Can nitrification be inhibited /regulated biologically? Biological Nitrification Inhibition (BNI) - A novel phenomenon

Why Inhibition of Nitrification in Agricultural compounds of the root exudates can be detected by bioluminescence transformed with the pHLUX20 plasmid that has the lux gene. Because of the lux gene the metabolic activity of Nitrifiers can be monitored by luminescence detection (Fig.1). Inhibitory effects in the compounds of the root exudates can be detected by bioluminescence.

Rationale

To develop an integrated approach to study the BNI phenomenon in the plant-soil system and thus obtain a chemical, biochemical and molecular evidence of this phenomenon.

Methodology

Biomimicic assay to detect nitrification inhibition in root exudates. This assay uses an ammonium-oxidizing bacteria (Nitrosomonas europaea) developed by Duque et al. 1998 transformed with the pHLUX20 plasmid that has the lux gene. Because of the lux gene the metabolic activity of Nitrosomonas can be monitored by luminescence detection (Fig.1). Inhibitory effects in the compounds of the root exudates can be detected by bioluminescence.

Results and Discussion

Soil chemical compounds to study BNI activity. Soil nitrate (NO\textsubscript{3}\textsuperscript{-}) and nitrite (NO\textsubscript{2}\textsuperscript{-}) levels in the soil 1 day after fertilization (5th cycle) - and monitor AOB and AOA population analysis by Real-Time PCR. The lower the AOB and AOA population (gene copy number) the higher the grass’s BNI activity. The molecular data for BNI activity showed that the copy number of amoA gene both for bacteria and archaea is lower in the tropical forage grasses than soybean (both nitification stimulant) and the bare soil (control) (Fig. 3A and Fig. 3B). As for the bacteria (AOB) amoA gene, B. humidicola 16888 has highest BNI activity (less copy number) dry soil in comparing with other grasses) (Fig. 3A). Even though it was hard to find statistical differences between bare soil and the grasses due to the high variability obtained in the experiment, it is safe to say that biologically there is a huge numerical difference between them. Regarding the AOA population there is a clear statistical difference between bare soil and soybean compared with the grasses. Although Panicum maximum showed the highest BNI activity, it is not statistically different from B. humidicola 16888. This molecular data confirm the trend observed in soil chemical analysis and biomimicic assays, except for Panicum maximum which showed a significant difference from the others in soil chemical analysis (Fig. 3C).