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At what extent a key microbial functional community (the denitrifiers) could be modified by agricultural practices: the case of direct seeding in Madagascar

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Direct seeding mulch-based cropping systems (DMC) are increasingly adopted worldwide to minimize soil erosion and improve soil quality. In Madagascar, where the study was performed, DMC including mulches of soybean and rice residues is combined with mineral/organic fertilization on a clay ferrallitic soil. Previous studies showed that this land use induces significant changes on chemical, physical and biological soil properties such as soil carbon content, soil structure and diversity indexes. Therefore, the aim of this work was to investigate in which extent these practices (land use + three levels of organic/mineral fertilization) impacted on the denitrifiers community. In order to characterize the respective influence of crop rotation (rhizosphere effect) and mulch quality (residusphere effect), plots were sampled twice ; in February 2005 corresponding to soybean crop under rice mulch and in February 2006 corresponding to rice crop under soybean mulch. Soil samples were analyzed in terms of denitrifier density (quantitative PCR of narG/napA/nirK/nirS/nosZ genes), potential activity (nitrate reductase activity, Denitrification Enzyme Assay \pm C₂H₂, DEA).

The denitrifier activities (nitrate reductase and DEA \pm C₂H₂) were significantly increased by direct seeding in both years, whereas fertilization modalities and crop rotation had no impact at all. No significant reduction of N₂O (DEA without C₂H₂) was noticed. A general trend in 2005 and 2006 indicated that all gene densities (narG/nirK/nirS/nosZ genes) were significantly increased in plots under direct seeding except for plots with high fertilization levels. In addition, fertilization regimes and crop rotation seems to have the stronger impact on the napA community involved in the nitrate reduction process.

Overall, crop and mulch types as well as fertilization intensity appear to have far less impacted densities and activities of denitrifiers than direct seeding. Further investigations are needed to elucidate the in situ impact of this practice on nitrogen fluxes and losses through nitrogenous gases.