

# Preface

Plant development and productivity are negatively regulated by various environmental stresses. Abiotic stress factors such as heat, cold, drought, salinity, wounding, heavy metals toxicity, excess light, flooding, high speed wind, nutrient loss, anaerobic conditions and radiations etc. represent key elements limiting agricultural productivity worldwide. The loss of productivity is triggered by a series of morphological, physiological, biochemical and molecular stress-induced changes. Such an unfavourable situation is in contrast with the increasing global food demand. World population is increasing at an alarming rate and is expected to reach more than nine billion by the end of 2050, whereas, plant productivity is being seriously limited by various abiotic stresses all over the world. Global climatic pattern is becoming more unpredictable with increased occurrence of drought, flood, storm, heat waves, and sea water intrusion. It has been estimated that abiotic stresses are the principal cause for decreasing the average yield of major crops by more than 50 %, which causes losses worth hundreds of millions of dollars each year. Therefore, to feed the world population maintaining crop productivity even under unfavourable environment is a major area of concern for all nations. Developing crop plants with ability to tolerate abiotic stresses is need of the day which demands modern novel strategies for thorough understanding of plant's response to abiotic stresses. Molecular breeding and genetic engineering have significantly contributed to expand the basic knowledge of the cellular mechanisms involved in stress response, suggesting new strategies to enhance stress tolerance.

In this book "Crop Improvement Under Adverse Conditions", we present a collection of 17 chapters written by 55 experts in the field of plant abiotic stress tolerance and crop improvement. It is a timely contribution to a topic that is of eminent importance. The chapters provide a state-of-the-art account of the information available on abiotic stress tolerance and crop improvement. In this book, we present the approaches for crop improvement under adverse environmental conditions. Chapter 1 deals with the research, development, commercialization, and adoption of drought- and stress-tolerant crops, where the factors affecting adoption of stress-tolerant crops by farmers are explored which includes complementary technologies, competing technologies, appeal to first-time users, distribution and timing of benefits to users, and social perceptions of the technology. Chapter 2 uncovers the

impact of extreme events on salt-tolerant forest species of Andaman and Nicobar Islands. Chapter 3 deals with greenhouse gases emission from rice paddy ecosystem and their management. The plant development path of mitigating greenhouse gases (GHG) from agriculture cropping systems is not yet well established. Therefore aggressive research strategies and field validations are needed for establishing 'plant development' as a sustainable tool for GHG mitigation in agriculture sector. Chapter 4 covers remote sensing applications to infer yield of tea in a part of Sri Lanka. Chapter 5 deals with the polyamines contribution to the improvement of crop plants tolerance to abiotic stress, where, mechanism of action of polyamines to protect crop plants from challenging environmental conditions has been discussed. Chapter 6 discusses the overlapping horizons of salicylic acid in different stresses. In this chapter, the indigenous accumulation and overlapping roles of SA under different environmental and physiological conditions highlighting its recently updated roles and regulations in plants is discussed. Chapter 7 focuses on the effects of oxidative stress within the nuclear compartment where DNA becomes the main target of the highly toxic reactive oxygen species (ROS). Chapter 8 deals with a fast and reliable approach for crop improvement through in vitro haploid production. This chapter will act as a guide to prospective scientists working in the area of haploid production intended for crop improvement. Chapter 9 discusses the strategy for the production of abiotic stress-tolerant fertile transgenic plants using androgenesis and genetic transformation methods in cereal crops. Chapters 10 and 11 deal with the control and remedy of plant diseases through nanotechnology and the scope and potential of nanobiotechnology in crop improvement. The use of multifunctionalised nanoparticles as plant transgenic vehicle for developing disease and stress resistant transgenic plants is discussed. Nanotechnological approaches on plants allow more efficient and sustainable food production by reducing the chances of disease and pest incidence in plants. In Chap. 11, thorough studies and reliable information regarding the effects of nanomaterials on plant physiology and crop improvement at the organism level are discussed. Chapter 12 deals with the role of nematode trapping fungi for crop improvement under adverse conditions. Chapter 13 uncovers the role of sugars as antioxidants in plants. This chapter discussed that soluble vacuolar carbohydrates (e.g. fructans) may participate in vacuolar antioxidant processes, intimately linked to the well-known cytosolic antioxidant processes under stress. All these insights might contribute to the development of superior, stress-tolerant crops. Chapter 14 deals with chromium toxicity and tolerance in crop plants, where, the mechanism of phytotoxicity and phytotolerance under Cr stress is discussed. Chapter 15 deals with boron toxicity and tolerance in crop plants, where, attempts to improve crop yields under boron-toxic soils is discussed. Chapter 16 deals with the approaches for stress resistance and arsenic toxicity in crop plants. Chapter 17 uncovers the mechanism of cadmium toxicity and tolerance in crop plants.

The editors and contributing authors hope that this book will include a practical update on our knowledge of "Crop Improvement Under Adverse Conditions" and lead to new discussions and efforts to the use of various tools for the improvement of crop plants under changing environment.

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Narendra Tuteja  
Sarvajeet Singh Gill



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Tuteja, N.; Gill, S.S. (Eds.)

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