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Mitigating agricultural greenhouse gas emissions by improved pH management of soils (MAGGE-pH) - Swedish case studies

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Climate forcing by crop production is dominated by N_2O emissions. Although emissions can be marginally reduced by "good agronomic practice", we need more targeted approaches to make progress. For that, MAGGE-pH concentrates on the microbial processes responsible for the production and consumption of N_2O in soils. Our point of departure is the emerging understanding of how soil pH perversely controls the $N_2O/(N_2O+N_2)$ product ratio of denitrification. Since denitrification is the dominant source of N_2O, this indicates that N_2O emissions from cultivated soils can be reduced substantially by increasing the pH of moderately acidic soils beyond that needed to secure adequate crop growth.

The evidence for the pH effect on N_2O emissions stems almost exclusively from laboratory experiments. Now we need stringent testing of different liming strategies under realistic field conditions. This will be the core activity in MAGGE-pH and generate emission factors for a range of N fertilizers / manure / urine / biochar applications explicit for soil pH.

In the Swedish part of the MAGGE-pH project, we have two field trials in which we measure N_2O emissions, yields, soil physical, chemical and biological parameters. Field site "Broddbo" is a fen peat soil treated with finely ground limestone at the rates 0 (control), 10 t/ha and 20 t/ha, and field site "Linnes Hammarby" is a clay soil with 3 lime treatments, control, slaked lime and mixed lime (15% slaked lime and 85% CaCO3). On a campaign 2019, we compared the emissions from irrigated and non-irrigated plots.

Preliminary results show significant differences in pH, yield and some biological parameters. We found a significant effect of irrigation on N_2O emissions, but low or no lime/pH effect.