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Title: Regulation of Iron Dependent Dynamics of Root System Architecture and Role of WRKY Transcription Factor in Arsenic Stressed Rice (*Oryza sativa*)

Summary or findings of the thesis

Arsenic (As) is a toxic metalloid that restricts the growth and productivity of rice plants by altering their root system architecture (RSA). Iron (Fe) has been critically reported to act as a signal that can be interpreted to activate the molecular mechanisms involved in root developmental processes. The role of Fe in sequestering As and alleviating As-mediated oxidative damage in rice is widely known. However, what molecular mechanism gives rise to this property of Fe is still unclear. Our study analyzed the Fe-dependent dynamics of RSA and their regulation, targeting WRKY TFs and their interaction with MAPK (Mitogen-activated protein kinase) in As-exposed seedlings. For this changes in RSA, plant growth, and related biochemical parameters were evaluated under the influence of As and Fe alone and in combination. This together with *in-silico* screening, gene expression analysis, and protein-protein interaction studies suggest the role of OsWRKY76 in Fe-mediated As stress alleviation.

The study characterized OsWRKY76 as a substrate of OsMPK3 that acts as a transcriptional repressor for Fe transporter genes under As stress. The OsWRKY76 protein regulated the expression of *OsIRT1* and *OsYSL2,* and the down-regulation of these genes resulted in decreased Fe content, impaired Fe homeostasis, and disrupted phenotypic traits (plant height, fresh weight, and dry weight) and RSA. Additionally, our results also demonstrated that Fe is a regulator of OsWRKY76 which enhanced the transportation and homeostasis of Fe in rice under As toxicity. Furthermore, Ratna is characterized as As tolerant variety. However, the presence of Fe makes Lalat a better performer in As contaminated environment.