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Effect of plant development and N uptake on denitrification in two contrasting crop species

Pauline Sophie Rummel[1], Amanda Matson[2], Jonas Eckei[1], Reinhard Well[2], and Klaus Dittert[1]
[1]Georg-August-University Göttingen, Department of Crop Sciences, Plant Nutrition and Crop Physiology, Göttingen, Germany (pauline.rummel@uni-goettingen.de)
[2]Thünen Institute of Climate-Smart Agriculture, Federal Research Institute for Rural Areas, Forestry and Fisheries, Braunschweig, Germany

Denitrification is the main source of the greenhouse gas N_2O emitted from agricultural soils. While N_2O emissions and influencing factors have been very well studied in field experiments, there are hardly any reliable data for N_2 emissions on the field scale. However, these are essential to understand under which conditions complete denitrification occurs leading to N_2 formation and when N_2O is the main end product. Whether NO_3^- is reduced to N_2O or N_2 depends on several factors: the availability of NO_3^- and available organic C, as well as pH, oxygen availability, soil moisture, denitrifier community structure, and temperature. All of these parameters are highly dependent on crop development, as growing plants take up NO_3^- and water while increasing organic C availability via root exudates and dying roots, and alter soil pH as well as microbial communities by rhizosphere dynamics.

The objective of this field trial was to collect reliable measurement data on N_2 and N_2O emissions in typical German crops. Two crops were chosen that differ greatly in their temporal development: Winter wheat (*Triticum aestivum* L.) and sugar beet (*Beta vulgaris* subsp. *vulgaris*). Both crops were grown site-typically according to the rules of good agricultural practice. To measure N_2O and N_2 emissions, the improved ^{15}N gas flux method including high enrichment ^{15}N-labeled fertilizer was applied. Prior to gas sampling, chambers were purged with a mixture of helium and oxygen (80:20) to reduce the atmospheric N_2 background to < 2%. Soil samples were taken at regular intervals and analyzed for mineral N (NO_3^- and NH_4^+) and water-soluble Corg content. In addition, we monitored crop development, plant N uptake, N transformation processes in soil, and N translocation to deeper soil layers.