Plant-microbes interactions in the rhizosphere of maize inoculated with Azospirillum lipoferum CRT1: implications for soil N-cycling microorganisms

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Abstract

Background and aims Maize seed inoculation with the plant-growth promoting rhizobacterium *Azospirillum* is known to stimulate root growth and exudation, thereby enabling a better exploitation of the soil volume and indirectly enhancing N uptake, before it is leached or volatilised. We tested the hypothesis that *Azospirillum* induced-root stimulation could increase plant N uptake and thus enhance plant competition over N-cycling microorganisms for mineral N, leading to (a) a decrease of nitrification, and (b) a decrease of denitrification that can be counteracted by the stimulatory effect of root exudates-carbon on denitrifiers. **Methods** The extent of inoculation-induced changes in potential nitrification and denitrification activities, in the abundances of nitrifiers and denitrifiers and in root functional traits were assessed at 4 dates over two consecutive years in a multi-site field trial. **Results** Plant root traits, (de)nitrifier potential activities and abundances were affected by inoculation, with significant relationships between plant and microbial responses. However the observed effects varied among sites. Semi-potential denitrifying activity (i.e. when C or N sources were not made non-limiting) was measured in order to elucidate the differential response to inoculation observed on denitrifiers between sites. The site-specific level of C limitation for denitrifiers explained the differential inoculum effect observed across sites. **Conclusion** Our findings indicate that maize seed inoculation with *Azospirillum* can be a sustainable, though soil-specific, agricultural practice providing both agronomic and environmental benefits. Furthermore, soil organic C availability appears to be a good predictor of the potential for N losses through denitrification from the soil-plant system following inoculation.

Keywords: soil microbial ecology, nitrification: denitrification, Azospirillum, inoculation, carbon limitation

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