Comparing N Rates Using Solid and Composted Dairy Manure on Sandy Soils

Purpose:

To demonstrate the value of the organic matter from solid and composted manure on sandy soil while monitoring organic nitrogen availability, yields and soil quality changes.

Methods:

A site was selected on a sandy field near Langton in Norfolk country. The field was divided into treatments (30-40 ft width and 1000 ft length). Solid dairy manure was applied at 10 ton/ac in the fall of 2007. Composted manure from the same dairy source was applied at 5 ton/ac in the spring of 2008. Solid manure and composted manure were applied at the same rates in the same location in the spring of 2009.

One section of the field had no manure or compost applied. These sections were then sub-divided with 3 nitrogen treatments: starter fertilizer only, normal nitrogen rate (135 lbs/ac) and the Calculator N rate that considered the yield goal and organic additions.

The normal N treatments all received the equivalent of 135 lbs of nitrogen (commercial sources and organic source credits) The N rate for the calculator N treatments were calculated using the Nitrogen Calculator based on a yield average of 135 bu/ac. These plots received 110 lbs N (commercial sources and combined with organic sourced credits). The “starter only” plots were included for a baseline and to give an indication of the impact of the relatively low rates of compost and manure.

28% N was side-dressed to the plots in mid-June and plots were harvested in early November. Soil fertility and soil nitrogen were monitored throughout the season using soil nitrate and stalk nitrogen measurements. Soil quality measurements were taken at the start of the project and changes in soil quality will continue to be monitored.

Results:

Solid manure (with the exception of poultry) and composted manure are not meant to provide the majority of nitrogen for a corn crop, but they can be valuable in providing some nitrogen and more importantly, an improvement in soil health. Improved soil health can provide sustained yield and improved yields, especially on sandy soils. The question of organic matter value and whether compost can be economically applied for sandy soils comes up regularly, especially in dry growing seasons. This project was set up to try and answer some of these questions.

Soil fertility levels at this site are high, where no additional phosphorus or potash is required for increasing crop yields. pH levels and magnesium levels are borderline in some places in the field, although no deficiency symptoms were observed.

Table 1: Soil Test Data

Treatment	pH	BpH	OM %	P ppm	K ppm	Mg ppm	Organic Carbon %
	2008						
Dairy Manure	6.2	6.7	3.3	43	154	112	1.8
Dairy Compost	6.2	6.6	3.0	41	168	70	1.7
Nothing	6.5	6.8	2.7	47	135	87	1.5
Dairy Manure	6.8	---	3.3	50	168	131	1.8
Dairy Compost	7.3	---	3.3	32	105	123	1.8
	2009						
Dairy Manure	6.1	6.6	3.6	35	172	89	2.0
Dairy Compost	6.0	6.7	2.7	51	188	61	1.5
Nothing	5.3	6.4	2.8	52	190	50	1.6
Dairy Manure	6.1	6.7	3.3	35	202	109	1.8
Dairy Compost	6.0	6.6	2.8	31	192	77	1.6

Application of solid dairy manure and composted dairy manure and their nutrient contents are shown in the table below. The composted manure is from the same source as the solid dairy manure, but during the process has lost volume, thus concentrating the remaining nutrients. During the composting process, the amount of quickly available nitrogen is reduced to almost none (if the composting process has been completed). However, for the organic nitrogen portion of the manure and compost; the compost has a lower C:N ratio than the manure which indicates a more rapid mineralization is possible with the compost. The rate of mineralization depends on soil temperature and soil moisture.

Table 2: Organic Additions – Nutrients Applied

	Appln. Rate ton/ac	Date	Total N[1]	NH_4-N	Organic N		P_20_5	K_20	Avail. N[2]	Organic Matter
			lbs/ac							
2008						C:N Ratio				
Compost	5 ton	May 08	25	1.3	24	19:1	22	37	8	930
Manure	10 ton	Nov 07	40	21	19	28:1	29	58	19	2100
2009										
Compost	5 ton	May 09	52	5	47	31:1	28	39	18	2900
Manure	10 ton	May 09	78	16	62	46:1	37	60	21	6340

[1]Only a small portion of the Total N is available in the year of application [2]Available N based on NMAN software – application rates were determined before an analysis was available. Composted dairy manure is from the same source as the solid dairy manure P_20_5 represents the full long-term value

Note: The nutrient content (especially nitrogen) from the manure and compost was lower (about half) of average. This emphasizes the importance of sampling.

Regular soil N testing was done to track nitrogen from the various sources. Nitrogen application from manure and compost was relatively uniform, but at low rates, impossible to distribute as evenly as side-dressed 28%. Both nitrate and ammonium were tested for, but there was little ammonium-N measured except with the compost treatments in July 2008, indicating mineralization was occurring.

Table 3: Norfolk SCIA Solid Manure/Compost Project Summary – Nitrogen Soil Tests*

Treatment	2008 Spring N	2008 July N	2008 Harvest N	2009 Spring N	2009 Harvest N
	Total	Total $N0_3$ + NH_4	Total $N0_3$ + NH_4	Total $N0_3$ + NH_4	Total $N0_3$ + NH_4
	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac
Compost + normal "N"	29	21	19	41	18
Compost + starter only		26	22		23
Compost + calculator "N"		32	21		16
Manure + normal "N"	24	30	29	19	---
Manure + starter only		20	26		25
Manure + calculator "N"		14	14		19
Normal "N" rate	79	17	16	26	13
Starter only		10	20		14
Calculator "N"		16	17		20
Compost + normal "N"	35	63	32	29	31
Compost + starter only		38	40		42
Compost + calculator "N"		41	47		38
Manure + normal "N"	28	32	36	20	24
Manure + calculator "N"		39	56		35

Soil type – Silver Hill - sand over silt loam
*Note: Spring Soil and N samples were taken in mid field while all other N tests were taken near the front of the field.

Yields were highest both years where manure and compost was supplemented with commercial nitrogen. The highest yields came with the addition of organic materials, however the supplementation of commercial N improved yields significantly. Yields were higher in 2008, mainly due to warmer soil temperatures and increased soil nutrient cycling when corn N needs are at their peak. The average yields for each treatment are shown in the table below.

There is a yield boost from adding manure and/or compost to the soil, compared to commercial nitrogen sources only. The field demonstrated a high response to nitrogen as was seen by the nearly 100 bu yield difference between normal N rates and starter fertilizer only. Where the composted manure was applied, yields were higher than expected considering how little nitrate nitrogen (quickly available N) was being provided from the compost. This seems to demonstrate the increased nutrient cycling that occurs from increased microbial activity in the soil.

The soil quality benefits of increased water-holding capacity and less stress during dry weather was not measured since both 2008 and 2009 had adequate moisture during the growing season. A cooler than normal July 2009 also seemed to limited nitrogen availability from the organic sources when compared to the previous year.

Table 4: Norfolk SCIA Solid Manure/Compost Project

Treatment	Yield @ 15.5% (bu/ac)	Harvest Moist. %	Yield @ 15.5% (bu/ac)	Harvest Moist. (%)	Yield @ 15.5% (bu/ac)	Harvest Moist. (%)	N Rate (lb/ac)
	Average 2008-2009		Yield Average 2008		Yield Average 2009		
Compost + normal "N"	**206**	23.8	**210**	21.2	**202**	26.0	135
Compost + starter only	**136**	24.4	**160**	21.8	**112**	26.4	5
Compost + calculator N	**198**	24.4	**205**	21.8	**190**	26.4	110
Manure + normal "N"	**203**	23.7	**212**	20.5	**195**	26.5	110
Manure + starter only	**127**	23.5	**149**	20.8	**104**	26.2	5
Manure + calculator "N"	**194**	23.5	**196**	22.0	**192**	25.8	77
Normal "N" rate	**198**	24.2	**202**	22.2	**195**	26.2	135
Starter only	**102**	24.5	**111**	23.2	**93**	25.8	5
Calculator "N"	**194**	23.4	**197**	21.2	**190**	25.5	110

Summary:

Table 5: **2008-2009 Project Summary**

Treatment	Average Yield (bu/ac)		Average Yield (bu/ac)	Breakeven price for N* ($/lb N)
Compost	180	**Starter N only**	125	2.50
Manure	175	**Calculator N rate**	196	1.30
Commercial N	165	**Normal N rate**	203	---
Breakeven price = how much you could pay in for N (compared to normal N rate's yield) when corn is $4.50/bu and drying in $0.04/point moisture assuming 24% ave. moisture.				

Next Steps:

In 2010 yield will be measured to evaluate if there is a longer-term benefit to the organic materials added. Soil quality will also be monitored to identify changes.

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