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Nitrogen Metabolism, Acquisition and Assimilation, of Rice under Different Types of Nitrogen Fertilizer and Water Supply

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[Introduction]

Rice is one of the most important food crops for world population. Nitrogen is an essential element for plant growth and development. Two major nitrogen forms that plants can be available are ammonium and nitrate. Ammonium is directly assimilated in plants, on the other hand, nitrate should be ammonified in order to be an incorporation into organic compounds. Three types ($(NH_4)_2SO_4$, KNO_3 and NH_4NO_3) of nitrogen fertilizer have been applied for rice production. It was discovered that rice has 84 nitrate transporters (NRTs), 12 ammonium transporters (AMTs) and nitrogen assimilation genes, and nitrogen responding genes contribute to evaluate nitrogen use efficiency (NUE). Improving NUE is important to make better crop yield. In current study, we focused on comparing the expression of nitrogen metabolism-involved genes by different types of nitrogen and evaluating the NUE.

[Materials and Methods]

This study was conducted at an experimental greenhouse of Chungbuk National University, Cheongju, South Korea (36°37'48.6"N, 127°27'05.3"E) from June to October of 2022. Rice (*Oryza sativa cv.* Asemi) was used. Seeds were sterilized for 48 h at 28°C in 5L of water including 2.5mL of a seed sterilizer, in order to induce uniform germination, transferred in an incubator (28°C, darkness) for 5 days, and moved to growth chamber with a 12/12 h photoperiod, 60% (w/v) relative humidity and 24/20°C (day/night) after de-etiolation. When seedlings reached at 3^{rd} to 4^{th}- leaf stage, uniformly growing seedlings were transplanted to plastic containers including soil. Three types of nitrogen sources ($(NH_4)_2SO_4$, KNO_3 and NH_4NO_3) and two types of water supply (continuous flooding, CF; alternative wetting and drying, AWD) were employed. Samples (root, leaf blade) were collected at heading stage. The selected nitrogen metabolism genes such as NRTs, AMTs and assimilation were analyzed to compare the NUE. To do this, the quantitative real-time PCR was used.

[Results and Discussion]

The phenotypic difference in rice plants was not significant, and KNO_3-fed rice root showed shorter than others. The level of soluble carbohydrates was greatly affected by nitrogen sources rather than water supply. NUE and NUEg showed an opposite pattern with soluble carbohydrates; higher soluble carbohydrates, lower NUE in NO_3-only ($(NH_4)_2SO_4$ and KNO_3) application. The expression of ammonium (*OsAMT1.1* and *OsAMT1.2*) and nitrate (*OsNRT2.3a*) transport-involved genes decreased at KNO_3 condition. Currently, further study is on process to understand nitrogen metabolism genes-affected NUE.

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