Book Review

Molecular Genetics of Plant Development

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It is still a common feature of not only scientists to consider the relationship between older and new approaches to problems competitive, which often puts them into disserviceable fighting positions to each other.

A different viewpoint is shown in the book, outlined originally as a text for the upper-division undergraduates and first-year graduate students. This book is also a resource for the others, interested in the field of molecular biology of plant development where marvellous progress has been achieved. An up-to-date account of a rapidly evolving field is presented here to show a systems approach to the plant development, where new understanding, coming from the techniques of molecular genetics, enriches classical anatomy and morphology knowledge. The text of the book is organised in 13 chapters on the basis of life-cycle events and organ systems. Chapters 1 and 2 show the principles of up-to-date views of processes taking place throughout the life of plant organism, compared with those in animals. The remaining chapters deal with various life stages and organ systems.

Chapter 1 (Approaches to the study of plant development) shows how molecular genetics revolutionised our understanding of plant development. Precise descriptions of plant development, obtained in the past by taxonomists, anatomists and physiologists, can be revisited with molecular techniques, showing them from the aspect of complex processes that take place in the living plant organism. Developmental processes, described in phenomenological terms in the past, are put through molecular analysis with a renewed interest.

The author ascribes the reason for the leading role of genetics in this field to the use of mutants that affect a developmental process. Genetic approaches using developmental mutants are powerful because they require few assumptions. After having found such a mutant, recognisable by its phenotype, it is only needed to determine what genes are responsible for the mutation. Mutant genes can be tracked down by a variety of molecular techniques, as they are marked with insertions, deletions, base changes, and the like. Collecting the information on the genes and their effects can lead to gradual construction of the schemes that put together the genetic puzzle of functions of the genes in the future. Grouping similar mutants in categories and their examining allow us to make up conceptual models of the process in question. The most dominating model is the concept of pattern formation at present. This model arose through analysis of mutants of *Drosophila* and it has provided a theoretical framework to classify many developmental mutants in *Drosophila*.

According to this model, the hierarchical network of genes drives pattern formation, lying early in embryogenesis.

Although plants and animals are remarkably similar in their basic metabolism and cellular structure, the pattern formation processes may be quite different because plants and animals had diverged about 1 billion years ago, before they became multicellular organisms. The ancestors common to the both had the same basic genes that animals have used to assemble gene networks for embryonic development. Despite of the presence of similar transcription factor genes in plants, a different subfamily of genes, having a very important role in the spatial regulation of cell proliferation, have been found in meristematic plant tissues. This class of factors is discussed in Chapters 2 (Cell Lineages and Positional Information), 5 (Shoot Development), and 6 (Leaf Development). Though, plant developmental processes also match up to the basic features of pattern formation, which has successfully been applied to flower development (see Chapters 7, 8). A discussion in Chapter 3 (Embryogenesis) shows problems with transferring concepts from animals to plants without an appreciation for the differences between them.

Some profound differences between plant and animal development are shown in Chapter 9 (Development of Floral Reproductive Organs), dealing with the germ line development. Cell lineage analysis has shown that, contrary to animals, no populations of such cells in the embryonic shoot are present (see also Chapters 2 and 5).

The body plans of animals are predetermined by embryonic development, but plant development shows more plasticity. The roles of shoot apical meristem (SAM) and root apical meristem (RAM) are discussed in Chapters 5 and 12 (Root Development), respectively. Division patterns and planes are not invariant, despite of the uniformity of appearance of the organs, which is discussed in Chapters 2 and 6.

Remarkable capacity of plants to regenerate from the cells of specialised vegetative parts that retain their totipotency (see Chapters 3 and 11) enables indefinite propagation in a vegetative state as nontumorous, differentiated tissue. Higher animals have finite lifetimes, as do their cells. The explanation to that was suggested that the limit might be set, in part, by the loss of telomeres, specialised structures at the end of chromosomes. Though, it has been reported that telomeres in barley shorten during differentiation of tissues, but then they grow during dedifferentiation processes. Another question arises whether organ formation in plants is required for cell differentiation, as at least one example is described where these processes are uncoupled (see Chapter 3).

The problems of hormones, growth factors, and signalling molecules are discussed in Chapter 4 (Seedling Development), showing that more such molecules could be discovered in future.

To make up a mosaic of developmental processes, it is of benefit to use model plants, such as *Arabidopsis* and maize, where collections of mutants and databases of sequences allow easier orientation and deeper probing into the questions. Genetic maps have been constructed for them and new mutant genes are identified by advanced techniques such as tagging by insertional mutagenesis, followed by sequencing of DNA.

The book is an excellent guide through the field of developmental biology of plants that gives us a lot of up-to-date information on the subject. It is also an invitation to enter an extremely intricate labyrinth of processes taking place in plant organisms, where we can enjoy the search for finding a right way through the multidimensional system of pathways.

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The book was bought from the funds of Project No. L1011004 of the Ministry of Education, Youth and Sports, and can be borrowed from a library of Agricultural Research Institute Kroměříž, s.r.o. Contact: kroftova@vukrom.cz