

From Flower to Seed: How Phytohormones Fine-Tune Plant Reproductive Success.

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Abstract

Plant reproductive success depends on the precise coordination of developmental programs with environmental and physiological signals. Phytohormones act as central integrators in this process, modulating gene expression, cellular behavior, and developmental timing across the transition from flower formation to seed development. In this seminar, I will present ongoing work from my laboratory, together with collaborative studies, aimed at dissecting how hormonal signaling networks regulate key stages of plant reproduction.

In the first part, I will focus on the interplay between two major phytohormone pathways in controlling male fertility. Using a combination of genetic, molecular, and transcriptomic approaches, we demonstrate that these pathways function in a hierarchical and interdependent manner, wherein one pathway establishes developmental competence while the other governs execution of late-stage processes. Perturbation of this regulatory balance results in defects in anther development, microspore progression, and pollen maturation, ultimately leading to male sterility. Our findings support a model in which hormone-responsive regulatory modules converge on shared transcriptional networks to coordinate male gametophyte development.

In the second part, I will address early embryogenesis and seed development, with a focus on the role of cytoskeletal dynamics. Our collaborative work reveals that actin organization is dynamically regulated during early embryonic stages and is essential for proper developmental patterning. Furthermore, we provide evidence that transcriptional control of cytoskeletal components is functionally integrated with hormonal signaling pathways, establishing a mechanistic link between hormone-dependent regulation and cellular architecture during seed formation.

Collectively, these studies advance a unified framework in which phytohormones coordinate transcriptional programs and cytoskeletal dynamics to ensure robust reproductive development from flower to seed.