PREFACE

A large shift in the activities and dynamics of the field of plant nitrogen metabolism has occurred since the beginning of the millennium. In terms of research in this field, the pre-genomic era was largely characterized by extensive developments in molecular physiology and the identification of transporters and signal transduction cascades, work that was greatly aided by the intensive effort worldwide to sequence different plant genomes. However, after the millennium, we entered the post-genomic era that has concentrated greater effort on elucidating the information concealed within the genome. In the past 10 years, we have witnessed the widespread application of '-omics' (including phenomics, transcriptomics, proteomics and metabolomics) technologies, together with computational biology and bioinformatics in an intensive interdisciplinary cooperation to explore all the facets of nitrogen metabolism from the single cell to whole plant biology and its interactions with the environment. The post-genomic era has facilitated intensive study at these multiple levels of complexity, including a much greater appreciation and understanding of how genome structure supports genome function, but with a deflationary picture of the gene as a structural unit. The recent rise in our understanding of the importance of epigenetic mechanisms of regulation has posed a significant challenge to conventional assumptions about the relationships between genome structure and function, and between genotype and phenotype. An appreciation of recent developments in the field of nitrogen assimilation metabolism is essential for anyone with interests in plant biology, the environment and the needs of agriculture.

The goal of much of the present-day research into plant nitrogen metabolism is to develop and apply new experimental technologies and to provide computer-based methods for coping with and interpreting the vast amounts of -omic data that are being produced and understanding the basic patterns that are being uncovered. The field of plant nitrogen metabolism and improving plant nitrogen use efficiency remains one of the grand challenges of our times. The field continues to require a large basic research aspect, since we are still not close to understanding the interplay of biological systems even at the cellular level. At the same time, the field is faced with a strong demand for immediate solutions, because improving plant nitrogen use efficiency is crucial to future agricultural sustainability and the future economic success of agriculture. The 13 chapters that comprise this volume bring together the expertise and enthusiasm of an international panel of leading researchers to provide a state-of-the-art overview of the field. Topics covered include nitrogen sensing and signalling, uptake and membrane systems, nitric oxide,

primary nitrogen assimilation and C–N balance, and interactions, regulation of root and plant architecture and much more. Together, these chapters provide an up-to-date insight into key issues related to these processes, describing the very latest developments in our understanding of how plants coordinate carbon, nitrate and ammonium assimilation into the organic compounds required for growth on an organ, plant and global scale. The transcription factors that act to integrate environmental nutrient (nitrogen) signals to coordinate primary and secondary metabolism are discussed together with new concepts of cross-talk, transport and signalling, and how such molecular networks influence nitrogen and carbon cycling processes in the environment. The different lines of research and the processes described in these chapters interact in many ways and illustrate how we are starting to disentangle these multiple interactions. These chapters demonstrate the intricacies of this rapidly evolving subject where state-of-the-art post-genomic era technologies are being applied to maximum benefit. We hope that these chapters provide useful, interesting and thought-provoking insights that will prompt further experimentation and breakthroughs in this exciting and expanding field.

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