FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: GHG 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: 1) CH_4-C loss; 2) N_2O loss; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- In average, the technologies reduced losses of CH_4-C and N_2O-N by 18.1% and 23.8% during pig manure composting, respectively.
- The different technologies had variable effects. No effect on CH_4 emissions was found for Storage with microbial inocula and mixed additives.
- The use of additives significantly reduced CH_4-C (29.9%) and N_2O-N (24.2%) emissions during pig manure composting. However, the mitigation efficiencies varied with the different additive types.
- Covering did not reduce CH_4-C losses. Covering had no effect on N_2O-N loss.

Factors influencing effect sizes

- Type of technology : Adjusting the C/N ratio and covering did not reduce total C or CH_4-C losses. Adjusting the moisture and optimizing ventilation significantly reduced CH_4-C loss by 25.6% and 39.5%, respectively. Adjusting the turning frequency significantly reduced CH_4-C loss by 41.5%. Additives significantly reduced CH_4-C by 29.9%.
- Type of additive : Variable effects depending on the type of additive (no significant effect of microbial additives on CH_4 emissions, but significant reduction of CH_4 emissions with physical and chemical additives).

Conclusion

Overall, the studied technologies can reduce total C and N losses. Applying additives, especially biochar and superphosphate, was found to be an effective method for synergistically mitigating C and N losses.