Managing Manure

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Covered manure storage systems: Tangible and non-tangible benefits

Study surveys costs and benefits of manure storage covers in NY.

There are six main benefits associated with covering manure storages with impermeable covers: reduction in manure spreading costs, increased storage time (for existing storages) or reduced storage size required for a given target storage period (for new storages), retained manure fertilizer value, increased flexibility to spread during delayed spring years, reduced odors and greenhouse gas emissions, and reduced safety hazards.

During the spring of 2014 we sampled manure from a NY dairy farm that has an impermeable cover over their long-term manure storage. This farm also stores manure at an uncovered satellite location; nutrient data from the satellite storage from previous years of sampling were provided by the farm. Since manure from the same source went to each of these storages, we made rough, preliminary comparisons between the nitrogen levels measured in the covered and uncovered manure storages.

The estimated annual savings for this particular farm due to the preclusion of precipitation from the storage location during the winter months is shown in Table 1. For this estimation, it was assumed that manure was stored for five months over the winter and that evaporation was minimal. Average precipitation values for the farm's location were used along with an average cost of $0.01 to spread one gallon of manure. According to this estimation, this farm could save over $7,000 per year on spring manure spreading costs. In years of high rain or snowfall, the savings would certainly be greater. There would also be additional savings from the preclusion of precipitation from the storage during the other months of the year.

The manure in the covered storage contained about twice the ammonium N per thousand gallons over the uncovered storage (see Table 2). However, it is unclear how much of this is due to lower dilution from rainwater or reduced volatilization when storage is covered. Using these values, we looked at a spring manure incorporation scenario to estimate the nitrogen values of each source. An average nitrogen fertilizer cost of $0.50/lb N was used and about 65% of ammonia-N and 35% of organic-N being available for plant uptake. Spring incorporation is a practice where the best N capture for manure is obtained. Under the spring incorporation scenario, the covered manure was estimated to be worth about $2.53 more than the uncovered manure per 1,000 gallons of manure.

In terms of the dilution or volatilization impact, it should be noted that additional factors need to be considered. While the cover will conserve nitrogen by minimizing volatilization loss by reducing interactions of the storage surface with air and wind, the added precipitation to the uncovered storage also had a dilution effect on the nitrogen levels in the samples. Without knowing the volume of manure in the uncovered storage and the actual amount of precipitation, it is not possible to determine how much the lower nitrogen levels in this manure is due to volatilization and how much can be attributed to dilution. Regardless, gallon for gallon, the covered manure had a higher fertilizer value. If 4 million gallons of manure are stored and land applied in the spring, covered manure estimated to be worth over $10,000 more than uncovered manure.

Another benefit of a manure storage cover is the reduction in odor and greenhouse gas emissions when outfitted with a properly sized and maintained flare. From a safety hazard reduction standpoint, covered manure storages with impervious covers all but eliminate the risk of a person falling into the storage.

The total annualized cost of this cover system is about $19,000/year over the 20-year expected life of the cover. This includes ownership costs (including capital investment, annual depreciation, and lost opportunity cost of the investment) and operating costs (maintenance, repairs, and electrical costs). While better documentation is needed, if these differences hold up, the estimated cost savings due to the preclusion of precipitation from the storage, the increased nitrogen fertilizer value of the manure, and the intangible benefits from reduced odors and greenhouse gas emissions can significantly offset the cost of the system. ❐

Table 1: Estimated Incremental Cost Associated with Spreading Winter Precipitation

Average Winter Precipitation for Area (in)	14.5
Total Surface Area of Manure Storage (sq ft)	78,225
Volume of Potential Rainfall in Storage (cu ft)	94,521
Extra Liquid in Storage (gal)	707,024
Average Cost to Spread 1 gal	$0.01
Estimated Cost to Spread Precipitation	$7,070

Table 2: Estimated Nitrogen Economic Value of Covered vs. Uncovered Manure

	Uncovered Storage	Covered storage
Total-N (lbs/1,000 gal)	16.30	24.35
Ammonia-N (lbs/1,000 gal)	7.40	14.88
Organic-N (lbs/1,000 gal)	8.90	9.47
Avg N Fertilizer Cost/lb	$0.50	
% of Ammonia-N Plant Available	65	
% of Organic-N Plant Available	35	
N Value of Manure ($/1000 gal)	$3.96	$6.49
N Value Per 1 Million gallons	$3,960	$6,490
N Value Per 4 Million gallons	$15,840	$25,960