

A multidisciplinary approach towards the reduction of N₂O emissions from agricultural fields

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Nitrous oxide (N₂O), one of the greenhouse gases, is emitted from agricultural fields following the application of nitrogen (N) fertilisers. This study aimed to mitigate the N₂O emissions from agricultural soils and investigate soil physicochemical and microbial factors controlling the emissions. The details of the study are explained below.

- 1) The evaluation of soil physical factors controlling N₂O emissions, including soil compaction**¹⁾: The study revealed that the positive effect of soil compaction on N₂O emissions was not observed in the aggregates larger than 4 mm diameter. Thus, the presence of large soil aggregates (> 4 mm) is vital to mitigate N₂O emissions.
- 2) Study on the microbial processes and soil management methods related to N₂O emissions**²⁾: The efficacy of the coated fertilisers to reduce N₂O emissions varies depending on soil types, but the reasons behind the variability were unknown. Thus, ¹⁵N-labelled nitrate ammonium was used to understand different soil processes' contribution to N₂O emissions. The study revealed that the response of nitrifiers was one of the keys to controlling the N₂O mitigation efficacy of coated fertilisers. Also, the mRNA level responses of N₂O-producing microbes during the simulated heavy rain event after the drought was observed.
- 3) Study towards the use of N₂O-reducing microbes at the field level**³⁾: By using a soybean field, I tested the effect of the inoculation of N₂O-reducing microbes on soybean seeds on N₂O emissions. For the first time in the world, the study showed that it is possible to mitigate N₂O emissions by inoculating microbes at the field level.

Through the above series of studies, I have shown that a multidisciplinary approach, including soil environmental factors, microbial ecology, and gene expression, is effective in efficiently using N fertilisers and developing N₂O reduction technologies.

- 1) Uchida, Y., Clough, T. J., Kelliher, F. M., Sherlock, R. R.: *Soil Biol Biochem* 40(4): 924–931 (2008).
- 2) Uchida, Y., von Rein, I., Akiyama, H., Yagi, K.: *Soil Sci Plant Nutr* 59(1): 46–55 (2013).
- 3) Uchida, Y., Wang, Y., Akiyama, H., Nakajima, Y., Hayatsu, M.: *FEMS Microbiol Ecol* 88 (2): 407–423 (2014).