FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: AIR POLLUTANTS EMISSIONS

Reference 14

Pardo, G; Moral, R; Aguilera, E; del Prado, A 2015 Gaseous emissions from management of solid waste: a systematic review Glob. Chang. Biol. 21, 1313–1327 10.1111/gcb.12806

Background and objective

The establishment of sustainable soil waste management practices implies minimizing their environmental losses associated with climate change (greenhouse gases: GHGs) and ecosystems acidification (ammonia: ammonia). Although a number of management strategies for solid waste management have been investigated to quantify nitrogen (N) and carbon (C) losses in relation to varied environmental and operational conditions, their overall effect is still uncertain. The authors have analyzed the current scientific information through a systematic review. The authors quantified the response of GHG emissions, ammonia emissions, and total N losses to different solid waste management strategies (conventional solid storage, turned composting, forced aerated composting, covering, compaction, addition/substitution of bulking agents and the use of additives).

Search strategy and selection criteria

The authors gathered the available peer-reviewed literature published before November 2013 concerning gaseous emissions during composting and/or storage of organic solid waste. Articles were searched on the ISI Web of Knowledge and Google Scholar database by combining specific keywords related to treatment. First, studies describing data of CH_4, N2O, or NH3 fluxes (at least one of them) over a reported measurement period were collected. We decided to analyze gaseous losses in terms of cumulative emissions, as a proportion of initial carbon (C) or N content in the waste material (%CH4-C, %NH3-N, %N2O-N). Thus, to harmonize the data included in our dataset, in some cases, it was necessary to transform the reported data into values referred to an element mass basis. Those studies not describing results as cumulative emissions or not reporting enough details to perform this conversion were excluded from the analysis. Additionally, we decided to include articles which expressed results just in terms of total N losses, based on a N mass balance, because this approach can add valuable information with regard to the general influence of different treatments and conditions in the overall N conservation through solid waste management. This parameter involves the already mentioned N gaseous emissions (NH3, N2O) but also any other kind of N losses via gas or liquid, such as dinitrogen (N2) or nitrate (urn:x-wiley:13541013:media:gcb12806:gcb12806-math-0001).

Data and analysis

The only criterion used for weighting was the number of aggregated independent treatments contained in our composite datasets. Weighted mean effect sizes of each category were calculated, with bias-corrected 95% confidence intervals (CIs) generated by a bootstrapping procedure (10 000 iterations), using metawin software. Mean effects of treatments were considered different from the control at the 0.05 significance level when the 95% confidence interval did not overlap zero.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
76	Solid manure (dairy cows, swine, poultry, green waste)	Solid manure storage/treatment techniques (turning, forced aeration, compaction, covering, bulking agents, additives)	Solid manure conventional storage (heaps)	Metric: NH3; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Although results indicate that compaction and covering have an influence toward reducing ammonia-N emissions and total N losses, in the case of compaction statistical significance could not be found.
- The addition of additives has been shown to be effective at both mitigating ammonia emissions during storage or composting of solid waste and enhancing N conservation in the final material

Factors influencing effect sizes

- Temperature in the heap : Composting systems reached temperatures in the thermophilic range (>40 °C), where ammonia-N emissions are likely to be above 10%. In contrast, conventional storage, covering, and compaction often led to temperatures within mesophilic range (20–40 °C), which tends to prevent ammonia-N volatilization.
- Bulk density : The authors examined the relationship between the bulk density of the pile vs. N2O and ammonia losses, finding a positive relationship with N2O emissions and negative with ammonia emissions, which stresses the risk of pollution swapping when trying to mitigate N2O emissions by manipulating solid waste density.

Conclusion

Covering or compaction decrease ammonia volatilization. The use of specific additives reduces ammonia losses. Nevertheless, their effectiveness varies depending on the substance, dosage, and operational conditions.