Effect of Application Method on Ammonia Loss Following Application of Swine Manure

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A model of ammonia volatilization loss following application of animal manure was developed based on data from the literature and new data obtained by researchers at Clemson University[1]. The model provides estimates of the plant available nitrogen (PAN), ratio of PAN to total nitrogen (TN), and the mass of ammonia-N lost following application.

This new model was used to estimate the ammonia-N losses following application of swine manure of different consistencies and using different application methods. The objective of these calculations was to demonstrate the affect of manure consistency and application method on the amount of ammonia lost to the air.

The different swine manure consistencies were lagoon water and swine manure slurry. The lagoon water had a total solids content of only 0.50% (that is, 99.5% water) and was assumed to be applied at an application depth of greater than 0.25 inches. The solids content of the swine slurry was varied from 2% to 8%.

The application methods considered included big gun irrigation, broadcast spreading without incorporation, band spreading using trail or drop hoses, band spreading with immediate shallow soil coverage, shallow direct injection (≈ 2 to 3 in), and deep direct injection (≈ 4 in or more).

The results, given in Table 1, show that ammonia volatilization losses are the least for lagoon water and the greatest for broadcast application of swine slurries with high solids content. Therefore, irrigation of lagoon water does not result in large losses in ammonia—only 2.2%. However, application methods that reduce ammonia-N losses are needed for manure slurry since losses can be 13% to 26%. Such high-solids manure is commonly encountered when agitating and removing solids from lagoons and storage structures.

Three application methods in Table 1 use some method of immediate incorporation. The trenching method applies slurry in a shallow trench and a sliding foot covers it immediately with a small amount of soil. Shallow and deep direct injection both use a shank and shoe to cut open a trench, and manure is spread in bands below the soil surface. These three methods reduce ammonia losses by 88% to 92%. Therefore, even a small amount of incorporation can greatly reduce ammonia loss.

The main disadvantage of shallow or deep direct injection is the large power requirements to cut open the soil. The high cost of fuel necessitates the use of more efficient means to apply slurry while reducing ammonia losses.

In conclusion, it has been shown that irrigation of lagoon water (TS = 0.50%) does not result in high ammonia losses following application. However, some method of immediate incorporation is needed to reduce ammonia loss following application of swine manure with a total solids content of 2% or more. Even a small amount of soil cover immediately following slurry manure application can greatly reduce ammonia loss.

Table 1. Ammonia volatilization loss following application of swine manure in terms of percent of ammonium-N applied (NH_4^+-N).

	Lagoon Water	Swine Manure			
Total Solids Content =	0.50%	2%	4%	6%	8%
Big gun irrigation	2.2	6.6	13.1	19.7	26.3
Broadcast without incorporation	2.2	6.6	13.1	19.7	26.3
Band spreading (trail hose or drop hose)	1.1	3.3	6.6	9.9	13.1
Trench with shallow cover	0.3	0.8	1.6	2.4	3.2
Shallow direct injection	0.2	0.7	1.3	2.0	2.6
Deep direct injection	0.2	0.5	1.1	1.6	2.1

[1] Chastain, J.P. 2006. A model to estimate ammonia loss following application of animal manure. ASAE Paper No. 064053. St. Joseph, Mich.: ASABE. Available at: http://asae.frymulti.com/.

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