

Diffusion of CO₂ into the leaf, the stomatal conductance and CO₂ entry into mesophyll cells and into the chloroplasts constitute a delicate balance between CO₂ and water loss. Development of fast-measuring techniques for assessing stomatal conductance such as chlorophyll-*a* fluorescence and isotope discrimination techniques have brought about remarkable improvements in our understanding of the complex process of acquisition of CO₂ into the mesophyll cells, particularly in C₄-type plants. Comprehensive reviews of the current status of our understanding of the entry of CO₂ from air to chloroplasts in higher plants and in cyanobacteria and algae and also that of carbonic anhydrase (CA), the enzyme that catalyses anhydrase reversible hydration of CO₂ in microorganisms, including cyanobacteria and higher plants as well as the α , β and γ isoforms this CA provides a deep appreciation into complexities involved in the regulation of photosynthetic CO₂ fixation in plants. The chapters devoted to these topics enhance the depth of our understanding of these complex processes.

The regulatory physiology of CO₂ fixation by the so-called C₄ plants having specialized anatomical and biochemical features to suppress oxygenation reaction of Rubisco and photorespiration, the transport of CO₂ in these C₄ plants and developmental aspects of C₄ photosynthesis and the ecophysiology of C₄ plants have been elegantly elucidated in three consecutive chapters of the book. In spite of the overlapping contents, each contribution gives a new dimension to our current understanding of photosynthesis in C₄ plants and also in C₃-C₄ intermediate plants. Topics on C₄ photosynthesis as well as that of C₃-C₄ intermediates have attracted many crop and ecophysiologicalists in India. Thus the detailed discussions of these topics and also molecular aspects of Crassulacean acid metabolism (CAM) and ecophysiology of CAM plants may provide new directions to research in these fascinating aspects of plant metabolism. The physiological diversity of plants would add to genetic biodiversity features.

Photosynthesis is the unique feature of plant biochemistry. However, the molecular acrobatics involved in the photosynthetic carbon reduction reactions and complexities involved in the energetics and economy of CO₂ import

and metabolite transport of photosynthates as well as environmental regulation of the physiology of photosynthesis make the presentation of photosynthetic metabolism in an integrated and coordinated fashion difficult and thus in many texts, these uniquely fascinating aspects of photosynthesis have fragmentary presentations. This book paves the path for integrated presentation.

The editors of this book have done a commendable job dealing with all aspects from molecular biology to ecophysiology, comprehensive and current overviews of physiology and metabolism of photosynthesis in higher plants, algae and cyanobacteria. Each chapter contains a wealth of information, includes some 200 to 500 citations and is laden with illustrative sketches, diagrams, tables and reproduction of original data. The presentations in the 24 chapters are uniform and quite up to date. However at times, too many citations in the text make the reading difficult. This book will be useful to all plant scientists and crop biologists and because of its scope and contents will have predictably a long shelf-life. The book also has many attractive and novel features beginning from the cover page to the end – it provides the readers with a feeling of fresh new tasty breads in colourfully attractive basket.

Teachers and instructors in plant and crop physiology, molecular biology, biochemistry, structural biology and microbiology would find this book a tempting source for use in the classrooms and researchers will like to have a handy desk copy. This reviewer shares the agony of the students for not being able to add a copy of this book to their own collections because of the high cost. But this copy should be made available in their libraries.

The editors and the contributors of this volume will receive the appreciation of the large body of readers which they richly deserve for their scholarly efforts. The Kluwer Academic Publishers have leadership in publishing high quality text and reference books in plant biology and this book will add to their reputation.

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Plant Galls of India. M. S. Mani. Science Publishers, Inc., P.O. Box 699, Enfield, New Hampshire 03748, USA. 2000. 2nd edn. 477 pp. Price: Indian subcontinent – Rs 375; other countries – US \$112.

The study of plant galls in the Indian subcontinent is, in essence, synonymous with M. S. Mani. His efforts match those of the world pioneers, E. P. Felt (America), W. Docters van Leeuwen (South-east Asia), C. Houard (France), and A. Trotter (Italy). Over the last seventy-odd years, Mani has been relentlessly surveying the gall flora of India, in addition to studying the taxonomy and biology of gall-inducing cecidomyiids and chalcids. He will be remembered by gall researchers throughout the world for his volume *Ecology of Plant Galls*. When I received a copy of the present book – the revision of 1973 edition – for review, I felt pleased that he had up-dated his work for the newer generation of scientists interested in galls, both in India and elsewhere. Prior to his study in 1930s, only a few passing references on insect-induced galls were available through the works of the British Raj entomologists, C. F. C. Beeson, G. B. Buckton, Y. Ramachandra Rao, and T. V. Ramakrishna, and botanists, A. H. Sundar Raman and R. D. Saksena. Mani's predoctoral research on the biology and taxonomy of gall midges and his doctoral thesis (*Journal of Royal Asiatic Society of Bengal (Science)*, 1948, 14) brought thoroughness to this discipline by integrating the study of both the insect and host plant. The following incident illustrates his passion for galls: about 15 years ago, shortly after holidaying in Fiji, he published his paper on the plant galls of Fiji¹. Diverse galls and their inducers were investigated by the School of Entomology at St. John's College (Agra), which he founded and directed till the early 80s, the Allahabad group (S. N. Prasad and Prabha Grover), the Bangalore group (G. P. Channabasavanna), the Calcutta group (D. N. Raychaudhury and Samiran Chakraborty), the Dehra Dun group (R. N. Mathur), the Jodhpur group (H. C. Arya and Uma Kant), and the Madras group (T. N. Ananthakrishnan). It is no exaggeration to say that these groups became active only because of the direction and

vision Mani gave to cecidology in India. As one who studied Indian galls for more than two decades, I will take this opportunity to pay homage to Mani, a great biologist, entomologist, botanist, biogeographer and naturalist, for his enthusiasm and effort to remain committed to a singular research cause and contribute substantially to its growth.

The second edition of *Plant Galls of India* is a hardcover book with the cover sketch of the fascinating cylinder–piston gall on the leaflets of *Acacia ferruginea* induced by a cecidomyiid. The book includes the bulk of the information available in the first edition with some new sections. Given that gallers are currently being seen as potential control agents of weeds² and gall systems are being perceived as excellent models to understand the ecology and evolution of insect herbivory^{3–6}, volumes such as this make a significant contribution. Details of about 2000 galls of arthropod, fungal and nematode origins on more than 700 plant species under 90 plant families are available with the binomials of the host plant and the inducer. Half-tone plates referring to the gross morphology of the galls and line sketches explaining the overall structural changes consequent to galling are clustered at the end. The book commences with a brief overview of the biology of galls and their inducers. This section also includes a brief reference to the biogeography of gall-inducing arthropods. A few suggestions on collecting and preserving galls have also been provided. As in the previous edition, in each chapter a dichotomous key facilitates identification of galls. Since I have used the keys in the previous edition, I did not check the validity of the keys in the present edition. I assume they are helpful.

This being a 'revised' edition, I expected it to include references to information reported by Indian gall scientists since 1973. For instance, I could neither see the reference to Ananthkrishnan and Raman⁷ nor that to Mathur⁸ which summarizes thrips and psyllid gall research done by the Madras and the Dehra Dun groups, respectively. Under gall number 40 (bud galls of *Calycotris floribundus* induced by *Austrothrips cochinchinensis*) on page 174, there is no citation of the paper by Ananthkrishnan and Gopinathan⁹, which provides morphogenetic details of these galls. Furthermore, under gall number

57 (bud galls of *Mangifera indica* induced by *Apsylla cistellata*), Mathur's 1935 paper is cited, but I wished to see the citation of his later work⁸ which includes more information on these pine-cone-like galls. To an argument that such details would be irrelevant to a book of this sort, I would counter argue that relevant papers should have been cited in the references, offering scope for new workers to evaluate progress.

As in the previous edition, Mani refers to galls by numbers, a strategy that may be appropriate for his personal reference and notes. However, when numbers come to the fore in a book such as this, they are user-unfriendly. They distract even a trained eye. The illustrations also refer to numbers and not to the names of gall inducers. I had difficulty in understanding and relating the distribution details under each category; e.g. gall number 324 induced by *Amaradiplosis viridigallicola* (Rao) 'distributed in India' (page 91) and gall number 189 induced by *Oligotrophus mangiferae* Kieff. 'distributed widely in India' (page 90). Moreover, names of some of the localities are no longer valid (e.g. Travancore, page 60). The post-independence generation of scientists will find such names hard to relate to the present political demarcation.

In most of the chapters, Mani begins with a summary of the key aspects of gall incidence, gall-inducer behaviour and distribution within the Indian sub-continent. Although these details help the reader considerably, what raises concerns are his remarks on the biogeography of the gall in relation to its affinities. For example, on page 30, under the family Ternstroemiaceae, the following comment is available: 'With a pronounced Indo-Chinese affinity, some of the galls are discontinuously distributed in the extreme north-east and south-west India'. It would have been helpful to have evidence of the 'pronounced Indo-Chinese affinity' and a map to indicate the discontinuous distribution of these galls. Mani's eminence as a biogeographer is known¹⁰. I wished he had included a concluding chapter synthesizing the biogeography of Indian galls and inducing arthropods. In the absence of such a chapter, we look forward to a paper on the biogeography of galls and gallers from him in the near future.

Two new sections have been added in the present edition: (1) Flower galls within the syconia of *Ficus* (pages 384–385) and (2) Evolutionary trends in the foliar galls of mango. Coevolution of figs and associated Hymenoptera is being enthusiastically investigated outside India. Therefore, the list provided by Mani will encourage many Indian scientists to study this aspect. In the section that deals with the mango gall types, an effort has been made to characterize an apparent pattern of continuum based on gall structure – from simple to complex – as evident in selected midge galls. Evolutionary terms such as 'phylogenetic tree' have been superimposed on that interpretation and I am concerned with this approach. At a time when we are discontented with evolutionary interpretations made from sophisticated analytical procedures^{3,4}, I would hesitate to use this section. The last sentence in this section is an antithesis; we know too well that the same plant organ can respond in different ways to different species of gall-inducing arthropods^{11,12}. I experienced difficulty in linking figure 121 on page 416 to this part of the text. In figure 121, I realized that a connection has been provided between gall numbers 1108 and 190 through 1111 and 738. My confusion was enhanced when I tried to see the relationship in the structure between gall number 1111, a plurilocular (3-chambered) gall and gall number 738, a unilocular gall! Three-chambered galls suggest the simultaneous action of three larvae, while the one-chambered gall indicates the action of a single larva. Galls represent the dynamic relationship between two independent genomes. Therefore, in the evolutionary interpretation of galls, can we simply confine ourselves to patterns of plant responses alone, without considering the phylogenetic relationships of the involved gall inducers? I would think not.

Out of the 140 references cited at the end, about 30 citations are post-1973 publications. A random search for typographical errors revealed the following: Apaliaceae for Araliaceae (page x), *hopea* for *hopeae* (page 35), Voleoptera for Coleoptera (page 40), *cistella* for *cistellata* (page 90), *chavicae* for *chaviciae* (page 314), Scacia for *Acacia* (page 458), dibut for debut (page 462). I would have preferred seeing the modern

names for plant families in this revised edition (e.g. Apicaceae for Umbelliferae, Asteraceae for Compositae, Poaceae for Gramineae) and valid binomials (e.g. *Maytenus senegalensis* for *Gymnosporia heyneana* (page 66); *Liothrips karnyi* for *Gynaikothrips chaviciae* (page 314)). Publications of Wim Docters van Leeuwen are cited wrongly under Drs van Leeuwen.

I must add a word on the quality of publication. The book has been printed on glossy paper and that makes the book worthy of the price. However, I would have been happier had the copy editing been done more carefully, so that at least a majority of the glaring typographical errors could have been avoided and the names of plant and animal species and natural orders could have been up-dated. A binomials index and a glossary are, however, helpful inclusions.

After I had read through the book, I wondered if Mani, a name Indian biology respects profoundly, was in a hurry. Every one of us active in either basic or applied aspects of cecidology readily

consults his classic *Ecology of Plant Galls* which is 36-years-old – even though several new source books on plant galls have appeared in the last 20 years. Nonetheless, this edition, like the previous one, provides information on gall biodiversity and gall-inducer species richness in the Indian subcontinent.

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