Preface

In the present scenario of frequently changing environmental conditions, abiotic stress factors (salinity, water availability (less or excess water), temperature extremes (freezing, cold, or high), metal/metalloids, nutrient stress, etc.) have become unpredictable and severe menace to the global agricultural productivity. The abiotic stress factors basically restrict crop plants to reach their full genetic potential and cause significant loss to agricultural productivity worldwide. In general, the stress factors are complex and multigenic traits therefore affect the plant performance by significantly inhibiting the growth, development, and finally the produce. In response to the onset of adverse environmental conditions, plants have evolved efficient defense mechanisms by manipulating their tolerance potential through comprehensive defense mechanisms that help them to tolerate stresses through physical adaptation and/or by means of integrated molecular and cellular responses. Perception of stress signals and their transduction is a very crucial step for switching on adaptive responses to ensure the survival of plants. Therefore, understanding the mechanisms by which plants perceive and transduce the stress signals to initiate adaptive responses is essential for engineering stress-tolerant crop plants. Molecular and genomic studies have shown that several genes with various functions are induced by salinity, drought, and cold stresses and that various transcription factors are involved in the regulation of stress-inducible genes. Genetic engineering strategies rely on the transfer of one or several genes that are involved in signaling and regulatory pathways or that encode enzymes present in pathways leading to the synthesis of functional and structural protectants or that encode stress tolerance-conferring proteins.

In this book "Abiotic Stress Response in Plants," we present a collection of 18 chapters written by experts in the field of abiotic stress signaling and tolerance in plants. This book is an up-to-date overview of current progress in abiotic stress signaling in plants. The various chapters in the book provide a state-of-the-art account of the information available. Following an introduction on "abiotic stress signaling in plants," the book also discusses how the resulting increase in abiotic stress factors can be dealt with. The result is a must-have hands-on guide, ideally suited for agri-biotechnology, abiotic stress tolerance, academia, and researchers.

For the convenience of readers, the whole book is divided into four major parts:

Part I: *Abiotic Stresses – An Overview*
Part II: *Intracellular Signaling*
Part III: *Extracellular or Hormone-Based Signaling*
Part IV: *Translational Plant Physiology*

Part I: *Abiotic Stresses – An Overview* covers five chapters (Chapters 1–5). Chapter 1 deals with an introduction to abiotic stress signaling in plants, where emphasis has been placed on understanding the stress signaling and stress responses in plants. Chapter 2 focuses on plant response to genotoxic stress and discusses DNA damage sensing/signaling in relation to UV radiation and high temperature. Chapter 3 covers altered molecular dynamics in plants under changing environmental conditions. Chapter 4 comprehensively deals with crosstalk between salt, drought, and cold stress in plants, where emphasis is on developing strategies for engineering salt tolerance in crop plants. Chapter 5 sheds light on intellectual property management and rights.

Part II: *Intracellular Signaling* covers five chapters (Chapters 6–10). Chapter 6 discusses the role of cytoskeleton in abiotic stress responses in plants. This chapter deals with specific aspects of the latest advances in our understanding of the plant cytoskeleton and its relation with abiotic stress tolerance. Chapter 7 sheds light on molecular chaperones and their role in abiotic stress tolerance/managements in plants. Chapter 8 discusses the role and importance of glutathione in conferring abiotic stress tolerance in plants. Chapter 9 deals with the role of calcium-dependent protein kinases during abiotic stress tolerance. Chapter 10 also discusses the importance of lectin receptor-like kinases and their emerging role in abiotic stress tolerance.

Part III: *Extracellular or Hormone-Based Signaling* contains six chapters (Chapters 11–16). Chapter 11 covers the physiological and molecular perspectives of heavy metal–induced oxidative stress in plants, where the basic understanding of heavy metal stress and tolerance in plants has been discussed. Chapter 12 also deals with heavy metal tolerance in plants, pointing out the significance of metallothioneins and phytochelatins. Chapter 13 specifically covers the plant response to arsenic stress. Emphasis has been placed on exploring the role of selenium in overcoming arsenic-induced damages in plants. Chapter 14 discusses the physiology of Brassinosteroids and its significance in stress management in plants. Chapter 15 deals with biosynthesis, regulation, and role of abscisic acid in plant abiotic stress tolerance. Chapter 16 contains information on cross-stress tolerance in plants. This chapter tries to understand the molecular mechanisms and possible involvement of reactive oxygen species and methylglyoxal detoxification systems in stress tolerance.

Part IV: *Translational Plant Physiology* covers two chapters (Chapters 17 and 18). Chapter 17 focuses on the importance of molecular markers in crop improvement. Chapter 18 discusses the importance of polyamines in stress protection and management, where emphasis has been placed on developing tools that will facilitate the manipulation of polyamine levels in plants and can lead to practical applications in agriculture.

The editors and contributing authors hope that this book will provide a practical update on our knowledge of abiotic stress signaling in plants and will lead to new discussions and efforts to the use of various tools for crop improvement.

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