OB-06

Understanding Cadmium Tolerance Mechanism in Sorghum using Gel-Based and Gel-Free Proteomics Technique

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[Introduction]

Recently, the molecular mechanism for plant interaction with heavy metals has attained considerable interest in the field of metalloproteomic studies. Many abiotic stresses directly or indirectly affect agricultural crops drastically. Among the abiotic stresses, heavy metals (HM) including cadmium (Cd) is thought to be the most detrimental not only reducing plant growth and development but also deteriorating the quality of food. Cropping of *S. bicolor* plants facilitated by agronomic practices may be a sustainable technique for partial decontamination of heavy metal contaminated soils. 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 field of proteomics has grown at an astonishing rate, mainly due to tremendous improvements in the accuracy, sensitivity, speed and throughput of mass spectrometry (MS), and the development of powerful analytical software. It appears to be gaining momentum as proteomic techniques become increasingly widespread and applied to an expanding smorgasbord of biological assays.

[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. For Cd-induced experiments, three replicates each consisting of seven seedlings were included for both control and Cd treatment. The 10 days old plants were subjected to the nutrient solutions supplied with 0, 100, 150 μM $CdCl_2$ and the leaves were harvested after 5days of Cd-treatment for the analysis of morpho-physiological and proteome characterization.

[Results and Discussions]

The present study was performed to explore the Cd tolerance mechanism in Sorghum seedling. The plant growth characteristics (fresh weight, plant height, shoot length, dry weight) were inhibited compared to control plants under Cd stress. The results obtained from the ionic imbalance study revealed that excess Cd stress has an adverse effects on up taking others ion under Cd stress. Using the 2-DE method, a total of 33 protein spots from sorghum leaves while 86 differentially changed proteins were identified at 15-day-old sorghum roots between Cd stress and control conditions ($p<0.05$) whereas 39 increased and 45 decreased. However, the over-expression of GAPDH plays a significant role in assisting Sorghum bicolor to attenuate the adverse effects of oxidative stress caused by Cd, and the proteins involved in resistance to stress helped the sorghum plants to tolerate high levels of Cd. 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. Taken together, the results suggest that photosynthesis and energy metabolism was inhibited under oxidative stress and the over-expression of GAPDH plays a major role in assisting *S. bicolor* to attenuate the negative effects of oxidative stress caused by Cd stress.

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