FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: GHG EMISSIONS

Reference 18

Gu, JX; Nie, HH; Guo, HJ; Xu, HH; Gunnathorn, T 2019 Nitrous oxide emissions from fruit orchards: A review Atmospheric Environment 201, 166-172
10.1016/j.atmosenv.2018.12.046

Background and objective

Agricultural soils are a dominant source of atmospheric nitrous oxide (N2O). A clear understanding of N2O emission from fruit cropping systems is urgently needed to improve the global budget and establish mitigation options. The primary aims of this study were to (i) quantify the variations in N2O emissions from orchards, (ii) evaluate the major controls of N2O emissions, and (iii) discuss potential mitigation strategies across climates, soil types and field managements.

Search strategy and selection criteria

Peer-reviewed publications were collected by searching Web of Science (http://apps.webofknowledge.com) with the keywords "fruit," "orchard" or "plantation," and "nitrous oxide," "N2O" or "greenhouse gases." The collections were then refined to perennial fruit trees by reading the references. The field measurements were usually conducted by using non steady-state chambers. A study that used an intact soil cores technique in an olive orchard (Maris et al., 2015) was also included. The consecutive measurement periods ranged from one whole growing season to four years in respective studies. Gas fluxes were measured in tree rows and the alleyways between tree rows to account for spatial variation; and area-weighted cumulative emissions and EFs were calculated. In cases where cumulative emissions were not reported directly (Ge et al., 2015; Pang et al., 2019), mean fluxes on an hourly or daily basis were extrapolated to the whole year or growing season.

Data and analysis

Replication-based weighting was adopted for the analysis. The weighted response ratios were back-transformed and are reported as effect size. A study (Maris et al., 2015) was excluded during the meta-analysis process that reported N2O uptake on an annual basis because the natural log could not be calculated. Mean effect sizes and the 95% confidence intervals (CIs) were generated by a bootstrapping procedure with 4999 iterations using METAWIN 2.1 (Rosenberg et al., 2000). The impact of management on N2O emissions was considered significant if the 95% CIs did not overlap with zero.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
31	Cover cropping versus non-cover	Cover crops (legume and non-legume) and native grasses in orchards	No soil cover	Metric: N2O emission; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Cover cropping increased N2O emissions by 15% compared to non-cover treatments, but the effect was not significant (95% CIs: −30% to 89%).
- Cumulative N2O emissions from fertilized orchards ranged widely from −0.116–26 kg N ha−1 per year or growing season across the globe (CV = 144%, n = 97; Table S1). The data series followed a right-skewed distribution, with a mean and median of 3.06 and 1.12 kg N ha−1, respectively.
- The largest emission occurred in a rain-fed peach orchard in Eastern China, with a subtropical monsoon climate and large annual N fertilizer input rate of 1006 kg N ha−1 (Cheng et al., 2017). The lowest emission, also the only observation of N2O uptake on an annual basis in the dataset, occurred in a drip-irrigated olive orchard in Spain, with a continental Mediterranean climate and relatively low N input rate of 50 kg N ha−1 plus nitrification inhibitors (Maris et al., 2015). The large uncertainty was similar to the result from cultivated upland soils, which varied from −0.75–56 kg N ha−1, with a mean and median of 3.2 and 1.3 kg N ha−1, respectively
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Cover cropping increased N2O emissions by 15% compared to non-cover treatments, but the effect was not significant (95% CIs: −30% to 89%).