Nitrification inhibitors as tool for reduction of greenhouse gas emissions

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The use of nitrification inhibitors (NI) in combination with ammonium based fertilizers is a proven method to improve nitrogen use efficiency, to reduce nitrogen losses through nitrate leaching and to reduce greenhouse gas relevant emissions of nitrous oxides in agriculture. Nitrous oxide (N_2O) is a potent greenhouse gas, with approximately 294 times higher warming potential than CO_2. The first step of nitrification is the oxidation of ammonia into nitrite in the soil by the enzyme ammonia monooxygenase (AMO). AMO is present in soil borne chemolithoautotrophic ammonia-oxidizing bacteria (AOB) with the genera *Nitrosomonas*, *Nitrosovibrio*, *Nitrosolobus* or *Nitrosococcus*, and ammonia-oxidizing archaea (AOA). Literature suggests that the enzymatic activity of AOB is the main driver of nitrification activity in the soils, rather than AOA. This is observed in studies with NI´s, which show that they have a much stronger effect on AOB than on AOA. The inhibition of AMO by NI decreases directly the nitrification rate, and reduces indirectly the nitrate concentration in the soil which serves as substrate of the denitrification. These are two main pathways of nitrous oxide (N_2O) production in the soil. Due to their efficient blocking by using NI´s the agricultural borne N_2O emissions are considerably reduced. Compared to other agronomic measures NI´s have the greatest potential in reducing the emission of nitrous oxide emissions from agriculture. Measurements in several studies were able to prove this consistently. Akiyama et al. (2010)[1] reviewed 85 studies of 2008 and earlier, which showed a reduction in nitrous oxide emissions between -14% to -51%, or 38% in average of six commercial available nitrification inhibitors used during vegetative growth periods. The reduction potential seems realistic for temperate, Mediterranean and

[1] Akiyama H, Yan X, Yagi K (2010) Evaluation of effectiveness of enhanced-efficiency fertilizers as mitigation options for N2O and NO emissions from agricultural soils: meta-analysis. Global Change Biology 16:1837-1846

tropic climates, but regions with colder climate, intense frost or thaw cycles lack of studies to confirm this reduction potential.