Book Reviews

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Plant cell separation and adhesion. Annual Plant Reviews, Volume 25.

Since the publication of Addicott’s book Abscission (1982) and Koslowsky’s book Shedding of Plant Parts (1973) no text book has appeared charting the subsequent progress in our understanding of the physiological and hormonal control of abscission and adhesion. The present volume is thus very timely and is an excellent example of how molecular genetics had enhanced plant biology at both basic and applied levels. While the authors fail to tell us who this book is aimed at, there is no question that it has intrinsic scientific interest and contributes strongly to improving our understanding through new molecular experimental methods. It may also be important in agriculture and horticulture. However, in many chapters, the molecular and genetic information is too introverted for readers whose interest is not primarily in molecular genetics.

A list of the titles of the chapters alone indicates the wide scope of this volume: ‘A short introduction to cell separation and adhesion processes in plants’; ‘Cell wall structure, biosynthesis and assembly’; ‘Vascular cell differentiation’; ‘Cell adhesion, separation and guidance in compatible plant reproduction’; ‘Cell separation in roots’; ‘Organ abscission’; ‘Fruit ripening’; and ‘The role of polymer cross-linking in intracellular adhesion’. The strength of this volume is that most chapters are lucidly and logically written and are up-to-date. The main weakness of this volume is that it omits much of physiological and horticultural relevance. This leads me to wonder why the Editors did not add a short physiological background to the anatomical and hormonal background contained in their introductory chapter. It is unfortunate that those readers – even scientists with a high level of scientific experience in plant science – who are not closely familiar with the topic of this volume will be forced to seek this information elsewhere.

The synthesis and biochemistry of the primary cell wall is one of the main ‘pillars’ of the book. The relevant chapter describes very thoroughly the biosynthesis of the primary cell wall, focusing on its composition of polysaccharides, proteins and enzymes. The authors discuss new molecular information that previously available biochemistry could not provide. However, this chapter is too specific, and only those who are deeply familiar with the subject will find their way satisfactorily through all the genetic details. Moreover, it seems that the Editors did not really encourage co-ordination between the authors of this chapter and those of the other chapters that also discuss various aspects of cell walls. This lapse has given rise to some overlap between the different chapters, although, in some cases, this was probably unavoidable.

Tracheary differentiation has been chosen by the authors of the chapter on vascular cell differentiation as a model of cell–cell connectivity. They focus on meristematic cell differentiation and on the effect of tissue organization on cell differentiation, and also on cell wall components and the co-regulation of cell wall degradation in relation to programmed cell death (PCD). The chapter describing the development of pollen from the initiation of pollen mother cells until pollen-tube penetration of the female gametophyte is one of the most fascinating and well-illustrated in the book. There is a detailed description of the role of different cell wall components and of specific hydrolytic enzymes involved in cell separation and adhesion along the route of pollen-tube’s extension through the style. The chapter on cell wall solubilization in roots suffers from a serious weakness by introducing microbial enzymes involved in the process straight away. There is no prior description of the anatomical background of the phenomenon of cell shedding from the root cap region during its penetration into the soil and the loss of adhesion between root cells associated with the outgrowth of lateral roots. This unbalanced chapter also describes root cell-wall pectic polymers and the pathway of their degradation by different pectic hydrolases.

The chapter on organ abscission is central to this volume. Its authors demonstrate... how genetic analyses in model plants has contributed to our current understanding of the organ abscission process... They concentrate their discussion on molecular studies with Arabidopsis thaliana, tomato and Solanum pennellii and only in one specific case refer to citrus, assuming correctly that ‘... Since abscission process appears to be quite similar across species... the genes that are essential for abscission...’ in organs of these model plants ‘... likely control abscission of these organs in other species as well’. The description of ‘... the genes from each of these pathways that are known to be involved in the abscission process...’ is one of the most important contributions of this chapter. The review covers a wide spectrum of research with mutants and the expressions of genes at different locations of the abscission zone and at different stages of the separation process. The main weakness is that the reader is given little of the much-needed background physiology and anatomy of
abscission required to view the process in the round. There are also almost no references to recent physiological and applied studies on abscission in tree fruit crops. However, the strength of this chapter is its impressive up-to-date presentation of the molecular genetics.

Another important chapter deals with the genes of the hydrolyzing enzymes Endo-β-1,4-glucanase and polygalacturonase. These are the major enzymes involved in cell wall separation. The authors conclude their review by stating that 'The organ abscission studies described in this chapter represent only a few enticing episodes of a much more intricate story yet to be told'. I cannot think of a better way to conclude the chapter. The chapter on dehiscence, the opening of dry fruits to release their seeds is rare in that it takes the trouble to introduce the subject with a balanced overview of the anatomy and physiology essential for a proper understanding of the topic. After its wide-ranging but concise introduction, the authors provide a thorough description of the shatter-resistance phenomenon in cereals that minimizes seed loss. Several brassica species are also mentioned in which shatter resistance occurs. Special attention is given to the morphogenesis and anatomy of the dehiscence zone, cell wall dissolution and its hormonal regulation, as well as the role of hydrolytic enzymes in the process. In contrast to all previous chapters, the one dealing with fruit ripening is mainly limited to a short description of studies of gene expression and mutants of arabidopsis and tomatoes at different stages of fruit development and maturation. The focus is directed mainly at selected aspects of the ripening process and cell wall modifying enzymes. I completely agree with the concluding remark that 'Whilst in a fleshy fruit it is clear that, during softening, major changes in the adhesion between cells take place, the precise biochemical and molecular changes that bring these about have yet to be determined'. Some answers to that statement can be found in a very good last chapter that deals with polymer cross-linking in intercellular adhesion in relation to fruit ripening. I can only agree with the authors that '… understanding of the chemistry and biochemistry of cell adhesion is of considerable importance for the future control and exploitation of plants used for both food and non-food uses'. I am puzzled as to why this chapter was placed at the end of the book rather than directly after the chapter dealing with the biochemistry and structure of the primary cell wall. This final chapter is well balanced and provides important basic information. The authors discuss up-to-date issues related to the role of cross-links in cell adhesion, such as important recent evidence to '… indicate that cell adhesion is probably dependent on cross-links present predominantly at the edges of cell faces, also known as tricellular functions'. This view contrasts with previous belief '… that the middle lamella is generally the area of cell adhesion'. The role of pectic polysaccharides and their cross-links is another topic included in this chapter. In addition, the link to other molecules that interact with the primary cell wall in relation to adhesion, such as proteins, phenolics and ferulic acid, is also discussed. I urge anyone who is interested in cell wall adhesion not to miss this outstanding chapter.

In conclusion, this volume embraces most, if not all, aspects of cell separation and adhesion. However, it is questionable whether some of the peripheral topics, although biologically significant in themselves, have received too much attention for the context. Despite the shortcomings, I recommend this book to all those interested in how cells hold on to each other or choose to separate, and interested in the significance of these processes in a plant's vegetative and reproductive development. It is the first such book to appear for many years and is therefore essential reading for those wishing to be updated on the subject, especially the molecular–genetic aspects of this important area of plant biology.

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Light and plant development. Annual Plant Reviews, Volume 30.

Volume 30 of the Annual Plant Reviews Series, edited by Garry C. Whitelam and Karen J. Halliday, focuses on the impact of light on plant development. The first part sets the stage by providing detailed, state-of-the-art descriptions of the traditional phytochrome, cryptochrome and phototropin photoreceptor families with special emphasis on knowledge gained in Arabidopsis thaliana. Chapter 1, by A. Hiltbrunner, F. Nagy and E. Schäfer, starts by reviewing the long history leading to the identification of the phytochrome family and then mainly concentrates on photochemical properties and the molecular underpinnings of regulated subcellular phytochrome partitioning. In Chapter 2, A. Batschauer and colleagues review structure and function of the cryptochrome family and discuss recent insights into the molecular mechanism of the light-driven electron transfer within the molecules, nicely illustrated by a coloured scheme. The identification of interaction partners begins to shed some light on cryptochrome signalling. Chapter 3, by J. Christie, describes the phototropins and other LOV domain proteins. Particularly useful is the small comparative section on the well-characterized WHITE COLLAR and VIVID proteins in fungi and bacterial LOV-containing proteins. A short paragraph describing bacterial phytochromes would also have added to Chapter 1, since the connection between phytochromes and bacterial histidine kinases is mentioned en passant in later chapters.