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Insights into Drought Responsiveness in Rice at the Reproductive Stage Through Proteomic Analysis

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Rice is grown under irrigated and rainfed conditions on all continents. Drought is a major cause of yield loss under rainfed conditions, while economic water shortages limit productivity in irrigated areas. These factors have intensified research on the causes of yield loss under water deficit. Rice is most susceptible to drought stress at the reproductive stage. One of the most sensitive events is elongation of the peduncle, which is the uppermost and longest internode of the stem. Peduncle elongation is essential to exsert the panicle and its florets from the flag leaf sheath, but drought stress starting 4 days before flowering in potgrown plants arrests peduncle growth and traps the peduncle in the flag leaf sheath, causing floret sterility and yield loss. Internode elongation is known to depend on the phytohormone gibberellic acid (GA), but, as many actions of GA are antagonized by the drought-induced phytohormone abscisic acid (ABA), it is likely that this antagonism plays a major role in causing yield loss. Spraying of drought-stressed plants with GA_3 reverses the arrest of peduncle elongation and panicle exsertion and allows one-third of the yield loss to be recovered. However, two-thirds of the yield loss remains, with failure of anther dehiscence identified as a major problem. Here we use proteomic analysis to examine the changes in the peduncle and the anther caused by drought and phytohormones. In addition, we use proteomics to examine the impact of drought stress on the ability of the leaves to rehydrate during re-watering and thus supply photosynthate during grain filling. We also compare changes in proteome and transcriptome. These studies lead us to suggest several targets for breeding to enhance drought tolerance.

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