FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: AIR POLLUTANTS EMISSIONS

Reference 1

Zhang Z., Liu D., Qiao Y., Li S., Chen Y., Hu C. 2021 Mitigation of carbon and nitrogen losses during pig manure composting: A meta-analysis Science of the Total Environment 783 147103 10.1016/j.scitotenv.2021.147103

Background and objective

Composting is a reliable way to recycle manure for use on croplands in sustainable agriculture. Poor management of the composting process can result in a decrease in the final compost quality and negative environmental impacts. Optimization technologies during composting have varied effects on the mitigation of carbon (C) and nitrogen (N) losses. Assess the effects of seven technologies on reducing C and N losses during pig manure composting.

Search strategy and selection criteria

Global per-reviewed publications from 2000 to 2019 were collected using the China Knowledge Resource Integrated Database (CNKI) and Web of Science (WOS). The keywords aimed to identify researches focusing on the pig manure, composting, C loss, and N loss. The selected studies were restricted by the following criteria: (i) the study should focus on pig manure composting; (ii) the study should include control group and treatment group; (iii) the study reported on at least one of TC, CH_4, CO_2, TN, NH_3, and N_2O; and (iv) the composting process was complete. TC loss, CH_4 and CO_2 emissions were calculated as cumulative TC, CH_4-C and CO_2-C losses, respectively, and as a proportion of the TC content of the initial feedstock, and TN loss, NH_3 and N_2O emissions were calculated as cumulative TN, NH_3-N and N_2O-N losses, respectively, and as a proportion of the TN content of the initial feedstock.

Data and analysis

Many of the studies did not report any measure of variance for the response variables. Therefore, to include as many studies as possible, an unweighted meta-analysis was used in this study. Mean effect size and bias-corrected 95% confidence intervals for each study were calculated by a bootstrapping product (5000 iterations) using Meta-Win software (version 2.1.4).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
68	Pig manure composts	Technologies: covers, amendments, and using air-dry or hyperthermophilic pretreatment. Physical additives: zeolite, biochar, medical stone, grape seeds and physical mixtures. Chemical additives: acidic substances, metal salts, phosphogypsum, Mg-P salts, Ca-superphosphate and chemical mixtures. Microbial additives: NOB (nitrite oxidizing bacteria), NTB (nitrogen turnover bacteria) and compound microbial agents.	No application of technology	Metric: NH_3-N loss; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Overall, the technologies reduced losses of total N and ammonia-N by 27.5% and 32.7% during pig manure composting, respectively
- The different technologies had variable effects.
- The use of additives significantly reduced total N (31.8%) loss and ammonia-N (35.8%) emissions during pig manure composting. However, the mitigation efficiencies varied with the different additive types.
- Storage covers significantly reduced ammonia-N loss by 14.6%.

Factors influencing effect sizes

- Type of technology : Turning and ventilation did not reduce total N loss, but all other technologies significantly reduced total N loss. With the exception of turning increasing ammonia-N loss by 9.0%, all other technologies significantly reduced ammonia-N loss, ranging from covering 14.6% to additives 35.8%. With the exception of covering, which had no effect on N_2O-N loss, all other technologies significantly reduced N_2O-N loss, ranging from adjusting the C/N ratio by 14.7% to ventilation by 50.6%.
- Type of additive : Variable effects depending on the type of additive and the measured outcome.

Conclusion

Overall, the studied technologies can reduce total N losses by 32.7%. Applying additives, especially biochar and superphosphate, was found to be an effective method for synergistically mitigating C and N losses. Storage covers significantly reduced ammonia-N loss by 14.6%.