Improving Crop Productivity by Understanding Root Development

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Abiotic stress is an increasing threat to ecological and agricultural systems worldwide. Roots exhibit significant developmental plasticity, adapting to their environment by adjusting cell division and differentiation rates in response to external cues. Root meristem activity is a crucial process that drives root development and determines the final root architecture. Early meristem activity is also responsive to environmental conditions, enabling plants to form robust root systems that can withstand abiotic stress. Despite the identification of several regulatory factors affecting meristem activity in rice, research on enhancing root meristem activity remains limited. In our study, we focused on root meristem activation and identified a transcription factor that significantly promotes root development. We have shown that the homeobox protein OsZHD2 increases ethylene levels by increasing the transcript levels of ethylene biosynthesis genes. We also obtained ChIP assay data showing an interaction between OsZHD2 and the chromatin of *ACS5*. Analysis of transgenic rice plants carrying *DR5::GUS* and *DR5::VENUS* revealed that the expression of the *DR5* reporter genes was induced following treatment with ACC, an ethylene precursor. The results suggest that OsZHD2 increases the biosynthesis of ethylene and subsequently auxin, which stimulates root growth. Leveraging this discovery, we developed rice plants that achieve higher yields even under nutrient-poor conditions. Understanding root development is essential for creating crops that are resilient to abiotic stress, providing a pathway to improve crop productivity in challenging environments.