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How does UVB seed priming affect agronomic and yield traits of rice genotypes under UVB-stress?

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Abstract

Rice cultivation has shifted to higher altitudes, up to 3000 m a.s.l. in Nepalese highlands, increasing cultivar exposure to higher ultraviolet-B (UVB) radiation. UVB-seed priming enhances abiotic-stress defense in some crops, but its genotype-specific effect on rice under UVB stress remains unexplored. This study investigated how UVB-seed priming affects agronomic and yield-related traits of selected rice genotypes and quantified the trade-offs between priming and UVB-stress exposure.

The experiment was conducted in a UV-climate chamber and greenhouse. Seeds of four rice genotypes, IR29 (sensitive, lowland), Marshi (highland, UV and cold-tolerant), CH1 and DBB (highland, stress response - unknown), were exposed to a UVB dose (22 kJ m^{-2} day^{-1}) as priming before germination. Primed and non-primed seedlings were transplanted into 2.5 L soil pots and grown under UVB-stress (22 kJ m^{-2} day^{-1}) for two weeks. After two weeks of UVB treatment, rice plants were grown in a greenhouse until harvest. Agronomic and yield traits were evaluated among four different UV-treatments (-UVp/-UVB, -UVp/+UVB, +UVp/-UVB, +UVp/+UVB). Tiller number, shoot height, physiological stress response indices (chlorophyll, anthocyanin, flavonoids, NDVI, PRI), shoot biomass and yield traits (panicles, grains) were assessed.

Chlorophyll content and yield increased with UVB-seed priming in IR29 and Marshi, with potential yield increased about 14% in IR29. Interestingly, grain yield increased by 18 % under primed (seed) and UVB (seedling) treatment for genotype CH1. However, about 44 % yield reduction was observed for Marshi under UVB-priming treatment. NDVI was higher in CH1 under combined treatment (+UVp/+UVB), and photochemical reflectance index (PRI) was higher in CH1 and DBB under primed treatments, showing a stronger stress tolerance response. Overall, these genotype-dependent responses suggest that UVB-seed priming may enhance stress resilience and can reduce yield loss under high UVB-stress growing conditions.

Keywords: Abiotic stress, highlands, NDVI, *Oryza sativa*, ultraviolet radiation

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