Preface

The field of plant anatomy is one of the oldest life science disciplines. Starting its journey from the inquiries of Greek philosophers, this branch of science has provided a strong support to plant taxonomy, physiology and more recently plant developmental biology and molecular biology. Not very surprisingly, anatomy of crop plants has attracted less attention to botanists and taxonomists, since the major food crops belong to only few taxonomic families. In certain model crops such as rice and maize, the progress in developmental biology can largely be credited to the field of anatomy. However, relating structural anatomy with crop adaptation and productivity has received comparatively less attention from either agriculturists or botanists and few books give proper importance to this field of agricultural science. However, while searching literature, one can find overwhelming support provided by anatomical investigations towards drawing meaningful conclusions from research experiments on crop plants, particularly in the area of physiology and adaptation. Still, the significance of anatomical variation in explaining the adaptation of crop plants towards different abiotic stresses needs to be further investigated. In comparison to many other modern techniques, which target cellular or nucleic acid variation, anatomy provides low cost phenotypic screening options at organ, tissue or cellular level, further helping emerging fields of life sciences such as transcriptomics and system biology as well as providing rapid and reliable phenotypic screening procedures for selection of better performing genotypes.

Increasing crop productivity is the most immediate concern of mankind in today's world. Crop anatomy is intrinsically linked with better genetic potential for productivity of all crops, be it a derivative of primary or secondary metabolic pathway. To a large extent, anatomical structures determine the synthesis of food by crop plants, absorption of mineral nutrients for maintaining the process and channelling of reserve metabolite in certain organs, which are harvested by humans as economic product. Crop plants have thus been selected and manipulated during the course of evolution and selection for storing higher reserve elements. The clue to further improving productivity thus lies in the process of improvement of these physiological processes, which obviously need modifications of structural anatomy at cellular, tissue, organ or whole plant level. Thus in future crop science, anatomy is certain to play a pivotal role in helping crop improvement approaches, both at phenotype and genotype level.

In presenting this book the authors hope to fill a need for a textbook in crop plant anatomy with an applied approach towards crop adaptation and productivity. Not only, however, in our opinion, is there a need for a book for class study and guidance, but also for one which shall serve as a reference text for workers in fields of agricultural science, applied botany, and for teachers and students in other fields of crop ecology and botany.

This book first discusses the significance of anatomy in modern plant science followed by an outline of the basic anatomical structures of angiosperms to give readers a basic idea about plant anatomy. In the second section, structural anatomy of major crop plants has been discussed in detail with an objective to delineate the significance of variations in the anatomical features under different environments. These are followed by two sections, one emphasizing the role of anatomy in adaptation of crop plants and the other on signifying impact of the variations in structural anatomy on crop productivity, both of which are very important for increasing agricultural productivity. Throughout the book we also show how simple, low-cost light microscopy of hand sections can be used for rapid identification of anatomical features and be used for selection of genotypes under different environments, along with citing examples from research publications for further justification. Almost all the anatomical figures presented in the book have been prepared from live samples by the authors using simple light microscopy and low cost digital cameras, which is expected to encourage students and new researchers in the field of agricultural science to explore the tremendous possibility of utilizing anatomical techniques in their research fields. Training on anatomy is mainly undertaken only by laboratory practice. On such practice the authors believe emphasis must be given not only on lectures and text study, but also on extensive practical training. For laboratory teaching the present book should provide a background of facts, terms and history; it may, indeed, be used, in part, as a laboratory guide. The sequence of subjects adopted mainly on the long experience of the first author is giving emphasis of possible application of anatomical traits for adaptation of the particular crop to biotic and abiotic stress factors.

In the treatment of subject matter, emphasis has been placed on adaptability to classroom use from the standpoint of the student beginning anatomical study. Thus the book is, first of all, a textbook in the elements of crop plant anatomy and their significance, providing an introduction to the field. It presupposes an acquaintance only with the fundamental structure and activities of plants, an acquaintance such as is ordinarily obtained from a first course in botany. However, we also understand that while dealing with crop anatomy, which has vast and numerous research applications in the field of plant and crop science, some areas may be neglected, which may not be on purpose. We welcome any suggestions or critical input for further improvement of this book.

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