PREFACE

Floral development –Re-evaluation of its importance–

Floral development: re-evaluation of its importance

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Floral development, a fundamental issue in plant morphology, provides an understanding of how flower organs arise in the plant body and offers linkages to many fields of plant biology, such as developmental genetics, systematics, biophysics, crop science, physiology, and so on. Although plant morphologists have been interested in floral development for a long time with the aid of light microscopy, more studies on floral development in various species have been published from the early 1980s in particular since scanning electron microscopy became widespread. However, interest in floral development as a core part of plant morphology has recently declined in the context of plant science as a whole. For example, in JPR, the journal that gathers and disseminates fundamental knowledge in all areas of plant sciences, only two papers relevant to floral development were published in 2017 out of more than 90 regular papers and reviews: one focused on the flower structure and development of *Smalanthus* (Ibañez et al. 2017) and the other on the embryology of *Pera* (de Olivera Franca and De-Paula 2017).

In contrast, this century has witnessed several attempts at reconsidering one of the oldest disciplines of plant science, namely, plant morphology, introduced by Goethe (1790) in the late eighteenth century (Claßen-Bockhoff 2001). From the late twentieth century to the early twenty-first century, several prominent plant morphologists appealed for the need to re-evaluate plant morphology. Sattler and Rutishauser (1997) elucidated the potential impact of plant morphology on future plant science research, and Kaplan (2001) expressed concern that plant morphology is regarded as a provider of morphological characters for systematics

research due to a decline in the interest in plant morphology and insisted that re-evaluating the importance of plant morphology is necessary. Tobe (2003) also claimed that the importance of plant morphology has increased and that further morphological research is essential to appropriately evaluate the increasing data from molecular phylogenetic research and to understand plant evolution.

In the field of floral development, a core part of plant morphology, attempts have also been made to re-evaluate its importance and to promote future studies. Ronse De Craene (2010) published a landmark book integrating the results of many studies on floral development to expatiate flower morphology, and this promoted further studies in this field for several years. Bull-Hereñu et al. (2016) also presented a collection of papers on flower morphology and biology, including floral development, which renewed interest in floral development.

This special issue of JPR entitled “Floral development: Re-evaluation of its importance” aims to accelerate this movement. One review and five regular papers in this issue re-evaluate the importance of floral development and shed light on its essential linkage with the evolution of flower morphology. Ronse De Craene (2018) reviews floral development from two perspectives: a historic and physico-dynamic one. The former focuses on the phylogenetic aspect of floral development, clarifying how flower morphology is the result of change over time. The latter focuses on the physical factors that affect floral development, clarifying how changes in the physical environment of floral meristems affect development, e.g., shift in space, time of organ initiation, mechanical pressures of organs, and changes in the size of the floral meristem. This review presents developmental events as drivers of evolutionary change in flower morphology.

Iwamoto et al. (2018) observe and compare the floral development of five members of the “petaloid” Alismatales. As the Alismatales is placed in the second most basal position and represents the highest diversity in floral

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morphology in the monocots, their floral development is an important clue in elucidating the origin of the trimerous pentacyclic floral Bauplan in monocots, a topic which is still controversial. Tobe et al. (2018) focus on the floral structure and development of the Nartheciaceae, a small dioscorealean family consisting of five genera. A comparative study reveals distinctive variation in nine floral characters and the evolutionary direction of these characters, showing inferior ovaries and the presence of septal nectaries to be plesiomorphic in the Nartheciaceae. Bull-Hereñu et al. (2018) examine floral development in five species of *Eucryphia* and test whether differences in the number of floral organs can be explained by changes in the size of the floral meristem and floral organs. The study reveals that a larger floral meristem size prior to organ initiation is related to a higher organ number. Furthermore, continuous meristem expansion allows additional organ initiation and a chaotic stamen arrangement. The results suggest that the flower phenotype in this genus is determined by the heterochronic interplay of space and time during floral development. Claßen-Bockhoff and Melanie (2018) reveals the morphological organization of enigmatic flower-like inflorescences (pseudanthia) of *Davidia involucrata* by examining floral development. The study confirms that the development of a pseudanthium is similar to that of a typical flower with regard to acropetal growth limitation, meristem expansion, and fractionation. This result indicates that the pseudanthium should not be misinterpreted as a condensed inflorescence but as a floral unit (Claßen-Bockhoff and Bull-Hereñu 2013). Finally, Kitazawa and Fujimoto (2018) examine the organ arrangement of six- and seven-tepaled flowers in six *Anemone* species and reveal that variation in organ arrangement is commonly limited to three types, despite the existence of more theoretical geometric possibilities. The authors explain this restriction with a mathematical model describing the stochasticity of excessive primordia initiation. Analysis of the mathematical model also indicates that interspecific differences in the frequency of the observed arrangement types are explained by changes in model parameters representing meristematic and differential organ growth.

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