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The Influence of Nitrogen Nutrition on Root Exudates of Rice (*Oryza sativa*)

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Abstract

Plant root exudates play an important role for plant nutrition. They consist of a complex mixture of organic acids, amino acids, phytosiderophores, sugars, carbohydrates, root border cells and other low molecular weight compounds that create interactions between the root and the microorganisms and other plants present in the rhizosphere. They play a role in the solubilisation of unavailable nutrients and to overcome toxicity. Nitrogen nutrition is known to greatly influence the carbon allocation in plant metabolism. We thus hypothesise that changes in nitrogen nutrition will affect the composition of the root exudates. Rice plants (*Oryza sativa*, cultivar IRRI-154) were pre-cultivated in hydroponic systems until the stage of maximum tillering, with 20 replicates per treatment. Three different levels of nitrogen as NH_4NO_3 (control: 2.86 mM N, high: 4.0 mM and low 0.4 mM N) were used. To collect the root exudates, rice plants were individually immersed in a sterile solution containing 10 % of the micronutrients for 2 hours during daylight. Next, the samples were lyophilized and rediluted in a solution of 80 % methanol. GC-MS analyses were performed after derivatisation with MeOX and MSTFA, using ribitol as internal standard. Principal Components Analysis revealed a clear separation in the root exudates composition between the different nitrogen levels, with a decrease for the plants with high level of N fertilisation, especially for ribose, glucose, myo-inositol, glycine, GABA and organic acids. On the contrary, plants under low level of N did not experience bigger changes in comparison with the control, except for shikimic and quinic acid, which were slightly higher. Plant growth and photosynthesis were severely affected by the long term nitrogen deprivation, so the relative surplus of reduced carbon may thus have induced a shift towards formation of more C-rich compounds. The results suggest that the release of root exudates is influenced by nitrogen nutrition. Surprising is the influence of an increased N supply. Tackling this question needs further research.

Keywords: Nitrogen nutrition, organic acids, root exudates, sugars, rice

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