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**Hotspots of soil N2O emission enhanced through water absorption by plant residue**

Understanding hotspot N2O production can help design better cropping practices and improve estimates for this important greenhouse gas.

**The Science**

Assessing and predicting field-scale soil N2O (nitrous oxide) emissions remains imprecise because much of N2O production occurs within very small soil volumes called “hotspots.” In this study, we found that water absorption by plant residue creates unique conditions that can result in accelerated N2O emissions.

**The Impact**

Understanding and modeling hotspot microscale soil characteristics is important for predicting emissions of the highly potent greenhouse gas N2O and for developing effective mitigation strategies, including cropping practices.

**Summary**

In this study, we quantified physical and hydrological soil characteristics resulting in accelerated N2O emissions in plant residue-induced hotspots, including plant residue quality, soil moisture, and soil pore size distribution. We examined N2O emissions for 110 days in microcosms constructed from soil dominated by either small (<10 m) or large (>35 m) pores. The results reveal a mechanism for microscale N2O emissions: water absorption by plant residue that creates unique micro-environmental conditions markedly different from those of the bulk soil. Moisture levels within plant residue were over those of bulk soil by 4-10-fold and led to accelerated N2O production via microbial denitrification, suggesting that the presence of large pores (>35 m) was a prerequisite for maximized hotspot N2O production and for subsequent diffusion to the atmosphere; in the presence of smaller pores, there were additional anaerobic areas around the decomposing residue, facilitating reduction of N2O to N2. Incorporating plant residue is a commonly used agriculture practice, sometimes promoted as an effective climate change mitigation strategy due to soil carbon accumulation. However, these studies suggest that incorporating residue might promote N2O emissions, counteracting the climate benefit of soil carbon storage. By Identifying the cause of the accelerated N2O it should be possible to provide a basis for the design of cropping practices that would avoid this trade-off, and to more accurately represent N2O fluxes in models and improve estimates for this greenhouse gas.

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**Publications**

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