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Interactive plant and soil effects on denitrification potential in agricultural soils

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Microbial denitrification is a microbial soil process reducing nitrate (NO_3-) to nitrite (NO_2-), nitric oxide (NO), and nitrous oxide (N2O) and the terminal end product dinitrogen (N2). The main ecological importance of denitrification is the production and consumption of the potent greenhouse gas N2O as well as the removal of reactive nitrogen (N) from the biosphere. Main controls are carbon and nitrate availability as well as oxygen levels because denitrification is a predominantly anaerobic process. Despite, all major controls of denitrification are directly or indirectly affected by plants. However, the effects of plants on denitrification as well as interactions with different soil types are so far severely understudies.

Here we investigated the effect of three common agricultural crops (wheat, barley and ryegrass), on denitrification potential in two different agricultural soils using the commonly used acetylene-method. Denitrification potential significantly differed between the two soil types with plants increasing denitrification potential in rhizosphere of both soil types. Plant species however did not exert different effects on denitrification potential. Interactive effects of plants and soils on denitrification potential were either of additive, synergistic or antagonistic nature. In sum, our results underline the decisive but so far hardly quantified role of plants on denitrification in soil. In order to provide a holistic understanding of plant control of denitrification, future studies should focus on disentangling plant-soil-microbe effects on actual denitrification rates and N gas product ratios, despite this remains a methodological challenge.