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Hosted by Prof Yu Hao

Single-cell and AI-guided discovery of regenerative cell states in plants

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Prof. Jian Xu is a plant systems biologist at Radboud University whose work is grounded in a physiology-centered view of plant development and regeneration. His research focuses on how plant cells acquire regeneration competence, transition between cell identities, and rebuild tissues in response to developmental and environmental cues. His group integrates single-cell and spatial omics, mechanobiology, and AI-facilitated computational biology to study plant regeneration, somatic embryogenesis, and cellular plasticity. More broadly, his work aims to advance green tissue engineering and regenerative strategies for plant biotechnology, with applications in food and medicine. Prof. Xu was previously a staff member at the Department of Biological Sciences, National University of Singapore.

Plant regeneration provides a powerful system to understand how differentiated cells regain developmental competence and acquire new cell identities. In this seminar, I will discuss how time-course single-cell and single-nucleus transcriptomics, spatial transcriptomics, and AI-facilitated computational biology can be integrated to decode regenerative cell-state transitions in plants. Using root regeneration, de novo shoot regeneration, and somatic embryogenesis as model systems, we investigate how tissue context, developmental history, and regulatory networks shape regeneration competence, cell identity transitions, and totipotency. These studies reveal that regeneration proceeds through defined transitional cell states and spatially organized signaling environments rather than a simple reversal of differentiation. I will also discuss how AI-guided approaches can improve cell-state annotation, trajectory interpretation, gene regulatory network inference, and cross-system comparison, providing a framework for understanding and engineering plant cellular plasticity.