



Effectiveness of a nitrification inhibitor to reduce N₂O emissions - A case study in Estonia

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Nitrous oxide (N₂O) has become a subject of intense research in the last years, not only because of its high global warming potential as a greenhouse gas (almost 300 times that of carbon dioxide), but also for being currently the main ozone-depleting substance. The main anthropogenic source of N₂O is agriculture, especially because of organic and inorganic fertilization. The focus has been placed on how to make fertilization more efficient minimizing N losses. To achieve this, the use of substances known as nitrification inhibitors (NI) has been proposed. 3,4-Dimethylpyrazole phosphate (DMPP) is known as an effective NI, inhibiting the activity of ammonia-oxidising bacteria and increasing nitrogen-use efficiency and crop yield, while having lower toxicity than other NIs. Many experiments have shown DMPP's effectiveness in reducing N₂O under lab conditions but field experiments have shown variable results.

We conducted an experiment to test the efficiency of DMPP to reduce N₂O emissions from a winter rape-seed (*Brassica napus*) field in central Estonia from August 2018 until August 2019. The field was divided into two plots. Prior to sowing, 30 t/ha of dairy slurry were mixed in the upper layer of the soil. On the treatment plot, slurry was mixed with DMPP to achieve a rate of 3 l/ha of DMPP, while on the control plot only slurry was applied. Nitrous oxide, carbon dioxide and methane emissions were measured from both plots using the manual closed chamber technique, with five chambers (replicates) per plot initially once every two days, with decreasing frequency for the first two months, and once per week afterwards. Soil temperature and moisture were also measured, and soil and leaching samples were also collected.

Contrarily to what we expected fluxes were higher at the treatment plot where the nitrification inhibitor had been applied than at the control plot. A heavy rainy period starting immediately after the slurry application and during the expected period of NI activity raised the soil moisture resulting in favourable (anoxic) conditions for denitrification that may have been masked the inhibitory effect. Thus, the observed effect of DMPP was negligible. The higher soil moisture and therefore denitrification activity was most likely the cause of higher N₂O fluxes from the treatment site.