

Effects of Digested Dairy Manure on Nutrients and Soil Quality

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ANAEROBIC DIGESTERS HAVE A VARIETY OF USES IN TODAY'S industry and agricultural sectors. On-farm digesters, used for manure management, tend to be plug-flow or continuous flow stirred tank digesters. Raw manure is fed into the digester where microbes decompose the volatile fatty acids that cause odor. This decomposition results in the formation of methane which can be captured and used for electricity or heat production. The digested effluent is stored and land field applied.

Study Site and Objectives

Haubenschild Farms, Inc. is a family owned and operated 800-cow dairy farm near Princeton, MN. In 1999 the farm installed a heated plug-flow digester with a 130-kilowatt engine/generator to utilize bio-gas. The monitoring project was designed to compare effects of anaerobically digested manure, undigested manure, and inorganic fertilizer, applied each year (annually) and every other year (biennially) on crop yields and soil properties.

What Was Measured?

Data was collected in 2001, 2002, and 2003 at each of three fields with different crop and manure histories. Soil samples were taken twice during the growing season at the 0-6 and 6-12 inch depths. Yield samples were collected at the end of the growing season. Manure samples were taken monthly from October 2002 to August 2003. Manure was sampled before the manure entered the

digester, after the manure exited the digester, and from the manure basin.

What Do Yield Results Show?

At this site, yields were similar for digested manure, raw manure, and inorganic fertilizer applications. The only case where differences occurred in 2003 was the annual application treatment in the Appel field, where the raw manure had lower yields than the other nutrient applications (Figure 1).

What Do Soil Tests Show?

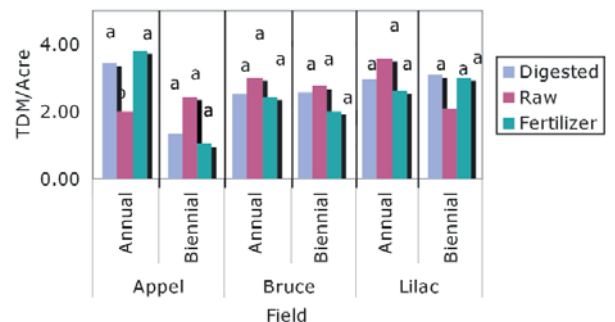
At this site there was no consistent difference in the soil carbon and nitrogen tested among the digested manure, raw manure and inorganic fertilizer treatments (Table 1).

What Happens to Nutrients in the Manure?

The nutrient concentrations of all three manures were fairly constant over the time period sampled as well as among the types of manures (Table 2). This means that the manure management system at the

Figure 1. 2003 Silage Yield

Matching letters above each bar indicate values that are not statistically different within the specified field and application frequency.



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Haubenschild's Farm does a good job of conserving nutrients. Values of P and K in the digested and manure basin samples tended to be lower than raw probably because of some settling. Manure was analyzed on a wet weight basis since it is applied as a liquid to the field. The manure basin could only be sampled during mixing and spreading operations.

Results of Manure Incubations

Raw manure tended to have less available N than digested or basin manure (Figure 2). This is because there was more easily decomposable carbon and higher microbial activity in the soil samples with raw manure added, so more of the available nitrogen was tied up in microbial biomass. Incubations were conducted to observe possible differences between the

Table 1. Soil C, N and Mineralizable N in Response to Annual Application of Manure or Fertilizer at the 0-6" depth, August 2003.

Field	Soil Amendment	Total Carbon g/kg	Total Nitrogen mg/kg	PMN* mg/kg
Appel	Digested Manure	8.83a	697a	17.93a
	Raw Manure	7.81b	535a	16.98a
	Inorganic Fertilizer	8.60a	662a	21.62a
Bruce	Digested Manure	5.39a	166a	12.55a
	Raw Manure	7.41a	383a	15.70a
	Inorganic Fertilizer	6.84a	385a	14.08a

Matching letters indicate values that are not statistically different at P= 0.10

* PMN is a test for N in the soil that could become plant available.

manures in a less variable environment. These results may not be observable in the field where conditions are highly variable and losses may result in no detectable differences among the manures. Manure was added to soil

and placed in a Mason jar for 8 weeks at 25°C. The concentration of manure tested was equivalent to application rates on the field plots (3,000 gal/acre) and a high rate used for comparison (15,000 gal/acre).

Table 2. Manure Nutrients Over Time.

Sampling Date	10/2002	2/2003	4/2003	5/2003	6/2003	7/2003	8/2003	
<i>Nutrient</i>	<i>Manure type</i>							
	<i>lbs/1000gal</i>							
Nitrogen	Raw	33.20	25.99	26.84	27.19	23.20	26.22	28.25
	Digested	32.72	37.18	34.40	28.30	27.79	22.41	25.55
	Basin	22.28	--	31.32	--	24.17	25.20	25.22
Phosphorus	Raw	12.54	6.91	4.52	8.90	8.15	9.24	6.30
	Digested	11.66	8.76	5.11	6.90	6.77	6.77	4.55
	Basin	6.02	--	4.65	--	6.52	6.30	4.47
Potassium	Raw	37.85	22.03	24.45	28.67	27.19	32.35	30.97
	Digested	34.17	29.96	28.84	21.15	27.11	27.64	27.48
	Basin	28.44	--	27.58	--	25.38	28.73	27.09

Matching letters indicate values that are not statistically different at P= 0.10

* PMN is a test for N in the soil that could become plant available.

Figure 2. Manure Incubations Over Eight Weeks

Some negative values occur because values are corrected by subtracting out amounts of extractable N obtained from a control treatment of soil plus urea added at the same rates as inorganic N in the manure.

* indicate a time point where manures were different

