Impacts of soil health focused nutrient management strategies on crop nitrogen uptake and nitrous oxide emissions in leafy green agroecosystems

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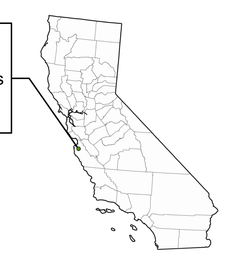
Introduction

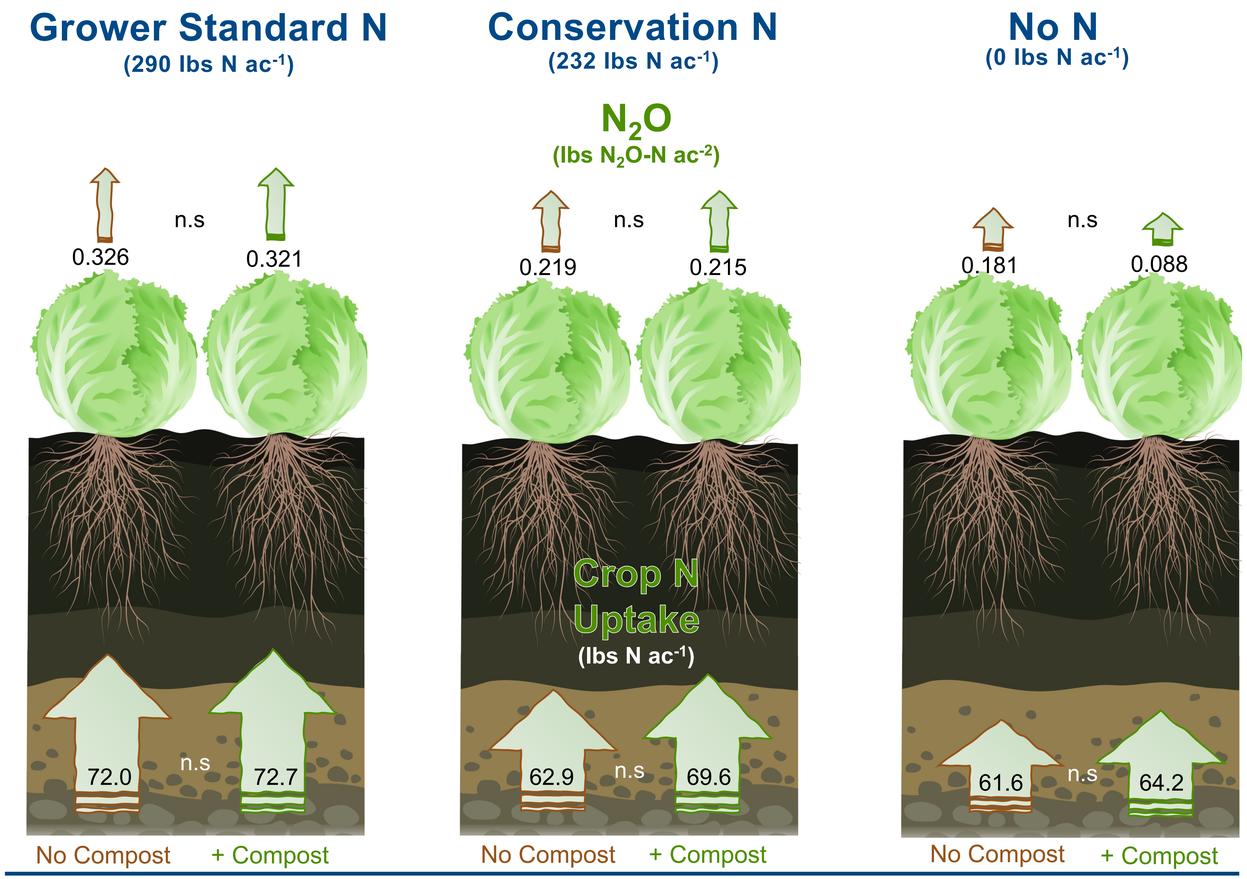
Producing fresh leafy vegetable crops, such as lettuce, demands large inputs of resources. Achieving sustainable N management through reducing fertilizer application rates and use of organic matter amendments is promising, yet more research is needed to determine the agronomic and environmental trade-offs. Here we combine two highly adoptable practices to evaluate N cycling outcomes under contrasting management practices. Our research question includes: **Can sustainable N management techniques be used to decrease N fertilizer inputs and reduce N loss as a greenhouse gas without impacting crop performance?**

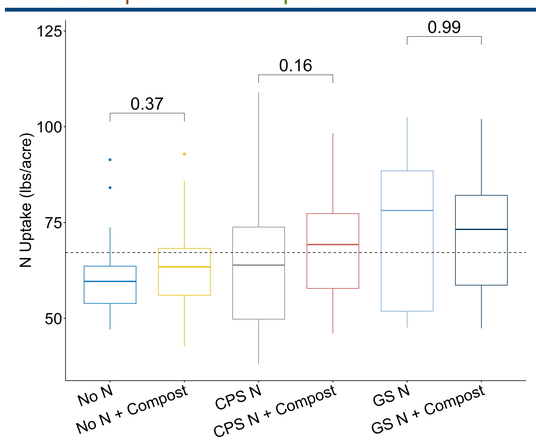
Methods

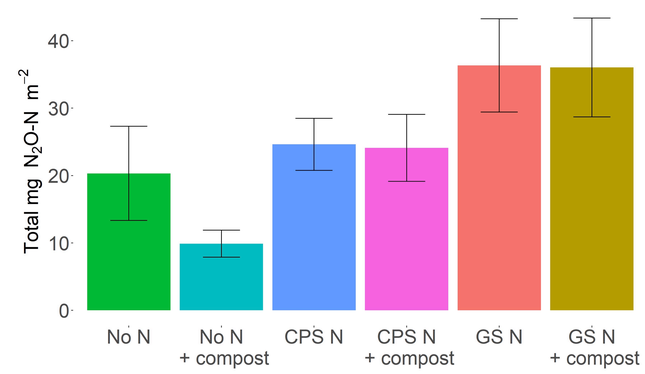
- Replicated, two-level split plot field experiment with three N application rates, grower standard (GS), Conservation Practice Standard (CPS) or No N, as the main factor and compost application as the secondary factor.
- Two crops, leaf (*Lactuca sativa*) lettuce, were grown over the 2021 season, harvested in May and September.
- Crop biomass and its N content in dry weight percent was determined by combustion analysis on a Costech EAS 4010 elemental analyzer.
- Gas measurements were made using in situ static chambers and analyzed on a gas chromatograph (Model 2014, Shimadzu Scientific Instruments). Mean cumulative area-based N_2O fluxes were calculated.

Experiment Location: Salinas, CA
Soil Type: Fine-loamy, mixed, superactive, thermic Pachic Haploxerolls
Average Precipitation: 39.24 cm
Average Temperature: 20° – 8.3°C









Results

- There was no significant difference in crop N uptake under CPS compared to GS N rates ($p=0.22$). Compost did not significantly improve crop N uptake, regardless of the N application rates ($p=0.16$ for the CPS rate and $p=0.99$ for the GS rate).
- For N_2O emissions, the only significant difference across all treatments was between the No N + Compost and GS treatments ($p=0.032$); emissions were three times as high in the GS treatment compared to No N + Compost. All the treatments that received compost had lower N2O emissions.

Conclusions/Further Study

In year one, we showed that N application rates can be reduced without compromising crop N uptake, with the added climate benefits of reduced GHG emissions. These results reinforce previous findings (Rosa et al., 2018), now specifically for central coast leafy greens. This project will help agricultural managers design and implement soil health improvements to support climate-smart agricultural practices while maintaining crop yield potential.

Acknowledgements

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Rosa, D. de, Rowlings, D. W., Biala, J., Scheer, C., Basso, B., & Grace, P. R. (2018). N_2O and CO_2 emissions following repeated application of organic and mineral N fertilizer from a vegetable crop rotation. Science of the Total Environment, 637–638, 813–824.