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Ammonia oxidizers (amoA) and denitrifiers (nirK) dynamics in the rhizosphere between hybrid and standard rice cultivars and linkage to N2O emission

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The rice paddy soils are known to have both nitrifying and denitrifying activities, but the microbial control of nitrous oxide (N2O) emission for rice cultivars is poorly understood. Therefore, the field experiment was conducted to investigate N2O dynamics and the structure and abundance of ammonia oxidizers (ammonia oxidizing archaea-AOA and bacteria-AOB) and denitrifiers in the rhizosphere of hybrid and conventional rice cultivars at four different sampling time points (unplanted soil and three developmental stages). PCR-denaturing gradient gel electrophoresis (DGGE) and real-time PCR approaches were used to evaluate the structures and relative abundances of ammonia oxidizers and denitrifiers by targeting a functional gene fragment coding amoA and nirK. N2O emission from hybrid and conventional cultivars were monitored with a closed chamber method throughout the whole rice growing season at different growth stages. Hybrid rice emitted less N2O than conventional rice cultivar through out period of rice growth. Denitrifying bacteria (nirK) predominated the AOA and AOB while AOA were abundant than AOB in the paddy soil. Hybrid rice stimulated higher bacterial-amoA (AOB) gene copies g-1 dry soil and lower nirK (denitrifiers) gene copies g-1 dry soil in the rhizosphere than the conventional cultivar. Moreover, hybrid rice also promoted higher AOB: AOA ratio and lower nirK: amoA (AOB) ratio in the rhizosphere than conventional cultivar. Comparison of AOB and denitrifying community structures by principal component analyses (PCA) of PCR-DGGE profile also revealed significant differences between conventional and hybrid cultivars at all growth stages. However, rice cultivars and growth stages did not significantly influence the structure and abundance of archaeal-amoA (AOA) in rhizosphere and bulk soil showing the higher stability. We also found significant correlation between N2O emission and rhizosphere denitrifying gene abundances from both cultivars across different sampling time points. The results suggest that less adaptability of denitrifying (nirK) bacteria than AOB in the rhizosphere of hybrid cultivar may be contributing factor for less N2O emission relative to conventional cultivar. This research will contribute to an understanding of the link between rhizosphere microbial communities and N2O emissions in a rice system.