

Zinc finger protein ZFP36 and pyruvate dehydrogenase kinase PDK1 are key elements in the ABA-mediated aluminum tolerance in rice

Nana Su¹, Qi Wu², Sergey Shabala³, Vadim Demidchik⁴, Min Yu⁵, Mingyi Jiang¹, and Liping Huang⁵

¹Nanjing Agricultural University

²Affiliation not available

³University of Tasmania

⁴Belarusian State University

⁵Foshan University

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Abstract

Aluminum (Al) toxicity is the major limiting factor for plant production and crop yield on acid soils. Previous works revealed that ZFP36 played a key role in plant adaptation to water stress and rice blast. Here, we report another function of ZFP36, which is associated with detoxification of Al toxicity through abscisic acid (ABA)- dependent mechanism, in rice. Al exposure significantly increased ZFP36 expression level in an ABA-dependent manner. Knocking down ZFP36 triggered Al sensitivity, while overexpressing ZFP36 resulted in an increased Al tolerance. Chromatin immunoprecipitation-sequencing (ChIP-seq), yeast one-hybrid assay, and dual luciferase test revealed that a tonoplast-localized Al transporter, OsALS1, and antioxidant defense enzymes were targeted by ZFP36. Moreover, by combining yeast two-hybrid assay, bimolecular fluorescence complement (BiFC), GST pull-down and in vitro phosphorylation assay, we showed that ZFP36 could interact with and be phosphorylated by the pyruvate dehydrogenase kinase OsPDK1. A strong association was found between the expression, protein content and kinase activity of OsPDK1 with the responses to ABA and Al. Using transgenic plants, we have showed that OsPDK1 could inhibit OsALS1 expression via regulating ZFP36. Overall, our data demonstrates a new ZFP36-controlled mechanism of Al defense in rice plants, which is mediated by OsPDK1.

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