

### Reference 4

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### 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<sub>3</sub> and N<sub>2</sub>O) 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<sub>3</sub>, N<sub>2</sub>O), 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
36	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 <sub>3</sub> , CaCl <sub>2</sub> , MgCl <sub>2</sub> , MgSO <sub>4</sub> ), gypsum, Mg-P salts (Mg(OH) <sub>2</sub> + H <sub>3</sub> PO <sub>4</sub> , MgSO <sub>4</sub> + H <sub>3</sub> PO <sub>4</sub> , MgO + H <sub>3</sub> PO <sub>4</sub> , MgCl <sub>2</sub> + H <sub>3</sub> PO <sub>4</sub> , MgSO <sub>4</sub> + KH <sub>2</sub> PO <sub>4</sub> , MgCl <sub>2</sub> + KH <sub>2</sub> PO <sub>4</sub> , Ca(H <sub>2</sub> PO <sub>4</sub> ) <sub>2</sub> + MgSO <sub>4</sub> ), Ca-superphosphate (Ca(H <sub>2</sub> PO <sub>4</sub> ) <sub>2</sub> ), and nitrification inhibitor DCD.	No mitigation technique	Metric: N <sub>2</sub> O-N 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 N<sub>2</sub>O-N by 35.8%.
- CO did not reduce N<sub>2</sub>O losses, but all other technologies significantly reduced N<sub>2</sub>O-N loss (MI 75.2% > PA 58.0% > CA 21.5%).
- Physical additives clay and biochar significantly reduced N<sub>2</sub>O-N by 35.4% (clay); and 66.2% (biochar). Zeolite reduced N<sub>2</sub>O-N loss by 77.4%. Of all CA, only DCD and Mg-P salts significantly reduced N<sub>2</sub>O-N losses (66.0 and 35.4%)

### Factors influencing effect sizes

- No factors influencing effect sizes to report

### Conclusion

C/N RR and CO did not reduce N<sub>2</sub>O losses, but all other technologies significantly reduced N<sub>2</sub>O-N loss (MI 75.2% > PA 58.0% > OAT 54.9% > CA 21.5%). Biochar and magnesium-phosphate salts emerged as the most effective N-conserving strategies.