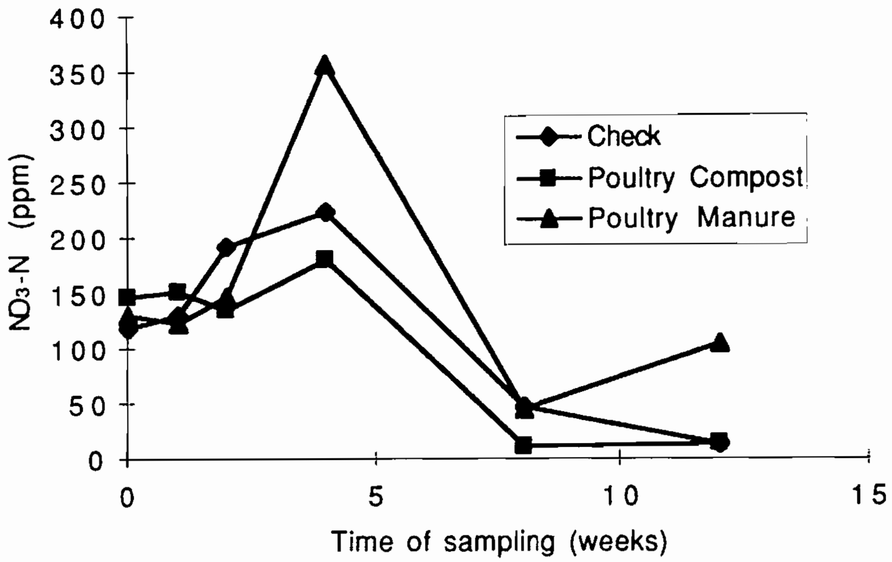


Figure 1. Soil nitrate-nitrogen from incubation of poultry manure and poultry manure compost with soil over a 12 week period.

Analysis of manure and compost applied in the first year of the field studies are summarized in table 1. There are considerable differences in the nutrient content of the manure and compost. Note especially the lower NH_4-N content in the compost compared to the manure. Since this makes up a significant proportion of the readily available fraction of the nitrogen, this would indicate a lower immediate nitrogen availability of the compost compared to the manure.

Table 1. Manure and compost analysis

Material	Loc.	Total N	NH_4-N	Org. N	Total P	Total K	Solids	C:N
		%	%	%	%	%	%	
Dairy Manure	Centre	2.56	0.69	1.87	0.41	1.02	22.85	14.0
Dairy Compost	Centre	1.28	0.23	1.06	0.36	0.85	30.63	22.7
Dairy Manure	Mont. & Col.	1.60	0.46	1.13	0.18	1.82	33.90	33.9
Dairy Compost	Mont. & Col.	2.42	0.01	2.41	0.73	2.61	24.31	19.45
Poultry Manure	Lanc.	4.58	1.5	3.08	2.25	1.79	28.97	6.3
Poultry Compost	Lanc.	2.15	0.06	2.09	2.93	2.06	34.81	8.8

Note also the difference between the two dairy manure and compost samples. The manure from Centre Co. was raw manure from a free stall barn with little bedding and thus it had a low C:N ratio. Consequently, a large amount of straw had to be added to the manure to make the compost. This dilution with the straw resulted in a lower nitrogen concentration in the compost compared to the manure. The other dairy manure contained a large amount of bedding and thus had a lower nitrogen content and higher C:N ratio. To make compost from this manure no additional straw had to be added and thus as the carbon was burned off in the composting process, the nitrogen was concentrated and the nitrogen content of this compost is higher than the manure. The main point here is that all composts are not the same and analysis for both total and NH_4-N are critical.

Yields from the experiments are summarized in table 2. Yields were consistently higher in the manure treatment compared to the compost treatment even though equal amounts of N were applied from both sources. This is an indication of the higher nitrogen availability from the manure compared to the compost. With a few exceptions, although the differences were not significant, the PSNT data for nitrogen availability followed the same trend also indicating higher nitrogen availability from the manure.

Table 2. Yields and PSNT levels from manure and compost treatments

Experiment	Compost	Manure	Compost	Manure
First Year	Yield (bu/A)		PSNT (ppm)	
Lancaster 1993 - Poultry	89	80	47	50
Centre 1993 - Dairy	104	132*	22	26
Montour 1994 - Dairy	82	94	14	19
Columbia 1994 - Dairy	115	128*	23	20
Second Year				
Lancaster 1994 - Poultry	83	103*	22	20
Centre 1994 - Dairy	103	110	22	23
Montour 1995 - Dairy	21	30	9	13
Columbia 1995 - Dairy	93	101	9	11
Third Year				
Centre 1995 - Dairy	33	34	12	12

* Yield differences between compost and manure treatments significant @ p>f =0.05, otherwise not significant.

It has been hypothesized that because of the lower nitrogen availability from composted manure, there may be lower levels of residual nitrate-nitrogen in the soil at the end of the growing season. In these studies, residual nitrate levels in the soils were generally very low and there were few differences in left-over nitrate between the manure and compost, treatments at the end of the year (Table 3)

Table 3. Residual nitrate nitrogen at the end of the growing season in the 0-6" and 6-12" soil layers.

Experiment	Compost		Manure		Check	
	0-6"	6-12"	0-6"	6-12"	0-6"	6-12"
First Year						
Lancaster 1993 - Poultry	15.0	17.8	16.8	22.9	14.0	17.5
Centre 1993 - Dairy	7.9	9.7	8.0	9.2	6.6	8.1
Montour 1994 - Dairy	3.0	3.5	4.0	4.2	3.3	4.0
Columbia 1994 - Dairy	6.3b	2.9	7.1c	2.8	5.0a	2.4
Second Year						
Lancaster 1994 - Poultry	8.0	5.5	7.9	6.3	7.3	4.9
Centre 1994 - Dairy	5.7	4.5	5.6	4.5	4.3	4.0
Montour 1995 - Dairy	7.4	3.0	4.6	2.7	5.3	3.4
Columbia 1995 - Dairy	4.7	3.8	5.4	4.6	4.8	3.3
Third Year						
Centre 1995 - Dairy	14.4	8.1	12.8	7.7	12.7	7.6

On the poultry farm there were generally higher levels of residual nitrate-nitrogen in the soil the first year of the experiment (Lancaster 1993) than at the other locations. This is most likely due to the history of heavy poultry manure applications on this farm. However, there were no differences between the manure and compost treatments and the check at this location. The only difference due to the treatments occurred with the dairy manure and compost in the first year of the experiment (1994) at the Columbia location. In this case, the levels were all low but the manure treatment was higher than the compost treatment which was in turn higher than the check.

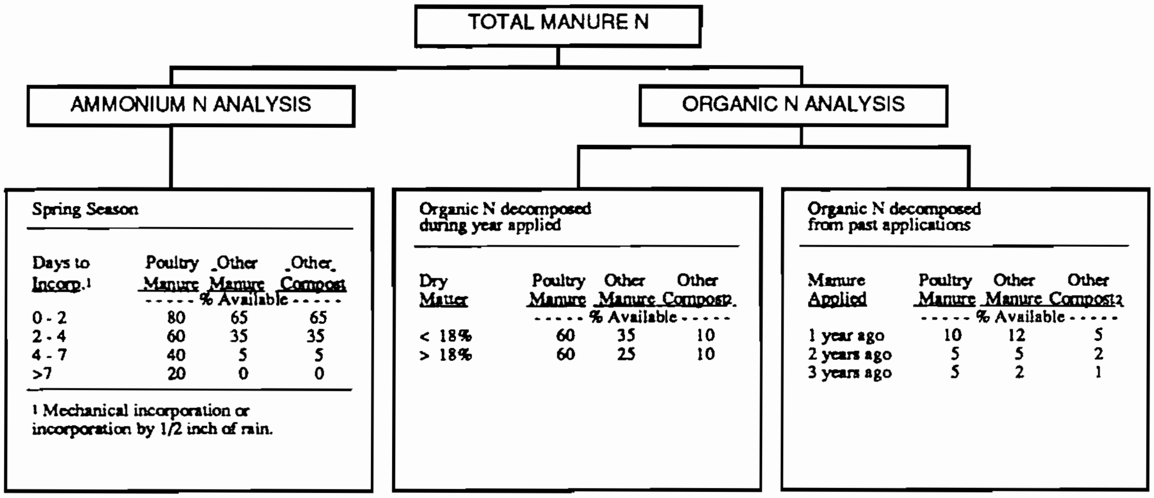
Four nitrogen fertilizer rates were applied to determine the nitrogen response at each location. From this response curve the fertilizer equivalents of the manure and compost treatments and thus the nitrogen availability factors were determined. These average availability factors for the manure and the compost are summarized in table 3 for the dairy manure. Factors could not be determined for the poultry manure in these experiments because of a lack of nitrogen response at this location. This lack of response is likely due to this farm having a history of heavy poultry manure applications. This is confirmed by the high PSNT levels for this location (Table 2-Lancaster).

Table 4. Nitrogen availability factors determined for dairy manure and dairy manure compost.

Material	% Organic N Available 1st year	% Organic N Available 2nd year
Manure	23	10
Compost	13	5

APPLICATION OF THE RESULTS

On the basis of these results it is proposed to modify the procedure for estimation available N used in Pennsylvania to include nitrogen availability factors for compost. The proposed procedure follows (Figure 2).



[2]Proposed availability factors for compost

Figure 2. Factors used in Pennsylvania for estimating nitrogen availability from manure and compost.

PROCEEDINGS OF THE TWENTY-SIXTH

NORTH CENTRAL EXTENSION-INDUSTRY

SOIL FERTILITY CONFERENCE

Published for
The North Central Extension-Industry Soil Fertility Conference
by
Potash & Phosphate Institute
700 - 22nd Avenue, South
Brookings, SD 57006
605-697-7149

November 20-21, 1996

St. Louis Westport Holiday Inn
St. Louis, Missouri

Volume 12

Program Chairman and Editor:

Dr. Peter Scharf
University of Missouri
Dept. of Agronomy
Columbia, MO 65211