BOOKS: BIOCHEMISTRY

Plant Biology at Center Stage

Hans Kende

Since the 1980s, plant biology has reemerged as a core discipline of the life sciences. Earlier, both research and teaching about plants were largely relegated to public universities. Many students, especially at top private universities, were never exposed to the biology of plants. (A survey on the use of a popular introductory biology text found that 65% of the instructors did not teach those sections of the book that dealt with plants.) The situation changed dramatically with the advent of plant molecular genetics. The introduction of genes into plants using the *Agrobacterium* transformation system has become routine, and the use of *Arabidopsis* as a model organism has opened undreamed-of research opportunities throughout plant biology. The rapidly evolving new methodologies have spawned the field of plant biotechnology, which promises to transform agriculture, to benefit the environment, and to create new opportunities for the production of valuable chemicals for pharmaceutical and industrial use. The imminent publication of the complete *Arabidopsis* genome will open another chapter in the elucidation of plant functions, and the rice genome is not far behind.

Biochemistry and Molecular Biology of Plants
Bob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones, Eds.
American Society of Plant Physiologists, Rockville, MD, 2000. 1407 pp. $149.95. ISBN 0-943088-37-2. Paper, $99.95. ISBN 0-943088-39-9.

It is against this background that the significance of *Biochemistry and Molecular Biology of Plants* must be viewed. Edited by Bob Buchanan (a biochemist), Wilhelm Gruissem (a molecular biologist), and Russell Jones (a cell biologist), the volume was written by an international group of over 50 scientists who are world-renowned experts in their respective fields. It was conceived as a textbook and will serve that purpose very well in graduate and advanced undergraduate courses. Over 1100 full-color illustrations and nearly 500 photographs (available separately on a CD-ROM) bring each topic alive and help explain complex concepts in a thoughtfully designed, didactic manner.

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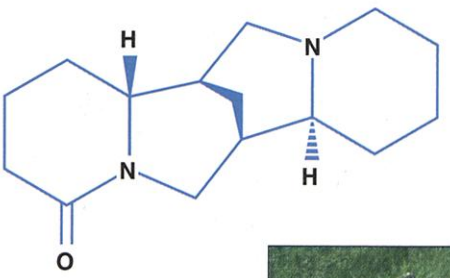
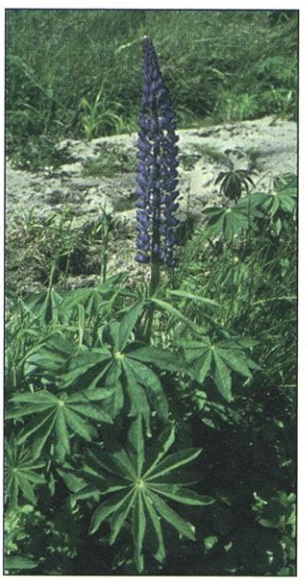
Beyond being a modern, up-to-date textbook, the volume will become an essential reference for practicing plant biologists and for the increasing numbers of scientists from other disciplines who are entering the field of plant biology. To exploit fully the wealth of new information provided by the genome projects and to integrate the metabolic, regulatory, and signal transduction pathways of complex organisms, biologists will require a solid command of biochemistry and physiology. For this reason, the publication of *Biochemistry and Molecular Biology of Plants* could not have come at a more opportune and auspicious time.

The book's first four sections deal with cell biology, reproduction, energy flow, and metabolic and developmental integration.





Effective feeding deterrent. The quinolizidine alkaloid lupanine from the bitter lupine *Lupinus polyphyllus* is toxic to grazing animals, particularly to sheep.

The fifth section extends the fundamentals of plant biochemistry and biotechnology to the solution of agricultural and environmental problems and the production of valuable plant products such as pharmaceuticals. Within this organizational framework, the authors place plant structures and processes in the context of general biological phenomena. Here I discuss three chapters that typify this approach.

In the chapter on lipids, the authors cover the unique features in the compartmentation, biosynthesis, and chemical diversity of plant lipids. Of particular interest to humans are the lipids that are deposited as storage reserves in specialized oil bodies of seeds and that we use as oils in our diet. The authors describe in detail current biotechnological efforts to improve the nutritional value of these oils and to harness the lipid-synthesizing capacity of plants for the production of soaps, detergents, specialized lubricants, and plastics.

The chapter on the cell wall recounts another plant variation on a general biological theme. Most eukaryotic cells have an extracellular matrix; that of the plant, the cell wall, is unique in its composition, function, and practical significance. It consists of crystalline cellulose microfibrils embedded in an amorphous matrix of polysaccharides, proteins, and aromatic substances, and it has the characteristics of synthetic composite materials. The plant cell wall has to withstand the enormous hydrostatic pressures exerted by turgid cells, but it must also be able to yield when cells elongate. It determines the shape of plant cells and, ultimately, the shape of the plant itself. Plant cell walls constitute the predominant renewable biomass on earth. They are the raw material for wood products, paper, and many textiles, and they add the fiber to our diet. The authors examine the potential of biotechnology to modify wall composition, ameliorate environmental problems (such as those caused during paper production), and optimize fiber formation.

The book's final chapter deals with the large class of compounds collectively referred to as secondary plant metabolites. These natural products include more than 25,000 terpenoids, about 12,000 alkaloids, and 8,000 phenolic substances. Many are used as dyes, fragrances, flavoring agents, or important pharmaceuticals. In recent years, a range of natural functions of these phytochemicals has been discovered, especially in the context of ecological interactions. Some secondary plant metabolites turn out not to be "secondary" at all: they protect plants against herbivory and microbial infections, attract pollinators, and influence competition among plant species. This vast area where natural products chemistry, biochemistry, and biotechnology meet offers many opportunities for fundamental and applied research, and the exquisitely illustrated chapter on phytochemicals is an effective introduction to the field.

The only significant shortcoming of the book is the paucity and arrangement of references. These are listed at the ends of each chapter (under "Further Reading") and as "Sources and Credits" for illustrations. This approach may be adequate for an undergraduate textbook, but it is unsatisfactory for an otherwise comprehensive work. Nonetheless, *Biochemistry and Molecular Biology of Plants* will serve as a rich source of information for research and teaching.

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