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# Raising a peat meadow's groundwater level: fertilizer strategies to minimize $N_2O$ emissions

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Peat soils store a large part of the global soil carbon stock, which can potentially be lost when they are drained and taken into cultivation. In the Netherlands, 75% of the peat and peaty soils are drained and are mainly used for grassland cultivation. This results in an estimated yearly emission of 5.6 Mton $CO_2$ due to peat oxidation, accounting for about 3% of the national $CO_2$ emissions. Groundwater level (GWL) management has been proposed to mitigate peat soil oxidation, but this may lead to increased emissions of nitrous oxide ($N_2O$). Peat meadows experiencing (intermediate) wet conditions, and frequent fertilization events, are favorable locations for $N_2O$ production.

We hypothesize that the selection of a fertilizer with a relatively low mineral nitrogen (N) content (such as farmyard manure), will limit the risk for increased $N_2O$ emissions as a result of raising the GWL, compared to fertilizers with a high mineral N content (such as calcium ammonium nitrate).

The effects of these two management factors (groundwater level and fertilizer type) were studied in a two-year field experiment. The experiment took place in 2022 and 2023, on two adjacent grassland fields of a dairy farm near Zegveld, in the low-lying western peat area in the Netherlands. On the first field, drainage was controlled by the ditch water levels, leading to GWLs ranging between -100 cm in the summer and -20 cm in the winter. The GWL of the second field was maintained at a more steady level around -40 cm using infiltration drainage pipes. In year two, a third groundwater level treatment was added, with infiltration drainage aimed at a GWL of -20 cm. Following a randomized block design for each GWL object, the $N_2O$ emissions and N yields were compared for six fertilizer products and an unfertilized control treatment in four replicates: calcium ammonium nitrate, ammonium sulphate, farmyard manure, cattle slurry and the liquid and solid fraction products after slurry separation.

The results of 2022 suggested that the combination of raising the GWL (using infiltration drains aimed at -40 cm) and application of cattle slurry or its liquid fractionation product - both having a relatively high mineral N content - led to a strong increase in $N_2O$ emissions. As expected, emissions were lowest for farmyard manure and the solid fraction of slurry. However, these fertilizers in combination with a raised GWL resulted in significantly lower N yield in the harvested grass, making the combination less attractive to a dairy farmer. Variation in $N_2O$ emissions was still large, indicating the importance of several measurement years. Here, we will present the combined results of 2022 and 2023, including fertilizer-specific $N_2O$ emission factors calculated over two years.