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A REVIEW

Ethylene - Auxin interactions in root architecture development of paddy and upland rice systems

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Abstract : Root architecture in rice (*Oryza sativa*) is critically shaped by ethylene–auxin crosstalk, enabling adaptation to contrasting environments like flooded paddies and drought-prone uplands. In paddy systems, hypoxia triggers ethylene accumulation, which stabilizes OsEIL1 to upregulate auxin biosynthesis (*YUC8*), inhibiting primary root elongation but promoting aerenchyma formation and adventitious root growth for oxygen diffusion. Auxin transport and signaling are essential for these ethylene-mediated responses, as evidenced by mutants like *iaa13*, which fail to form aerenchyma. Conversely, upland rice prioritizes deep rooting (via *DRO1*) and lateral root proliferation under drought, where ethylene–auxin interactions shift to restrict elongation while enhancing radial expansion and root hair development. Mechanical stress in compacted soils further modulates this crosstalk, with ABA-induced *OsYUCCA8* driving auxin-mediated root hair elongation. Molecular breeding targets like *OsEIN2*, *OsWOX11*, and *DRO1* leverage these pathways to improve stress resilience, though tissue-specific manipulation is crucial to avoid yield trade-offs. Systems biology approaches, integrating spatiotemporal hormone dynamics and mechanosensing, offer promising strategies to optimize root traits for diverse agroecologies. This review synthesizes mechanistic insights and agronomic applications of ethylene–auxin interactions, highlighting their pivotal role in rice root plasticity and climate adaptation.

Key Words : Rice root architecture, Ethylene, Auxin, Ethylene- auxin crosstalk, Upland rice

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INTRODUCTION

Importance of root architecture in rice adaptation:

Root architecture—the spatial configuration and structural characteristics of the root system—is a key determinant of rice plant adaptability. The configuration of roots affects nutrient acquisition, water uptake, mechanical support and resilience to environmental stresses, all of which directly influence rice yield and survival, particularly under climate stressors or variable field conditions. A well-developed root system enhances the efficiency of nutrient absorption and supports crop performance in both paddy and upland conditions, which differ drastically in water availability and soil aeration. In flooded paddy systems, rice roots encounter low oxygen conditions. To adapt, lowland rice cultivars

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