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Editorial

Plant development and reproduction

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As society progresses, we continue to face a global food security crisis because of an increasing demand for agricultural products. To supply the world's growing population with sustainable, nutritious, safe, and affordable high-quality food using limited arable land, under biotic and abiotic stresses, and declining resources under global climate change is a considerable challenge. Agricultural products such as grains and vegetables are derived from plant structures formed during development, which refers to the initiation of structure patterning, and maturation as plants grow via cell division, elongation, and differentiation. Unlike animals that form all their body parts early in their life, plants constantly generate new structures from meristems in the apex, vascular, and cork cambium tissues throughout their lives. The way plants generate new tissues may be affected by endogenous genetic mechanisms and environmental stimuli. Until a certain developmental stage, plants can sense environmental changes, which stimulate reproductive development from the vegetative phase to generate new individual plants or offspring via sexual or asexual reproduction. Seeds and fruits, the characteristic reproductive organs of angiosperms are major food resources for humans and animals. To enhance agricultural productivity, considerable effort has been made to understand genes/alleles and their interaction with environmental signals controlling the formation of plant organs. These new findings can be used to enhance crop yield and quality, and production stability.

In this special topic on 'Plant Development and Reproduction', we present three invited reviews and two research articles. Auxins refer to a group of phytohormones with a fundamental role in coordinating many growth events and organ formation in the plant's life cycle. In plant cells, auxin is mainly synthesized from tryptophan (Trp) and the concentration of auxin and Trp is closely modulated to ensure normal plant growth and development. Auxin biosynthesis using Trp as the precursor is a two-step reaction with indole-3-pyruvate (IPA) as the intermediate. In this special topic, Gao et al. [1] overexpressed a bacterial tryptophan oxidase in the model dicot plant *Arabidopsis thaliana* and found that it can convert Trp to the imine form of IPA and change IPA levels in transgenic plants. This proves that *Arabidopsis* uses two approaches to ensure no excess IPA is produced. Maintenance of stem cells within meristems is essential for plant body specialization and tissue formation. Despite accumulated knowledge on the molecular control of stem cells from studies on *Arabidopsis*, little is known about stem cells in grass species which include many agriculturally important crops. In another research article, Zeng et al. [2] reported stem cell lineage and differentiation during root and leaf development of the monocot model plant, rice (*Oryza sativa*). They concluded that in leaves and roots there are at least two common steps for vascular development, i.e., formation of a procambium and root pericycle or leaf outer sheath from the preprocambium, and the differentiation of the procambium into xylem, phloem, and circumambient cells. Furthermore, the authors investigated the expression patterns of stem cell identity genes in rice tissues.

SPECIAL TOPIC: Plant Development and Reproduction

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The formation of a secondary cell wall is important for plant cell function and plant structure. In this specific topic, the invited review by Li et al. [3] presents a summary of the hormonal and transcriptional control of transition from the primary to secondary wall, and addresses the gaps in current knowledge on metabolic mechanisms supporting this transition. The authors also discuss several tools potentially useful in future research on cell wall synthesis. The pollen wall is a specialized cell wall surrounding male gametophytes that protects them from various stresses, mediating male–female interactions, fertilization, and seed formation. The invited review by Xu et al. [4], illustrates the molecular and genetic control of key events during pollen wall development, such as callose wall synthesis and dissolution, primexine formation, and plasma membrane undulation, synthesis, and deposition of sporopollenin, and patterning of pollen aperture patterns in *Arabidopsis*. Effective communication between male and female gametophytes determines reproductive success including double fertilization, and seed and fruit formation in high plants. The molecular control underlying male and female interactions has been a challenging biological question. In the invited review by Chai et al. [5] new advances on the functionality of receptor-like kinases mediating pollen tube growth and fertilization have been summarized.

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