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"Filling gaps and removing traps
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Nutrient and Water Uptake of Rice in Response to Day and Night Root Zone Temperatures under Different Vapour Pressure Deficits

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Abstract

With climate change, air temperature is predicted to increase, particularly during the night. Likewise, temperature of the soil, and thus of the root system will rise. In flooded rice fields, the water layer can buffer peak temperatures, but with the progressive introduction of water saving irrigation technologies in many parts of the world, root zone temperature (RZT) will vary more widely. Moreover, increasing vapour pressure deficit (VPD) caused by climate change is also challenging rice production in many rice growing regions by increasing evaporative demand. In the study, we investigated the effects of day and night RZT on water and nutrient uptake under low and high vapour pressure deficit. Two rice varieties, IR64 (international check) and NU838 (hybrid, widely used in Vietnam) were grown hydroponically at three root temperature levels (19°C, 24°C, 29°C). Twice per day during seven days, the fresh weight of the plants, nutrient (NH_4^+, NO_3, PO_4^{3-}, K+) and water uptake were measured both at the end of the day and at the end of the night. Results showed that water uptake of the plants was strongly influenced by VPD, but not by RZT. In contrast, nutrient uptake was not influenced by VPD and did not correlate with water uptake, but strongly increased with RZT for both varieties in the observed temperature range. This increase was larger during the day than during the night, but indicates a temperature optimum for nutrient uptake above 30°C both during day and night. Furthermore, the higher N uptake at high RZT led to an increased concentration of free amino acids in the leaf tissue, implying a beneficial effect of higher temperatures on the plant's nutrient status and growth, which was also reflected in dry biomass of plants.

Keywords: Nitrogen assimilation, nutrient uptake, *Oryza sativa*, temperature, VPD

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