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Comparative physiological and proteomic analysis of leaf in response to cadmium stress in sorghum

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Abstract

Cadmium (Cd) is of particular concern because of its widespread occurrence and high toxicity and may cause serious morpho-physiological and molecular abnormalities in plants. The present study was performed to explore Cd-induced morpho-physiological alterations and their potentiality associated mechanisms in *Sorghum bicolor* leaves at the protein level. Ten-day-old sorghum seedlings were exposed to different concentrations (0, 100, and 150 μ M) of CdCl₂, and different morpho-physiological responses were recorded. The effects of Cd exposure on protein expression patterns in *S. bicolor* were investigated using two-dimensional gel electrophoresis (2-DE) in samples derived from the leaves of both control and Cd-treated seedlings. The observed morphological changes revealed that the plants treated with Cd displayed dramatically altered shoot lengths, fresh weights, and relative water content. In addition, the concentration of Cd was markedly increased by treatment with Cd, and the amount of Cd taken up by the shoots was significantly and directly correlated with the applied level of Cd. Using the 2-DE method, a total of 33 differentially expressed protein spots were analyzed using MALDI-TOF/TOF MS. Of these, treatment with Cd resulted in significant increases in 15 proteins and decreases in 18 proteins. Significant changes were absorbed in the levels of proteins known to be involved in carbohydrate metabolism, transcriptional regulation, translation and stress responses. Proteomic results revealed that Cd stress had an inhibitory effect on carbon fixation, ATP production and the regulation of protein synthesis. In addition, the up-regulation of glutathione S-transferase and cytochrome P450 may play a significant role in Cd-related toxicity and stress responses. Our study provides insights into the integrated molecular mechanisms involved in response to Cd and the effects of Cd on the growth and physiological characteristics of sorghum seedlings. The upregulation of these stress-related genes may be candidates for further research and use in genetic manipulation of sorghum tolerance to Cd stress.

Keywords: leaves, sorghum, cadmium, protein expression, physiological changes

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