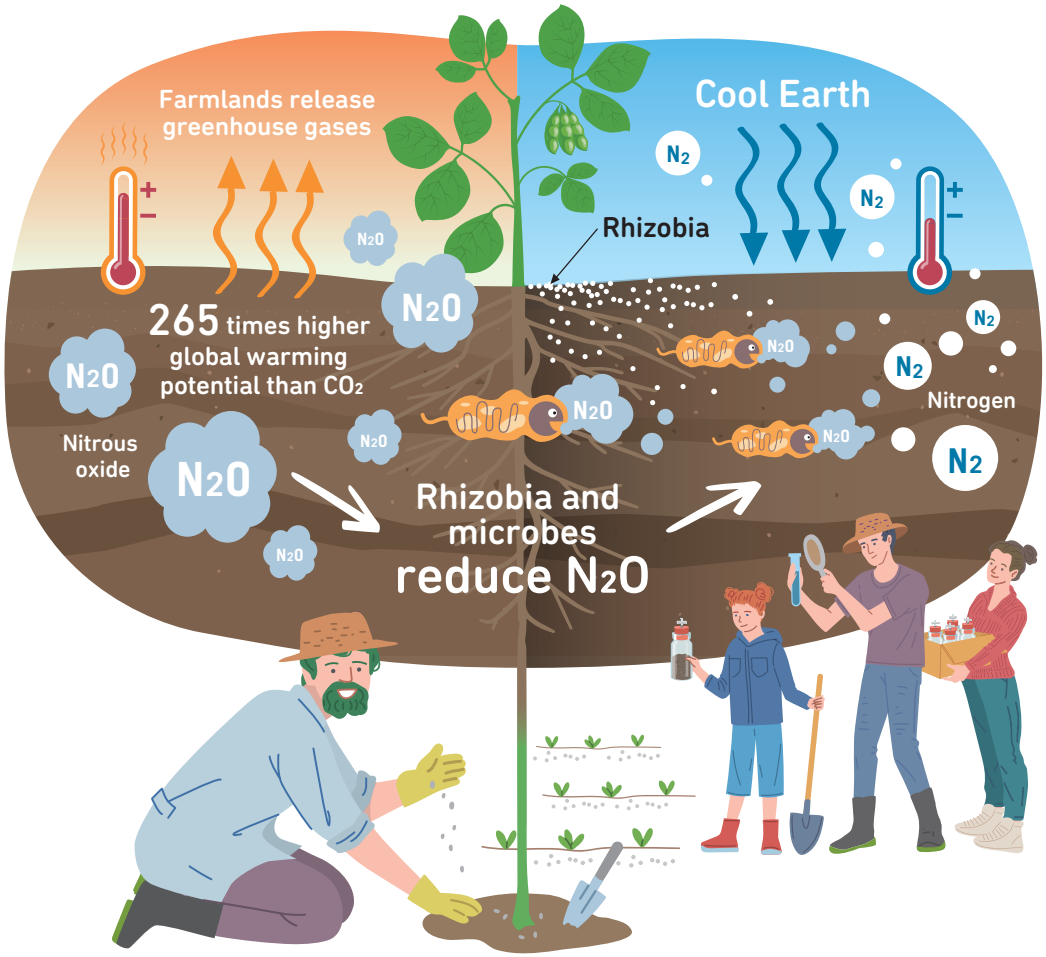
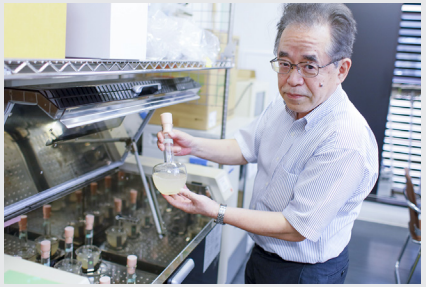
11 PROJECT

Microbes Hiding in the Soil Help Curb Greenhouse Gases

Mitigation of Greenhouse Gas Emission from Agricultural Lands by Optimizing Nitrogen and Carbon Cycles

You probably know that CO_2 is a greenhouse gas, but have you heard of N_2O? Nitrous oxide exists in the atmosphere in lower concentrations than carbon dioxide, but its greenhouse effect is 265 times higher! The largest source of human-caused N_2O emissions is agriculture, and approximately 60 percent of that comes from cultivated soil. As Earth's population continues to grow, more food is needed. If the use of chemical fertilizers increases proportionately, we will generate greater amounts of N_2O as well. Ways to reduce agricultural N_2O emissions without affecting food production are urgently needed to protect the global environment.





Soil Samples Collected by the Citizens Lead to New Possibilities

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Specially Appointed Professor, Graduate School of Life Sciences, Tohoku University

Our citizen science subproject was launched to raise awareness among the general public about N_2O and its connection to global warming. We asked people to collect soil and air samples that we used in our search for microbes that decompose N_2O. Inspired by the microorganisms we discovered and the soil aggregate structure in which these microorganisms live, we have developed ***artificial soil aggregates***. We have also partially succeeded in reducing N_2O from nitrogen fertilizers. Our goal is to contribute to a Cool Earth by reducing N_2O emissions from agriculture.

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» Beans and Bacteria Make the Strongest Tag Team

Fertilizers used to improve crop growth contain nitrogen compounds. These are broken down by microbes and fungi in the soil and released into the atmosphere as N_2O. Rhizobia, which live on the roots of legumes, are one such type of microbe. We were the first in the world to identify a specific strain that has a high capacity for decomposing N_2O. When this strain of rhizobia was used on actual farmland, the result was a 30 percent reduction in N_2O emissions. We call these N_2O-reducing microbes “Global Cooling Microbes.”

» Exploring Global Cooling Microbes

Rhizobia are amazing, but they can only reduce N_2O on the roots of leguminous plants. Reducing all types of agricultural N_2O means finding microbes that are not dependent on legumes.

This is why we launched our citizen science project. We have found several Global Cooling Microbe candidates from the soil samples submitted thus far, and we feel that our research is making progress. We hope to reduce agricultural N_2O through the application of these Global Cooling Microbes in agriculture.

KEYWORD

Artificial Aggregates

These ball-shaped clods of synthetic soil are designed to be a favorable habitat for N_2O-reducing microbes. Applying these aggregates like fertilizer can help create soil that does not release N_2O.

FUTURE VISION

2025

Collection of Data for Real-World Use

We aim to obtain data that will serve as the foundation for the development of rhizobial technology in Japan and internationally. We will continue research on rhizobia, artificial aggregates, and artificial carriers with the aim of deploying them in agriculture.

2027

Rapid Adoption of Rhizobia and Artificial Aggregates

Our objective is to commercialize the rhizobia, starting with domestic and then international application.

2029

The Dream Is a Society With Half the Nitrogen

With full-scale rhizobia deployment domestically and internationally, and the use of artificial aggregates and carriers underway, we aim to reduce N_2O emissions by about 50 percent. We will achieve results in our core research, clarifying the functions of soil microbes, and demonstrate both technological and academic progress.

Implementation Tohoku University, National Agriculture and Food Research Organization (NARO)

Project Introduction Video https://www.youtube.com/watch?v=1Rqh-tcPerI&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3