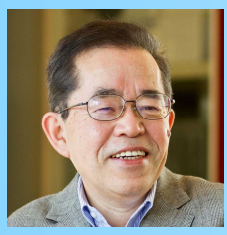


Mitigation of Greenhouse Gas Emissions From Agricultural Lands by Optimizing Nitrogen Cycles

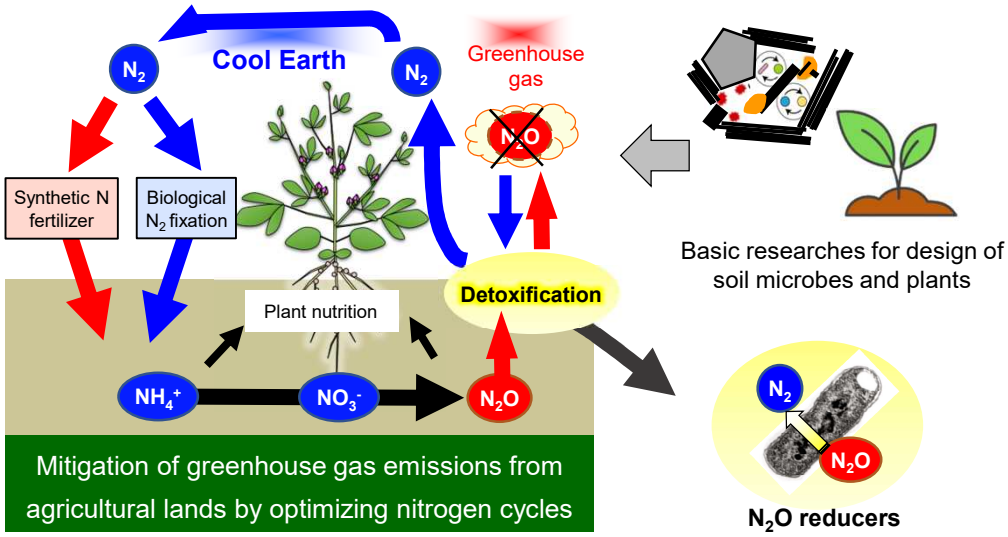
Project Manager (PM) : MINAMISAWA Kiwamu,
Tohoku University

Summary

We aim to develop innovative technologies to mitigate greenhouse gases nitrous oxide from agricultural soil by 2030 and to significantly reduce the greenhouse gas emissions from agricultural soil by 2050, as a part of Moonshot Goal 4 'Cool Earth' and 'Clean Earth'.

Nitrous oxide (N_2O) is a powerful greenhouse gas with a global warming potential of 265. Agriculture accounts for 59% of global anthropogenic N_2O emissions. Paddy rice fields are also a source of methane (CH_4) emissions, accounting for 11% of the global anthropogenic CH_4 emissions. Thus, it is essential to mitigation of greenhouse gases from agriculture. In the natural nitrogen cycle, atmospheric nitrogen gas (N_2) is fixed by microorganisms and converted into reactive nitrogen such as ammonia and nitrate. Reactive nitrogen circulate ecosystem and eventually return to the atmosphere as nitrogen gas (N_2). Although modern agriculture has succeeded to increase food production using nitrogen fertilizers, N_2O emission from agricultural soil is increasing rapidly. In this research project, we will develop mitigation technologies by using soil microorganisms regarding nitrogen cycles.

We found that some rhizobia can reduce N_2O to N_2. We will maximize such microbial processes at the field scale. However, the biggest challenge is that artificially inoculated microorganisms are usually eliminated due to the robustness of the soil ecosystem. Therefore, by integrating the latest research methods and activities of young researchers in different disciplines, we unveil the whole pictures of soil microorganism world, and reorganize plant-microbe relationships in order to achieve our goal.



KPI

FY2022	FY2024	FY2029
We will isolate soil microbes with higher N_2O-reducing and CH_4-oxidizing activities and develop new nitrification and denitrification inhibitors.	We will attain (i) 30% reduction of N_2O emission in field tests by inoculation with higher N_2O-reducing rhizobia in legumes, (ii) 30% reduction of N_2O emission in laboratory by application of N_2O reducing microbes to soil.	We will attain significant reduction of N_2O emissions from experimental agricultural fields by combining multiple N_2O reduction technologies for microbes and crops developed in this project with current N_2O reduction technologies.

Implementation

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