Simple sorbers for ammonia loss measurement in windrow composting.

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ABSTRACT

Inexpensive acid sorbers were evaluated for their ability to give a relative measure of ammonia volatilized among compost windrows. Windrows were made of either straw-bedded or wood residuals-bedded beef feedlot manure. Made of available materials and straightforward in their construction, the sorbers detected significantly higher ammonia emission from the straw mix as compared to the wood mix. While not an accurate measure of ammonia flux, the measurements obtained from the sorbers were precise enough as to be repeatable and to discern differences between the two treatments consistently.

INTRODUCTION

Ammonia volatilization is the major pathway of nitrogen loss in composting. An inexpensive and simple method of measuring ammonia emission is the passive sorber within a static chamber. An accurate measurement of flux is forsaken for a relative measurement of emission, but within the methodology's resolution, comparisons of treatment effects can be made. McGinn and Janzen (1998) provide a comprehensive review of ammonia sources in agriculture and their measurement, but there is little in the literature specific to ammonia volatilization from compost windrows.

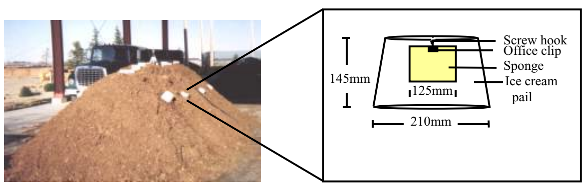

Figure 1 Photograph of wood mix windrow with sorbers (left) and diagram of a sorber.

OBJECTIVES

The objective of the work presented here was to evaluate the ammonia sorber methodology for use on compost windrows.

METHODS AND MATERIALS

The study was conducted at the Agriculture and Agri-Food Canada (AAFC) Research Centre at Lethbridge, Alberta, between July and October, 2000.

Sorbers were constructed as in Figure 1 and the sponges charged with 25mL of ortho-phosphoric acid/glycerol solution in a 2/1 ratio, respectively. Four windrows were established two of the straw mix and two of the wood residuals mix on a covered experimental compost pad. Internal windrow temperatures were monitored throughout the composting period and a windrow turner was used weekly until August 1, then every two weeks thereafter. Samples for chemical and physical analysis were taken just prior to each turning incident.

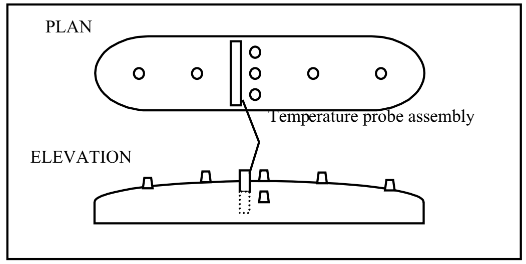

Figure 2 Diagram of ammonia sorber placement on windrows. In plan view, sorbers represented by circles. Rectangles represent temperature probe assembly.

Seven sorbers were placed on each windrow for exposure sessions of 12, 24 or 48h as in Figure 2. Side sorbers were placed to investigate possible differences in volatilisation between tops and sides of windrows. After exposure, sponges were collected and rinsed, and the rinse solution analysed for ammonia nitrogen on an AutoAnalyzer (Technicon Corporation, Tarrytown, New York).

RESULTS

- Based on sorber measurements, a statistically significant ($P<0.05$) difference between straw mix and wood mix windrows was discernable (Figure 3).
- No significant differences between one side and the other of the same windrow were found, nor between sides and tops. Significantly higher concentrations were measured in sorbers that were most windward on a given windrow (Table 1).
- No significant differences in ammonia concentrations were found among sponges exposed for 12, 24 or 48h. The mean ammonia concentrations measured for each windrow over time are presented in Figure 4.

DISCUSSION

Straw mix windrows were predicted to emit more ammonia than wood mix windrows because of their lower carbon-to-nitrogen ratio (~16 for straw mix, ~35 for wood mix) and higher pH (~8 for straw mix, ~7 for wood mix). The experimental results were in agreement with these predictions.

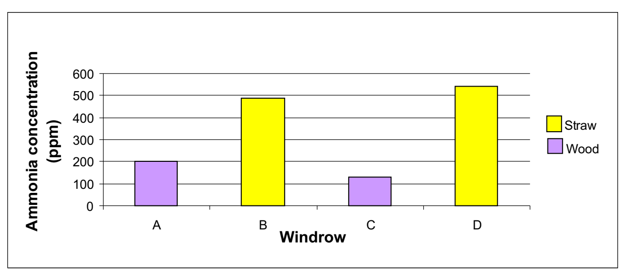

Figure 3 Mean ammonia concentrations of each windrow over the course of the experiment as measured by the sorbers.

Table 1 LS means for sorbers, by position

POSITION	LSMEANS (ppm NH_3-N)
Top, East	327.0647
Top	332.7403
Top, Middle	375.2550
Top	305.4554
Top, West	**421.9928**
Top, South	314.2281
Top, North	306.1322

The lack of a significant difference in ammonia concentration measured by sponges exposed for 12, 24 or 48h suggested a temporal capacity for the sponges of less than 12h, likely because Of sponge surface drying.

Convection currents, of hot air exiting the windrow out the top and replacement air entering through the sides, were predicted to cause there to be higher concentrations measured in sorbers placed on tops of windrows. That this did not occur suggests a limit to the sorbers' resolution, but may also suggest lower than predicted convection current air flow.

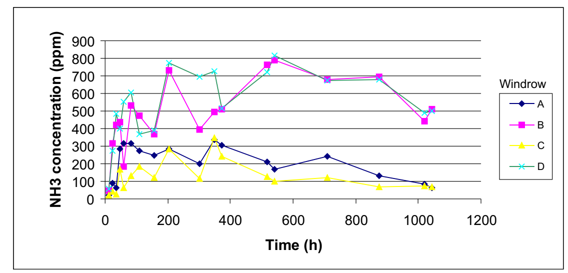

Figure 4 Profiles, by window, of mean sorber concentration of NH_3-N.

CONCLUSIONS

The sorber methodology was advantageous in that it was straightforward and easy to use, utilized available and inexpensive materials and gave measurements accurate enough to suggest statistically significant differences between treatments. One disadvantage to the methodology was the time commitment involved.

The sorber methodology described here could be applied to investigations comparing ammonia emissions involving suitably different treatments.

ACKNOWLEDGEMENTS

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