Book Reviews

Molecular Genetics and Breeding of Forest Trees. Sandeep Kumar and Matthias Fladung (eds.). 2004. Food Products Press, an imprint of the Haworth Press, Inc., 10 Alice Street, Binghamton, NY 13904-1580. 436 pages. $59.95 softbound. <www.haworthpress.com/store/product.asp?sku=4900>. ISBN: 1-56022-959-4.

Molecular Genetics and Breeding of Forest Trees, edited by Sandeep Kumar and Matthias Fladung, is a valuable book on the genomics, molecular biology, and genetic engineering efforts of the vast groups of forest trees. I do recall the days whereby the thought of any research efforts dealing with the genetics and genetic improvement of forest trees used to be looked upon with exasperation, as these plant systems are so genetically complex and have such long generation cycles that this field moved at a very slow pace. Well, things have changed drastically in the past 10 to 15 years, and in particular in the last few years, whereby significant strides have been made in accumulating genomics resources, including expressed sequence tags (ESTs), mapping, and, more recently, sequencing of the whole genome. Efforts to unravel the genetics as well as expression of genes involved in myriad traits, particularly those associated with wood formation, flowering, and insect resistance as well as developing reliable gene transfer and regeneration systems for recovery of transgenic plants, have been highly successful and have all contributed to a renewed hope and interest in this important group of higher plants. Whether our interests in forest trees are based on their critical roles in ecological, environmental, or biomass productivity, it is important to observe this remarkable expansion of knowledge into the genetics and breeding of these groups of plants. Therefore, this book provides a valuable resource for some of the advances in genomics and genetic advances of forest trees, although the fast pace of these advances, in particular with the sequencing of *Populus trichocarpa* genome (which obviously follows the publication date of this book), will bring about the necessity for a revised edition of this current book.

The book consists of four parts according to the following: Part I—Forest Tree Functional Genomics—covering chapters 1 through 4; Part II—Molecular Biology of Wood Formation—covering chapters 5 through 8; Part III—Forest Tree Transgenesis—covering chapters 9 through 13; and Part IV—Genome Mapping in Forest Trees—covering chapters 14 through 17. Some of these chapters cover advances in resources, such as EST databases, molecular markers and mapping resources, or genetic engineering efforts; while others focus on advances in the biology and biosynthetic pathways of valuable traits such as wood formation, lignin metabolism, or cellulose biosynthesis.

It was interesting to read about the challenges as well as opportunities that forest trees provide to research efforts in this field. The amount of knowledge that has been generated from the model system *Arabidopsis thaliana* has been highly useful, and this information has allowed for research advances in various forest tree species as our knowledge of complex traits, such as cellulose biosynthesis, that are controlled by multiple gene families, necessitates that we go back and forth between arabidopsis (with its complete genome sequence). There are several examples in some of these chapters where this approach is used and has contributed to robust advances in our knowledge about various groups of genes, particularly those associated with wood formation, cellulose biosynthesis, and lignin. Those chapters dealing with in vitro approaches are rather short and to the point; whereas those dealing with developing transgenic lines expressing genes involved in insect resistance, flowering, and marker-free systems are very well written, as they are detailed and provide fundamental information. Chapters dealing with molecular markers and mapping projects cover efforts in various pine, *Populus*, and *Acacia* species. There is a thorough review of the molecular markers that have been identified, with emphasis on microsatellite markers as well as efforts to look into other marker systems as well.

Overall, I think this book is well balanced in offering the reader a good overview of advances in genomics, proteomics, transcriptomics (with emphasis on ectomycorrhizal symbiosis), mapping, and transgenics. I find the chapters dealing with tree biology especially useful as they truly focus on the most valuable traits of trees. Those chapters on genetic engineering also tie well into the functional genomics studies that can be undertaken in various forest species. There are several illustrations, photographs, and tables throughout the different chapters, and these are well referenced. The index section is rather short, but would allow the reader to find some critical pieces of information on specific groups of genes or plant systems. I have to say that this book is a very good resource for those who are involved in this field or for those who are new to this field. It is a valuable resource, but considering the recent surge of information in forest genomics and molecular genetics, it will require revision in a mere, few short years.

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Natural Products from Plants, Second Edition. Leland J. Cseke, Ara Kirakosyan, Peter B. Kaufman, Sara L. Warber, James A. Duke, and Harry A. Brielmann (Editors). 2006. CRC Press Taylor & Francis, Boca Raton, FL. 611 p. $149.95, hardcover. ISBN-13: 978-0-8493-2976-0; ISBN-10: 0-8493-2796-0.

This book has 26 contributing authors, including the editors. The editors include three professors or professors emeriti of biology, a medical doctor, a retired economic botanist from the U.S. Department of Agriculture, and a professor of chemistry. I do not have the first edition for reference to compare with the second edition, but in the preface the editors note that the second edition updates and revises previous information and adds more that 50% new topics that deal with plant natural product biochemistry, biotechnology, and molecular biology and new separation techniques and bioassays.

The book has 15 chapters. The book is not organized into sections; hence, each chapter independently covers separate topics of chemical components of plants, synthesis and metabolism of these components, molecular biology, characterization, and biosynthesis of plant natural products, bioassays, and plant conservation, among other topics. The organization of the book proceeds from the identification of chemical components of plants, through the synthesis and regulation of synthesis of these compounds, through their extraction and preparation, to uses and risks and the relationships between plants and people, among other topics. The end of each chapter has an extensive list of references that were cited in the text. Illustrations of photographs, line drawings, and molecular structures and tables of data enhance the text of each chapter.

The first chapter, "Phytochemicals: The Chemical Components of Plants," addresses the organic components of plants. This chapter is organized to present components broadly in terms of their increasing oxidative states, beginning with lipids and their derivatives and continuing through hydrocarbons, unsaturated molecules, and hydrophilic molecules to salt-forming phytochemicals. Examples of specific phytochemicals in each component are quite complete and are too numerous to mention in this review. For each component, the authors mention the occurrence of the phytochemicals in specific and common plants and give uses and environmental effects of the compounds. Although this chapter does not use a lot of unusual technical terms, readers need to have a good knowledge of plant constituents and organic chemistry to understand the content. Readers also will learn a lot about plant constituents and organic chemistry when they examine this chapter.

The second chapter has a lengthy title and deals with the synthesis of phytochemicals. The chapter mentions primary metabolic pathways in plants (shikimic acid pathway, carbon fixation cycle, respiratory pathways) and shows the interrelations of these major pathways in plants and their connections with the synthesis of various phytochemicals in a broad sense. A section discusses the

subcellular compartments or microbodies of cells and how these structures function in the major pathways and in synthesis of phytochemicals. Specific groups of compounds discussed include lipids, proteins, nucleotides, cellulose, lignin, starch, fructans, gums, pigments, alkaloids, and many other chemicals. Roles of these compounds in plants are discussed, giving their functions in transfer of metabolic energy, catalysis, genetics, deterrence of predators, allelopathy, and attraction of symbionts and pollinators.

The third chapter is ''Regulation of Metabolite Synthesis in Plants,'' which adds mechanisms that regulate the expression of genes and enzymes that synthesize phytochemicals. This chapter helps in the understanding of how plants respond to environmental stresses and how the synthesis of phytochemicals is a response to these stresses. Factors that act within plants to influence the synthesis of plant metabolites, aside from responses to the environment, are discussed to include various biochemical and molecular (genetic) regulations.

Chapter 4 is ''Plant Natural Products in the Rhizosphere.'' It deals with collection and processing of plant exudates, degradation of products by microorganisms in the rhizosphere, genetic modifications of organisms, and other aspects called rhizoengineering and rhizoremediation for potential uses of activities in the rhizosphere.

''The Molecular Biology of Plant Natural Products,'' Chapter 5, applies molecular biology and genomics to the understanding of metabolic pathways. It is noted that the largest category of genes in plants involves plant metabolism and that perhaps tens or hundreds of thousands of genes contribute to the metabolic diversity of plants. Families of metabolic genes and enzymes are discussed to include cytochrome genes, various transferases, and RNA transcription. The structures and functions of enzymes are discussed for a few examples of metabolic processes.

The sixth chapter is ''The Study of Plant Natural Product Biosynthesis in the Pregenomics and Genomics Eras.'' The introduction of this chapter gives definitions of words such as genomics, proteomics, and metabolomics, which appear to be coined words but which have important meanings in studies of natural product biosynthesis in plants. The body of the chapter covers approaches used in the studies of biosynthesis of these products. The authors note that in the pregenomics era, before the study of the complete genetic makeup of an organism, biochemical approaches were employed widely, involving in vitro enzymatic assays to elucidate mechanisms of reactions, concentrating on one pathway, one enzyme, and one gene. Other pregenomics approaches relied on the development of mutants with observable phenotypes and cloning of genes that have the same sequence of nucleic acids or that have the same function. Genomic approaches include the study of all of the nucleotide sequences of all of the chromosomes of an organism, and terms such as bioinformatics (application of computer technology) and transcriptomics (global profiling of RNA expression) are introduced. The information generated is being used to understand the biological function of natural products and of plant biology in general.

Chapter 7 addresses ''Plant Biotechnology for the Production of Natural Products.'' The authors note that plant biotechnology has changed plant science in three major areas: 1) control of growth and development, 2) protection against environmental threats, and 3) expansion of ways in which specialty foods, biochemicals, and pharmaceuticals are produced. The review covers plant biotechnology from its early focus on in vitro cell and tissue culture to the current state of research on functional analysis and genome modification. Bioengineering of plants is expected to play a major role in the production of natural compounds in plants. Techniques through which biotechnology may be applied in the biosynthesis of natural products in several model plant species are discussed.

''Traditional, Analytical, and Preparative Separations of Natural Products'' (Chapter 8) is a lengthy chapter that looks at how one determines what plants have useful compounds by examining processes of collection of plants and extraction and separation of compounds from plants. The discussion covers issues such as how to equip oneself and how to proceed for collection of plants, storage of the plants, grinding and extraction protocols, and preparative and analytical protocols, which include many chromatographic procedures.

''Characterization of Natural Products'' (Chapter 9) addresses structural elucidation of natural products. Nuclear magnetic resonance and mass spectrometry receive emphasis along with overviews of infrared and ultraviolet-visible spectrophotometry.

Chapter 10 presents discussions of assays for biological activity of natural products. These assays include in vitro assessments of antimicrobial, cytotoxic activities against various plant and animals cells, and antiviral activities. Other tests assess the lethality of compounds on invertebrates. Biochemical screening involves evaluations of compounds in inhibition of enzymes, blocking of receptors, and interactions with biomolecules.

Chapter 11, titled ''Modes of Action at Target Sites,'' examines how phytochemicals participate in cell-cycle interactions, transmembrane signaling, toxic effects, and other molecular mechanisms at target sites in the human body.

Chapter 12 considers ''Uses of Plant Natural Products by Humans and Risks Associated with Their Use.'' The first section of this chapter considers food plants as sources of medicine and lists many food plants that contain chemicals with medicinal properties, along with the bioactivity of some of the chemicals. The structures of many of the chemicals are illustrated. Some case studies on the uses of plant natural products are presented. Discussions of risks include reports by the Centers of Disease Control and from other sources concerning adverse effects of plant-derived remedies and safety and efficacy of herbal supplements.

Chapter 13 examines the synergy or interactions of the multiple constituents of medicinal plants, noting that the actions of the many chemicals are greater than the sum of the actions of the individual chemical components. Several essays and examples of chemical synergy are given, including allelochemicals, medicinal cocktails, and antibiotic effects.

Chapter 14, ''Plant Conservation,'' points out the needs for plant preservation and ways by which over-exploitation of plant resources might be avoided. Preservation of natural habitats and ecosystems, prevention of destruction of natural and wilderness areas, the growing of rare and endangered plants by botanic gardens and arboreta, and development of seed banks are among the several concepts of plant conservation that are discussed and for which examples of actions for preservation are being taken.

Chapter 15, ''Relationship between People and Plants,'' mentions topics such as historic uses of herbs, effects of plants on people, effects of humans on plants, global cultural patterns, and standards for herbal preparation.

The book has an appendix on retrieval of information on natural products in plants from internet sources. The book also has an index of plant species and common names and a subject index.

This book is a powerful one on natural products from plants. Each chapter provides a strong summary of the subject matter addressed. Each chapter gives multiple examples indicating how the subject matter relates to specific natural plant products. This book is useful to anyone who has an interest in the chemistry and genetics of plant products.

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