

**Wood Formation in Trees: Cell and Molecular Biology Techniques**

NIGEL J. CHAFFEY

*Taylor & Francis Books, London, U.K.; US\$136.00, 384 p, Hardcover, ISBN 0-415-27215-7*

In the past, no one would have accused forest biologists of not seeing the forest for the trees. Until recently, tree scientists had little cellular or molecular information on which to develop an understanding of trees as individual organisms. However, recent advances in genomics have given rise to lists of expressed gene sequences from various tree tissues that need interpretation in terms of gene and protein function in organismal development. The task is particularly challenging because trees are the largest and most long-lived terrestrial organisms and are composed largely of wood, which is simultaneously among the most difficult tissues to study and the main object of interest because of its economic value and unique developmental mechanisms.

In this masterful book, focused on methods for studying the cell and molecular biology of trees, and in particular the secondary vascular system that gives rise to the accumulation of wood, Editor Nigel J. Chaffey and a distinguished list of contributors have addressed their subject in a way that makes it approachable for the first time to all scientists. The international contributors to this volume are experts who have blazed conceptual and technical trails in the study of trees. Their joint effort in producing this book shows a real passion for trees as objects of study and a wish to draw others into the field that they love, despite its special difficulties.

The 384-page book, comprising 18 chapters, puts detailed and approachable technical protocols into their scientific context through descriptions of relevant research problems and progress. Editor Chaffey begins the volume by reviewing reasons to study trees and the organizational levels at which they may be studied. He then enumerates eleven factors that make research on trees difficult, the last being "lack of detailed, published techniques." The mission of the book is to redress this last problem, which implies dealing intelligently with the first ten problems that arise from the inherent nature of the tree and its vascular cambium.

The study of the complex tissue represented by the vascular cambium and its phloem and xylem derivatives demands cell-specific approaches if development and differentiation are to be accurately understood. The book, therefore, places strong emphasis on microscopic approaches, including light, laser scanning confocal, transmission electron and secondary ion mass spectrometry. Each of these instrumental methods is discussed in the context of its most recent uses, e.g., cryofixation prior to sectioning, freeze etching to reveal wall structure, immunolocalization of proteins, GUS histochemistry to analyze promoter/reporter gene fusions in transgenic trees, and *in situ* hybridization to identify sites of native gene expression. The book also includes chapters on analysis of enzyme activity in defined cell types, determination of protein profiles by

one- and two-dimensional gels and Western blotting, and identification of gene diversity between species and differential gene expression between tissues through several PCR-based methods. Protocols for research techniques only recently applied to trees, such as analysis of gene expression by microarray technology, are omitted. In an admirable effort to make the book a unique contribution to the literature, there are no chapters on scanning electron microscopy, which is easily accomplished with wood, or on tree transformation, which is well described elsewhere.

There are many features of the book that make the methods approachable. The use of first-person language makes readers feel as if they are participants in an interactive workshop with the writers. In several cases, background information is assembled and evaluated comparatively. For example, basic histological techniques in older literature that are now "lost" to many researchers are summarized. Great effort has been made to describe small technical details, which, if not known, can preclude success. In the ultimate gesture of user friendliness, there are even hints on how to schedule protocols so as to avoid working weekends. Each chapter follows a common and approachable organizational scheme, with scientific context, enumerated protocols, boxes highlighting needed equipment and chemicals, high quality illustrations, including diagrams of methods and black and white or color photographs of results, and extensive reference lists. Often homemade equipment is described that can substitute for commercial apparatus. There is a comprehensive abbreviation list, a suppliers contact list and a comprehensive index. Much thought and effort must have gone into making this the truly useful book that it is. Demonstrating the book's usefulness beyond the field of tree biology, this reviewer immediately consulted the protocols it presents for solutions to current research problems experienced in her lab in studies with the non-arborescent woody perennial, cotton.

Inevitably, work with trees will continue to present challenges not experienced in studies with herbaceous plants or model culture systems. For example, sampling of the tree vascular system described in most of the protocols contained in this book requires hacksaws and chisels as well as tissue storage during transport to the lab. These unavoidable stresses and delays in sample analysis create the possibility of changes in gene expression, biochemistry and cellular organization. Hence, it will remain necessary to exercise caution when interpreting the results of molecular studies with whole trees and desirable, when possible, to seek confirmation of mechanisms in simpler systems.

Despite the difficulties of research in the field, this book achieves the major goal of providing researchers with a wide

range of investigative tools and procedures for cell and molecular biological studies with trees and other woody perennials. The contributors are to be commended for their willingness to share the results of personal technical travails and problem solving with the wider scientific community to facilitate and

broaden future research.

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**Tree Physiology** 22, 655–659

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## Physical analysis of the process of cavitation in xylem sap

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Received June 18, 2001; accepted October 8, 2001; published online May 1, 2002

On the cover of the June issue of *Tree Physiology* (Volume 22, No. 9) the title of the above paper was inadvertently replaced by the title of a different paper. The listing should have appeared as follows.

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