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Leaf and Root Proteome Responses of Sorghum to Heavy Metal Stress

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[Introduction]

Heavy metals at toxic levels have the capability to interact with several vital cellular biomolecules such as nuclear proteins and DNA, leading to oxidative stress in plants. The molecular mechanism for plant interaction with heavy metals has attained considerable interest in the field of metalloproteomic studies. The molecular response of plants to heavy metal stress is characterized by the synthesis of stress-related amino acids, protein, genes and signaling molecules. Proteomics is defined as the large-scale analysis of proteins of the genome that is also recognized as a powerful molecular tool for comparing proteomes under different physiological conditions such as exposure to heavy metal or other stressful conditions or several environmental stresses.

[Materials and Methods]

The seeds of *Sorghum bicolor* L. (BTX 623) were collected from National Germplasm Resources of USDA-ARS, plant stress and germplasm development unit, USA. Seeds were surface sterilized with 1% NaClO, placed in petri dishes and the seeds were then placed in a petri dish on growth chamber and grown in a controlled environment at 25°C with light intensity 8000 Lux and 70% humidity. For Cd and Cu-induced experiments, three replicates each consisting of seven seedlings were included for both control and Cd and Cu treatment. The 10 days old plants were subjected to the nutrient solutions supplied with 0, 100, 150 μM CdCl2 and CuSO4 and grown in the same controlled environment and the leaves were harvested after 5 days of Cd and Cu-treatment for the analysis of morpho-physiological and ionic alteration.

[Results and Discussions]

The present study was performed to explore the metal tolerance mechanism in Sorghum seedling. The observed morphological changes revealed that the plants treated with Cu and Cd displayed dramatically altered shoot lengths, fresh weights, and relative water content. In addition, the concentration of Cu and Cd was markedly increased by treatment with Cu and Cd, and the amount of interacting ions taken up by the shoots and roots was significantly and directly correlated with the applied level of Cu and Cd. Using the 2-DE method, a total of 24 and 21 differentially expressed protein spots from sorghum leaves and roots respectively, 33 protein spots from sorghum leaves under Cd stress were analyzed using MALDI-TOF/TOF MS. However, the over-expression of GAPDH plays a significant role in assisting Sorghum bicolor to attenuate the adverse effects of oxidative stress caused by Cu, and the proteins involved in resistance to stress helped the sorghum plants to tolerate high levels of Cu. Significant changes were absorbed in the levels of proteins known to be involved in carbohydrate metabolism, transcriptional regulation, translation and stress responses. In addition, the up-regulation of glutathione S-transferase and cytochrome P450 may play a significant role in Cd-related toxicity and stress responses. The results obtained from the present study may provide insights into the tolerance mechanism of seedling leaves and roots in Sorghum under heavy metal stress.

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