

transgenic plants could be invaluable tools in relating plant metabolism to plant physiology or plant ecology.

Of the 14 chapters, no less than four cover carbohydrate metabolism. Thus, Alison Smith reviews the regulation of starch synthesis in storage organs, while C.J. Pollock and co-workers consider fructan metabolism in grasses. Fructosyltransferase genes and their expression are the subject of a chapter by Irma Viju et al. and the sink metabolism in the potato and transgenic technology are discussed by R.N. Trethewey and L. Willmitzer. There is one chapter on the application of genetic manipulation to fatty acid biosynthesis and one on nitrate reductase and its control of intermediary metabolism. The remaining chapters deal with var-

ious other aspects of primary metabolism, including photosynthesis.

As a non-molecular biologist, I found that some of the chapters were too terse and I would have welcomed some expansion. To deal with the whole subject of modifying Rubisco the key enzyme of photosynthesis in only 12 pages was a pity. Nevertheless, this is an important contribution to the plant science literature. Anyone wishing to understand the complexities of the regulation of plant metabolism will need to read this volume.

Jeffrey B. Harborne

*Department of Botany, The University of Reading, UK*

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### **Heavy Metal Stress in Plants: From Molecules to Ecosystems**

M.N.V. Prasad and F. Hagemeyer. Springer-Verlag, Berlin, 1999, 401pp., ISBN 3-540-65469-0, 329,-DM

Over the last few years an increasing interest in understanding the molecular basis of heavy metal tolerance in plants has come into view, with regard to not only scientific but also commercial significance. In "Heavy Metal Stress in Plants" the authors attempt to give in 17 chapters a summary of the phenomenon of heavy metal stress also considering marginal aspects. Three introductory chapters discuss important basic principles of metal chelation and the molecules possibly involved in these processes in plants, giving a deeper understanding of how heavy metals principally react and how they are detoxified. The chapters on the impact of heavy metals on membranes, photosynthesis, respiration, water relations and growth are more descriptive. For the reader it is difficult to distinguish between artificial results, due to the experimental conditions, and physiologically relevant effects. Free radicals and reactive oxygen species are discussed as a part of heavy metal stress in plants in a particular chapter. Methods for a species-selective analysis of heavy metals and their complexes (GC, ICP-MS, HPLC-ESI-MS, analytical electron microscopy) are

described very briefly. Phytoremediation for purification of sewage sludges, soils and forest declines is discussed in four chapters in detail. Only little is known about how heavy metals pass the plasma membrane and the tonoplast. There is increasing evidence that heavy metal transporters like those found in bacteria and yeasts are also active in higher plants. A chapter discussing these aspects in detail is missing. Each chapter contains a bibliography, which is up to date and considers modern developments such as new analytical methods and recombinant DNA-techniques used to modify crop plants genetically. The articles describe the heavy metal action partially in great detail, but on the other side ecological and ecophysiological aspects are only briefly considered. Particular aspects of heavy metal tolerance are described in several chapters, e.g. the role of phytochelatins in chapters 3, 4, 10, 14 and 16. The book can be recommended as a valuable text for students and a literature review for scientists in plant physiology and biochemistry, agronomy, forestry and also industrial research workers.

D. Neumann

*Leibniz-Institute of Plant Biochemistry,  
Weinberg 3, D-06120,  
Halle, Germany*

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