
Preface

Image analysis is a useful tool for obtaining quantitative information for target objects. The application of imaging techniques to plant and agricultural sciences has previously been confined to images obtained through remote sensing techniques. Technological advancement in the development of powerful hardware, picture capturing tools, and robust algorithms in a cost-effective manner paves the path of image analysis toward nondestructive and objective evaluation of biological objects, and opens up a new window to look into the field of plant science. The complex, dynamic nature of plant responses to unexpected changes in the environment compelled scientists to contemplate the application of image analysis in high-throughput phenotyping for different purposes. Various types of imaging techniques, such as red, green, and blue (RGB) imaging, hyperspectral imaging, fluorescence imaging, and thermal imaging, have contributed significantly to different aspects of crop performance and improvement.

Predicting crop performance as a function of genome architecture is one of the major challenges for crop improvement in the twenty-first century to ensure agricultural production that will satisfy the needs of a human population likely to exceed 9 billion by 2050. Compared to the advancements made in the "next generation" genotyping tools, plant phenotyping technology has progressed slowly over the past 25 years. Constraints in plant phenotyping capability limit our approaches to dissect complex traits such as stress tolerance and yield potential. In recent years, phenomics facilities are popping up with the development of new methodological applications of nonconventional optical imaging coupled with computer vision algorithms and widening the set of tools available for automated plant phenotyping.

The present book provides a comprehensive treatise of recent developments in image analysis of higher plants. The book introduces readers to the fundamentals of images and image analysis and then features various types of image analysis techniques covering a diverse domain of plant sciences. It covers imaging techniques that include RGB imaging, hyperspectral imaging at the small canopy level, thermal imaging,

photochemical reflectance index (PRI) imaging, chlorophyll fluorescence imaging, reactive oxygen species (ROS) imaging, and chromosome imaging. The book includes 16 chapters presenting a wide spectrum of applications of image analysis that are relevant to assessment of plant growth, nutrient status, and photosynthetic efficiency both in vivo and in vitro, early detection of diseases and stress, cellular detection of reactive oxygen species, plant chromosome analysis, fruit crop yield, and plant phenotyping. The chapters are written by international experts who are pioneers and have made significant contributions to this fascinating field.

The book is designed for graduate students, research workers, and teachers in the fields of cell and developmental biology, stress physiology, precision agriculture, and agricultural biotechnology, as well as professionals involved in areas that utilize machine vision in plant science.

We express our deep sense of gratitude to all the contributors for their kind support and cooperation in our humble approach to present the current status, state of the art, and future outlook of plant image analysis. Thanks are also due to Dr. Rina Dutta Gupta for her support and encouragement throughout the preparation of this volume. Finally, we thank CRC Press for giving us the opportunity to bring out this book.

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