

PREFACE

The knowledge, generated by research, often gets obsolete by the occasion it is disseminated through education / teaching and finally trickles down to farmers and practitioners through extension due to big lapse of time! On the other hand, this is the matter of delight that due to absolutely informative contributions in time through World Scientists of distinction in unequivocal fields, the **Volume 10** of the *International Treatise Series on Advances in Plant Physiology* has been brilliantly shaped within a short span of the tenth year of this meaningful project, which also auspiciously coincides with the **Platinum Jubilee** of the **Department of Plant Physiology** and the **Institute of Agricultural Sciences**, Banaras Hindu University. Certainly, my conscience believe this volume a faithful tribute to those who created this great University, Institute and the Department of Plant Physiology for deep thinking in all spheres to resolve problems from grassroots level to the highest of civilization.

Undeniably, our objective is to publish ground-breaking science of value across the broad disciplinary scope of the treatise. In our Instructions for Authors, we state that work reported in international journals/ treatises including the **Advances in Plant Physiology Series** should be strongly carried out, provide new information, and move the field to the next level. I reiterate that this programme has been undertaken with a view to reinforce the identical efforts to recognize the outcome of meticulous research in some of the very sensible and stirring areas of **Plant Physiology-Plant Molecular Physiology/ Biology-Plant Biochemistry**. I am keen to keep on the exceptionality and the introduction of excellent new ideas, ensure that the treatise welcomes the best science done across the full extent of modern plant biology, in general, and plant physiology, in particular, keep trying on advancing the superiority of what is published, place high value on the quality of production, and be highly attentive and responsive to the rapidly changing face of academic publishing. The new proposals that I have in mind to further advance *Plant Physiology Treatise Series* come out from my trust that the treatise would significantly benefit by becoming more positive about illustrating the consequence of the science that we bring out. In a nutshell, I raise your spirits to share your suggestions and criticisms about what we are doing and how we are doing it with me; they may not always result in a change, but all vital suggestions will be given serious thought. The plant physiology and plant molecular biology research community has obviously endorsed the new directions taken by the treatise, accounting for the firm ability of **Advances in Plant Physiology** to draw the unsurpassed scientists in plant biology.

In *Volume 10*, with creative applied research, efforts have been made to bring together much needed **twenty review articles** by Fifty one contributors from

India, USA, Japan, France, Italy, Spain, Greece, Poland, Brazil and Argentina dispersed in eight different sections as described below:

The first and foremost *Section I* inescapably assigns seven crucial chapters related to *Molecular Physiology of Stress Response in Plants*. At the outset, the *Chapter 1* contributes to a better understanding of plant response to abiotic stress. The major roles that flavonoids play in plant response to abiotic stress are related to their photoprotective and antioxidant properties, which will be discussed by dedicated and distinguished Spanish scientists. In a short review in *Chapter 2*, authors from U.S.A. abridge the most recent advances that address the functions of the PM-associated signaling proteins in the ABA response network. These advances have been made possible mostly through reverse genetic approaches, although sometimes the biochemical approach is combined. Subsequently, *Chapter 3* on plant secondary metabolism in response to the environment by eminent Brazilian scientists will focus on abundant compounds that are readily produced in response to pollutant gases (CO_2 and O_3), ultraviolet-B (UV-B) radiation, heavy metals and attack by insects and microorganisms. Thereafter, the nationally renowned team of Indian plant physiologists and committed scientists of the Indian Agricultural Research Institute provide a concise and coherent picture on the advances of research work in the field related to impact of drought and temperature tolerance on physiological traits in chickpea genotypes with a special emphasis on the basic science behind the findings and their logical analysis in *Chapter 4*. In addition, in *Chapter 5*, the review attempts to elaborate physiological and molecular mechanisms associated with salt tolerance to deal with proteins/genes, which are induced in crop plants in response to salinity stress. Information on salt-responsive proteins/genes is crucial for improving salt-tolerance through genetic engineering techniques. Thereafter, the review in *Chapter 6* by extremely devoted team of the Banaras Hindu University focuses on our present status of understanding related to the mechanism of aluminium transport, toxicity, biochemical and molecular mechanisms of aluminium caused injury and tolerance as well as possible remediation measures of aluminium in acidic soils. Another well known team of Indian scientists in *Chapter 7* have reviewed the process of nodulation and nitrogen fixation as well as its relationship with environment with special reference to physiology and biochemistry of nitrogen fixation as well as interaction between legume *Rhizobium* symbiosis and environmental constraints in the light of available recent literature. Finally in this section, our team has illustrated Oxidative Damage and Oxygen Deficiency Stress under the sections of generation of reactive oxygen species (ROS) in biological systems and antioxidant system; salicylic acid in H_2O_2 production, oxidative stress, and H_2O_2 -metabolizing enzymes; ionic homeostasis, anoxia signaling, novel genes and flooding tolerance; calcium and oxidative stress.

In *Section II* on *Physiology of Dormancy and Germination*, the Japanese authors have presented a brief overview in *Chapter 9* on physiology of dormancy of onion bulb *Allium cepa* with due emphasis that investigations are needed to evaluate the exact nature of onion bulb dormancy, and the balance and relation among the different hormonal factors, which has significance for the modern agriculture. Similarly, the study of germination is challenging because there is an intrinsic difficulty in studying a process that involves a complex temporal sequence

of events generated by the embryo itself and from surrounding tissues. A prerequisite for germination is the accomplishment of specific steps during embryogenesis. This implies that a thorough understanding of germination requires knowledge of earlier events taking place during embryo formation. Therefore in *Chapter 10*, eminent Italian authors have meticulously infused excellent piece of information with regard to germination, which is a crucial step in plant growth. Later Section III on *Plant Growth Regulators: Somatic Embryogenesis* includes single review article as *Chapter 11* by a very active group of Indian workers that features like interactions between exogenous polyamines and endogenous polyamines; role played by their biosynthetic enzymes and inhibitors in different phases of somatic embryogenesis as well as relations between polyamines and ethylene during somatic embryogenesis. Afterwards, the only *Chapter 12* of the Section IV on *Molecular Physiology and Biotechnology of Flowering* deals wonderfully with the recent progress in understanding flower development by reputed group of Brazilian scientists. This has been greatly aided by molecular approaches using *Arabidopsis thaliana* mutants and transgenic plants. This review aims to integrate the information in recent published literature, bringing together master genes involved in the flowering process in *Arabidopsis* and its association to phytohormone signaling.

The relevance of mineral nutrients at physiological, biochemical and molecular levels has been intensely realized in the last two decades. In the recent decade, further advances have been made in this regard with special reference to micronutrient research. The knowledge is strengthened with four indispensable well-written reviews on this aspect in *Chapters 13 to 16* of the Section V on *Recent Advances in Mineral Nutrition Research*. In *Chapter 13*, dedicated Greek scientists from the Department of Agricultural Biotechnology have described the paradox of boron according to which the well-documented chemical interactions between boric acid and an overabundance of cellular components are not accompanied by a rational number of identified functions for cellular boron. Some research guiding principles that might address this paradox are discussed. Next to this in *Chapter 14*, the most needed molecular approach for enhanced iron acquisition to sustain crop productivity under calcareous soils has been well elucidated by experienced Japanese and Indian workers; whereas in *Chapter 15*, a brief account has been presented on the so far accumulated information regarding the structural characteristics of vanadium species present in bacteria, fungi, algae and lichens and discuss the functions of these new and very interesting bioinorganic systems. Some particular aspects related with the presence of vanadium in other natural systems are also briefly analyzed. Finally in *Chapter 16* of this section, devoted and experienced Indian scientists review the emerging trends towards the utility of different biochemical markers suitable for diagnosing mineral deficiencies in citrus as a viable alternative to other popular methods of diagnosis like soil or leaf analysis.

Accordingly, in the Section VI on *Molecular Plant Physiology and Metabolism*, three important and extensively written comprehensible reviews have been considered as *Chapters 17, 18 and 19*. The multiple isoforms of lipoxygenases can be distinguished by differences in their properties, kinetic parameters, reaction pH, substrate and product specificity, tissue-specific or subcellular localization, and

synthesis at the particular developmental stages, therefore, in *Chapter 17*; an overview on localization of lipoxygenases in higher plants has been overviewed by two illustrious Polish workers. Subsequently, in *Chapter 18*, genetic regulation of signal transduction pathways in *rhizobium*-legume symbiosis has been amply reviewed by well-known committed Indian workers. Finally, the review by a scientist from the Banaras Hindu University in *Chapter 19* accentuates the attempts for optimization of the enzyme assay of plant extracts, and the various steps to achieve it. It also gives a brief account of methods to check for complete recovery of enzymes during extraction. Ultimately, the importance of assay of maximum catalytic activity in the regulation of plant metabolism is briefly discussed with the centre of attention on its implications in the study on metabolic control analysis. Soon after this, only one chapter has been devoted for the Section VII on *Plant Organic Acids* that comprises valuable pieces of information by five outstanding French scientists on the content and different forms of chlorogenic acids in the green (unroasted) beans of cultivated coffee species in *Chapter 20*. That receives particular attention as these components are considered as precursors of the flavour and aroma of the coffee beverage. The aim of this review is to better understand the diversity of the chlorogenic acids in the *Coffea* genus through a brief overview of coffee plant diversity, a description of the nature of "chlorogenic acids", and a review of most of the available data on the diversity of chlorogenic acids in beans of wild coffee species.

In addition, the excerpts of intensive research of modern times turning to the bay for sustainability of agriculture have been given due attention in the Section VIII on *Plant Physiology in Sustainability of Agriculture* where two reviews by devoted Indian workers compile relevant information in this regard. In *Chapter 21*, scientists from the Banaras Hindu University, India highlight that mycorrhizal technology in sustainable development of stressed ecosystem is one of the important areas need greater awareness in the present scenario. This review aims to present some of the crucial roles of mycorrhizal fungi under different ecosystems as well as their interactions with soil microbes and biotic stresses in different segments. This review is followed by an exclusive research paper as *Chapter 22*, which reveals the efficacy of GA₃ applied as seed-soaking or foliar spray on utilisation of sulphur and productivity of mustard. These techniques can invariably cut short much use of inorganic fertilizers by using appropriate modes of their application along with judicious and meticulous use in field and can help improving the soil health that appears to be alarming in a pretty large cultivable land area.

In this committed undertaking, I am elated to state my genuine appreciation to all distinguished and talented *Members of the Advisory Committee*, for bringing up this unrivaled, realistic, thoughtful and far-reaching treatise up to the international standard. In addition, I am extremely grateful to the *Fellow Members of the Indian Society for Plant Physiology, New Delhi* for their trustworthy moral support and esteemed suggestions from time to time. My admiration is very much due to the *Hon'ble Vice-Chancellor* Prof. Panjab Singh, Banaras Hindu University, the Director, Institute of Agricultural Sciences Prof. Shiv Raj Singh, the Dean, Faculty of Agriculture Prof. Ram Pratap Singh, and my admired colleagues of the Banaras Hindu University and other universities and institutes of the world for their consistent moral support in this enormous task.

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