Research explores the relationship between nitrogen and carbon dioxide in greenhouse gas emissions

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A University of Oklahoma-led interdisciplinary study on a decade-long experiment (1997-2009) at the University of Minnesota found that lower nitrogen levels in soil promoted release of carbon dioxide from soils under high levels of atmospheric carbon dioxide, and could therefore contribute to furthering rising atmospheric greenhouse gases and climate

change.

"Soil microorganisms help extract carbon from non-living sources and make the carbon available to living organisms and play an important role in influencing future climate and carbon cycle feedbacks," said Jizhong Zhou, the OU director for the Institute for Environmental Genomics, a George Lynn Cross Research Professor in the College of Arts and Sciences, and an adjunct professor in the Gallogly College of Engineering.

Zhou and the international research team sought to better understand how regional differences in soil nitrogen levels resulting from pollution or natural soil variation could be affecting how soils release carbon dioxide and impact atmospheric carbon dioxide levels.

"The interactive effects of nitrogen and carbon dioxide on soil respiration, a measure of carbon dioxide released from decomposition in the soil, is particularly important for our future climate, but are not all well understood, due to the lack of long-term manipulative experiments of these two elements together," said Peter Reich, a Distinguished McKnight University Professor at the University of Minnesota.

In the study, published in the journal, *Proceedings of the National Academy of Sciences*, the researchers found that in the last four years of the experiment, elevated carbon dioxide levels stimulated soil respiration twice as much under low as under high nitrogen supply, which was not observed in earlier years.

"Our study highlights that low nitrogen supply gradually accelerates the amount of carbon dioxide released to the atmosphere through decomposition of soil detritus," said Sarah Hobbie, a Distinguished McKnight University Professor at the University of Minnesota. "Considering the worldwide nitrogen limitation in natural environments,

heightened release of CO_2 back to the atmosphere from soil may be pervasive under those conditions of persistent nitrogen limitation."

More information: Qun Gao el al., "Stimulation of soil respiration by elevated CO2 is enhanced under nitrogen limitation in a decade-long grassland study," *PNAS* (2020). www.pnas.org/cgi/doi/10.1073/pnas.2002780117

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