PREFACE

During their life cycle, plants undergo developmental transitions that profoundly change growth patterns. Regulation of the activity of meristems (groups of undifferentiated cells giving rise to all plant organs) is crucial to determine the correct progression through transitions and establish plant architecture. Different plant species have evolved complex regulatory networks to control meristems' fate and activity.

Upon perception of favourable environmental conditions and endogenous signals, plants initiate flowering and vegetative meristems, producing leaves and shoots, become inflorescence meristems. This transition is referred as the vegetative-to-reproductive or floral transition and commits the plant to flower. The timing of this transition is critical, because inflorescences are delicate organs eventually producing seeds, and plants need to flower when external conditions are optimal for offspring survival.

The first part of this book (Chapters One to Five) is dedicated to the molecular mechanisms that plants have evolved and adopted to measure environmental and endogenous parameters such as day length, temperature and hormonal levels, and how such information promotes or inhibits flowering by affecting expression of regulatory genes. Chapter 1 (Photoperiodic flowering regulation in *Arabidopsis thaliana* by Golembeski et al.), reviews the photoperiodic flowering pathway in *Arabidopsis*, the most studied plant model system, that has been instrumental to isolate the key players regulating flowering and to formulate current models for seasonal time measurement. Central to the photoperiodic flowering pathway is *FLOWERING LOCUS T* (*FT*), recently identified as the *florigen* and shown to be conserved across diverse plant lineages. In Chapter Two, Pyo et al. describe how specific ecotypes of *Arabidopsis* require exposure to cold in order to flower, a process known as vernalisation (Regulation of flowering by vernalisation in *Arabidopsis*). Stable repression of a transcription factor, *FLOWERING LOCUS C* (*FLC*), is essential to establish competence to respond to photoperiodic induction. The genetic and epigenetic regulation of *FLC* is very complex and requires remodelling of chromatin at the *FLC* locus. How this is achieved by distinct types of regulatory molecules is thoroughly described. Not only seasonal cues, but also the levels of internal signalling molecules, such as hormones and sugars, affect flowering. The contribution by V. Costa Galvão and M. Schmid (Chapter Three, Regulation of flowering by endogenous signals) provides an overview of the role of plant hormones on flowering. In this chapter the role of sugars as key nodes in regulatory networks is discussed, providing an exciting perspective of the connection between metabolism and gene regulation.

Arabidopsis is an extremely useful model to address the basic mechanisms of flowering in plants. However, not all plant species adopted the same developmental strategies to flower. In Chapter Four (Critical gates in day-length recognition to control the photoperiodic flowering), A. Osugi and T. Izawa describe how rice responds to changes in day length, flowering as days become shorter. The use of rice as model system has allowed the identification of novel regulatory mechanisms controlling photoperiodic flowering responses, clearly indicating that some molecular components specifically evolved in the monocot lineage and are not shared by dicot species. Further developing on monocot diversity, C. Campoli and M. vKorff present an overview of the pathways controlling flowering in temperate cereals, including wheat and barley (Chapter Five, Genetic control of reproductive development in temperate cereals). As opposed to rice, where no vernalisation pathway has evolved because of its tropical origins, flowering of temperate cereals is accelerated by exposure to low temperatures. Natural genetic variation at loci controlling flowering responses to photoperiod and low temperatures has been exploited by breeders to produce varieties better adapted to diverse cultivation areas.

Once committed to flower, inflorescence meristems produce branches and ultimately floral meristems that give rise to floral organs. Specification of distinct structures on the inflorescence main axis generates diverse architectures that constitute the focus of Chapters Six to Ten. D.S. O'Maoileidigh and colleagues set the stage in Chapter Six (Genetic control of *Arabidopsis* flower development), by describing how flowers are formed in *Arabidopsis* and how molecular cloning of regulatory genes from this species laid the foundation of models of flower development, largely applicable to many plant species. In Chapter Seven, J. Kyozuka describes the development of grass inflorescences (Grass inflorescence: basic structure and diversity), whose remarkable and distinctive characteristic is that they form spikelets, which are short and modified flowering branches. Rice flower development is the focus of Chapter Eight (Flower development in rice) authored by W. Tanaka et al. The ABC model of flower development, i.e. the basic molecular plan that instructs cells to form a flower, is largely conserved in rice. However, not all floral structures are shared between monocots and dicots, implying the evolution of regulatory mechanisms to establish the identity of novel organ types. In Chapter Nine (Genetic and hormonal regulation of maize inflorescence development), B. Thompson expands the discussion on grass inflorescence development, focusing on maize. Maize is a monoecious species, in which male and female flowers are produced on distinct inflorescence types formed on the same plant, providing a beautiful example of how some species have established regulatory mechanisms for sex specification. This chapter drives the reader through maize flower development, ultimately focusing on how hormonal pathways affect establishment of male or female identity. Flower shapes and colours are countless and it would be impossible to describe them all in one single book. However, the concluding chapter (Chapter Ten, Molecular Control of Inflorescence Development in Asteraceae) by Broholm and colleagues, addresses flower development in *Asteraceae*, a family characterized by producing a showy inflorescence called *capitulum* that is formed by the specific arrangement of different flower types. The beauty of such structures allows us to have a glimpse of Nature's endless work in shaping plant forms and to appreciate the sophisticated mechanisms that generate it.

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