# How farmers could fertilize more efficiently

October 11 2022

Credit: CC0 Public Domain

Nitrous oxide is a powerful greenhouse gas. Its global warming potential can be up to 300 times that of $CO_2$ over a 100-year period. Globally, more than half of man-made nitrogen oxide emissions come from agriculture. A reduction in the nitrogen fertilizer used and an improvement in the nitrogen use efficiency of crops are therefore

important measures in climate protection.

An international team, coordinated by the Vienna Metabolomics Center (VIME) of the University of Vienna, is now presenting a new concept in *Trends in Plant Science* with which the efficiency of nitrogen fertilization is increased and the emission of nitrogen oxide ($N_2O$) reduced.

The main goal of these new studies, building on many years of research, is to offer farmers a better economical alternative, where they can use crop plant derived biological inhibitors instead of highly polluting chemical fertilizers. An important task of the research is to better understand the complex root-soil microbiome ecosystem and to develop technological platforms that can use a root-soil balance for sustainable next-generation agriculture. The international team led by the University of Vienna has now taken an important step in this direction.

## Microorganisms in the soil produce greenhouse gases

The background to the study is a process in plant cultivation that produces the harmful greenhouse gas known as nitrification. Microorganisms in the soil convert the nitrogen fertilizer into nitrogen oxide and other substances. To counteract this, nitrification inhibitors are used in agriculture, which can slow down the nitrification of the nitrogenous fertilizer.

These inhibitors are recommended by the IPCC as a means of mitigating climate change and are already being used in agriculture; but they can also have disadvantages, such as poor efficiency, non-biodegradable and toxic to the environment. However, there are also naturally occurring, so-called biological nitrification inhibitors (BNI): for example, plant roots can exudate compounds with a similar effect that have an inhibiting effect on the nitrifying microorganisms in the soil.

# New approach to more efficient search for natural nitrification inhibitors

The Vienna Metabolomic Center (VIME) with the participation of the Japan International Research Center for Agricultural Sciences (JIRCAS) is now presenting a new approach with which the natural slowdown in the nitrification process can be better understood and used.

The systems biologist and ecologist Wolfram Weckwerth, director of VIME and lead author of the study, explains that "with a new and holistic methodological approach, we are opening a new chapter in understanding the interaction between root exudates of plants and the nitrification-inhibiting compounds in the soil and, above all, we develop plants that perform this process more efficiently. Ideally, these crops will not only supply our staple foods, but can also significantly improve the negative climate gas balance in agriculture."

Arindam Ghatak, also an ecologist at the University of Vienna and one of the main authors of the study, adds that "it is important to characterize the substances released by the plant roots and to decode the interaction with the soil organisms. With the help of complex metabolomics analysis platforms, we can test the messenger substances of the roots and thus their potential to inhibit or prevent the nitrification process. This is possible by using OMICS technologies such as proteomics and metabolomics."

**More information:** Arindam Ghatak et al, PANOMICS at the interface of root–soil microbiome and BNI, *Trends in Plant Science* (2022). DOI: 10.1016/j.tplants.2022.08.016

Provided by University of Vienna