FARMING PRACTICE
MANURE STORAGE TECHNIQUES

IMPACT: NUTRIENTS RECOVERY

Reference 4

Zhao, SX; Schmidt, S; Qin, W; Li, J; Li, GX; Zhang, WF 2020 Towards the circular nitrogen economy - A global meta-analysis of composting technologies reveals much potential for mitigating nitrogen losses Sci. Total Environ. 704, 135401 10.1016/j.scitotenv.2019.135401

Background and objective

Composting is an important technology to treat biowastes and recycle nutrients, but incurs nitrogen (N) losses that lower the value of the final products and cause pollution. Technologies aimed at reducing N losses during composting have inconsistent outcomes. Advance quantitative knowledge of N losses during composting and the mitigation potential of in situ technologies. 1) quantify N losses (TN, NH_3 and N_2O) from composting, 2) analyze the factors driving N losses; and 3) determine the N mitigation potential of in situ technologies. Here, we report only data regarding the mitigation potential of in-situ technologies. Here we report only results regarding mitigation technologies.

Search strategy and selection criteria

The authors searched for relevant peer-reviewed publications between 2000 and 2018 in international and Chinese journals using Google Scholar and Web of Science. Studies related to composting and N loss were searched with keywords "compost, co-compost (i.e. compost consisting of two or more types of feedstock), nitrogen loss, ammonia volatilization, nitrous oxide loss, nitrogen emission reduction, pig manure, chicken manure, cow manure, organic household waste, kitchen waste, sewage sludge, food waste". 1) the focus had to be on active composting (traditional static stockpiling studies were excluded), 2) studies reported on raw feedstock characteristics (type of feedstock, total C and TN, C/N ratio, pH, moisture), composting procedure (composting type, duration, aeration rate, turning frequency), N loss mitigation technology (C/N ratio modulation, microbial inoculation, physical or chemical additives, covering, aeration rate and turning frequency), 3) studies reported on at least one of the focus N losses (TN, NH_3, N_2O), on gas emissions as cumulative emissions and as proportion of the initial N content of the feedstock, 4) studies provided sample size for treatments and, lastly, 5) data that had been used in multiple publications were analyzed only once.

Data and analysis

The authors used the bootstrap resampling procedure (4999 iterations) to obtain the weighted mean effect size and the 95% confidence intervals (CIs) of each technology category

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
114	Soild manure and organic waste	Mitigation strategies in solid manure storage, i.e. microbial inoculation (MI), physical additives (PA), chemical additives (CA), covering (CO). Physical additives were classified into clay, zeolite and biochar. Chemical additives were classified into six types: acidic substances (apple pomace, citric acid, elemental sulphur, phosphoric acid, bamboo vinegar), metal salts ($FeCl_3$, $CaCl_2$, $MgCl_2$, $MgSO_4$), gypsum, Mg-P salts ($Mg(OH)_2$ + H_3PO_4, $MgSO_4$ + H_3PO_4, MgO + H_3PO_4, $MgCl_2$ + H_3PO_4, $MgSO_4$ + KH_2PO_4, $MgCl_2$ + KH_2PO_4, $Ca(H_2PO_4)_2$ + $MgSO_4$), Ca-superphosphate ($Ca(H_2PO_4)_2$), and nitrification inhibitor DCD.	No mitigation technique	Metric: Total nitrogen loss; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Taken together, the in situ technologies reduced losses of total nitrogen by 31.4.
- The reduction of total nitrogen losses across all technologies was statistically, and averaged CA 38.1%, PA 28.6%, CO 27.8% and MI 20.1%.
- Physical additives clay and biochar significantly reduced TN by 38.8% (clay); and 30.2% (biochar). Zeolite did not affect TN losses. Chemical additives (with the exception of DCD that had no measurable effect) significantly reduced TN loss, ranking Mg-P salts 60.9% > acid substances 44.8% > metal salts 41.5% > Ca-superphosphate 19.7% > gypsum 15.0%.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The reduction of total nitrogen losses across all technologies was statistically, and averaged chemical additives 38.1%, physical additives 28.6%, C/N regulation 27.9%, covering 27.8%, optimized aeration 26.9%, and microbial inocula 20.1%. Biochar and magnesium-phosphate salts emerged as the most effective N-conserving strategies.