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UV-B Irradiation-Induced Transcriptional Changes in Flavonoids, Lignin and Tryptophan Biosynthesis Genes during growth of Rice Seedlings

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An excess absorption of unfavorable light like UV-B for plant growth and development leads to huge impacts on morphological and physiological perturbations of plants. In this study, we have focused on explaining time-dependent changes in secondary metabolisms such as UV-B absorbers and screeners. To achieve this goal, rice seedlings in 4th leaf stage were irradiated with supplemental UV-B for 5 days (8.6 kJ m^{-2} day^{-1}, 3hrs/d). The newly developing leaf blades (5th leaf) of rice seedlings were harvested at 1(sink), 3(sink to source transition) and 5(source) days after UV-B irradiation. Differential gene expression and metabolites for each day were analyzed with or without UV-B treatment. The sink leaf blades (1 days of UV-B) strongly induced the expression of genes in response to flavonoid and lignin biosynthesis. The expression level of flavonoid-related genes, chalcone synthase, chalcone isomerase and flavonone-3-hydroxylase, increased 6-, 107- and 453-fold change (FC) after 1 days of UV-B irradiation. Cinnamate 4-hydroxylase, cinnamyl-alcohol dehydrogenase and peroxidase associated lignin biosynthesis increased 16-, 7- and 9-FC. The sink-to-source leaf blades (3 days of UV-B) led to not only the increase in the level of tryptophan but genes encoding anthranilate synthase (10.0 FC), anthranilate phosphoribosyl transferase (10.0), phosphor ribosyl anthranilate isomerase (16.0), indole-3-glycerol phosphate synthase (174.0) and tryptophan synthase (26.0), which are involved in tryptophan biosynthesis at 3 days of UV-B stress. Similarly, the source leaf blades (5 days of UV-B) increased the expression levels of tryptophan biosynthesis-related enzyme genes (phosphor ribosyl anthranilate isomerase, indole-3-glycerol phosphate synthase and tryptophan synthase). From the present study, we conclude that the leaf growth of rice plants under the UV-B tends to consume photosynthates to UV-B absorbing and screening substances (tryptophan and flavonoids) to protect (sink phase) and adapt (sink-to-source and source phases) against unexpected photo-environment.

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