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Topic of Research: Cross-talk of Arsenic and lron Exposure in Rice (***Oryza sativa***) Varieties Differing in Iron Content Using Biochemical and Molecular Approaches

Findings

The toxic metalloid arsenic is a major concern in agriculture, particularly in rice, which is a highly demanding crop. Arsenic is easily absorbed by phosphate and silicon transporters, leading to its hyper-accumulation in the plants. This issue is particularly prevalent in South and South-East Asian countries, including India. Arsenic exposure disrupts the balance between reactive oxygen species and antioxidants, leading to imbalances in nutrient levels, causing plant growth reduction and yield loss. On the contrary, iron is an essential trace element required by plants to carry out physiological processes such as photosynthesis, respiration, chlorophyll biosynthesis, macromolecule synthesis etc. The co-existence of arsenic and iron in mineral ores is linked to their availability in the environment. Also, the formation of iron plaque at the root surface of rice plants is promising to sequester arsenic, and inhibit its translocation to above-ground parts of the plant.

This comprehensive research work involved understanding the cross-talk between arsenic and iron in various Indica rice varieties at morphological, physiological, biochemical, and molecular levels. The differential response of selected rice varieties towards metalloid/metal exposure were based on level of stress modulators, indicators and antioxidants, iron uptake related assays, their accumulation, and nutrient profiling. The results demonstrated a positive impact of iron on mitigating arsenic toxicity in rice plants. Further, the influence of the two on the expression levels of their acquisition & transporter genes, detoxification-related and homeostasis genes were observed. It was found that iron is crucial to regulate the transcript levels of arsenic uptake and transport genes. Besides, the gene expression analysis also revealed the inclination of rice varieties PB-1 and Varsha, respectively, towards strategy-1 and 2 of iron uptake. Moreover, the presence of arsenic and iron alone or in combination also triggered the genes of mitogen-activated protein kinase (MAPK) cascade. On the basis of which, a protein-protein interaction study was done to determine important residues involved in the network of arsenic and iron transport. The experiments established an interaction of arsenic (OsLsi1) and iron (OsIRT1) transporter with defense related signalling molecule- MAPK (OsMPK3 or OsMPK4).

These findings suggest the potential of iron in mitigating arsenic stress in rice plants. Further researches are required to elucidate the importance of MAPK cascade in regulating the plant machinery under the co-influence of arsenic and iron.