

# **ABIOTIC STRESS TOLERANCE IN CROP PLANTS**

**BIDHAN ROY - ASIT KUMAR BASU**



# Abiotic Stress Tolerance In Crop Plants Breeding And Biotechnology

**Vijay Rani Rajpal, Deepmala  
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## **Abiotic Stress Tolerance In Crop Plants Breeding And Biotechnology:**

*Abiotic Stress Tolerance in Crop Plants* Bidhan Roy, Asit Kumar Basu, 2009 Abiotic stresses have become an integral part of crop production. One or other persist either in soil water or in atmosphere. The information in the areas of injury and tolerant mechanisms, variability for tolerance breeding and biotechnology for improvement of crop plants against abiotic stresses are lying unorganized in different articles of journals and edited books. This information is presented in this book in organized way with up to date citations which will provide comprehensive literatures of recent advances. More emphasis has been given to elaborate the injury and tolerance mechanisms and development of improved genotypes against stress environments. This book also deals with the plants symptoms of particular abiotic stress, reclamation of soil and crop cropping pattern to overcome the effect of adverse conditions. Each has been laid out with systematic approaches to develop abiotic stress tolerant genotypes using biotechnological tools. Use of molecular markers in stress tolerance and development of transgenic also have been detailed. Air pollution and climate change are the hot topic of the days. Thus the effect of air pollution and climate change on crop plants have been detailed in the final three of this book. Under abiotic stress, plant produces a large quantity of free radicals, oxidants which have been elaborated in a separate *Oxidative Stress*. This book has been divided into seven major parts: physical stress, salt water stresses, drought and waterlogging, temperature stresses, heat and cold, metal toxicities, aluminium, iron, cadmium, lead, nickel, chromium, copper, zinc etc. and non metal toxicities, boron and arsenic, oxidative stress and finally atmospheric stresses, air pollution, radiation and climate change. Hope this book will be of greater use for the students and researchers particularly Plant Breeders and Biotechnologists as well as the Botanists to understand the injury and tolerance mechanisms and subsequently improvement of crop genotypes for abiotic stresses.

*Plant Breeding for Abiotic Stress Tolerance* Roberto Fritsche-Neto, Aluizio Borém, 2012-06-05 The rapid population growth and the increase in the per capita income especially in the group of emerging countries referred to as BRIC countries (Brazil, Russia, India, China and South Africa) has created huge pressure for the expansion of the agricultural growing area and the crop yields to meet the rising demand. As a result, many areas that have been considered marginal for growing crops due to their low fertility, drought, salinity and many other abiotic stresses have now been incorporated in the production system. Additionally, climate change has brought new challenges to agriculture to produce food, feed, fiber and biofuels. To cope with these new challenges, many plant breeding programs have reoriented their breeding scope to stress tolerance in the last years. The authors of this book have collected the most recent advances and discoveries applied to breeding for abiotic stresses in this book, starting with new physiological concepts and breeding methods and moving on to discuss modern molecular biological approaches geared to the development of improved cultivars tolerant to most sorts of abiotic stress. Written in an easy to understand style, this book is an excellent reference work for students, scientists and farmers interested in learning how to breed for abiotic stresses, scenarios presenting the state of the art in plant stresses and allowing the

reader to develop a greater understanding of the basic mechanisms of tolerance to abiotic stresses and how to breed for them

**Drought Stress Tolerance in Plants, Vol 2** Mohammad Anwar Hossain, Shabir Hussain Wani, Soumen Bhattacharjee, David J Burritt, Lam-Son Phan Tran, 2016-08-24 Drought is one of the most severe constraints to crop productivity worldwide and thus it has become a major concern for global food security Due to an increasing world population droughts could lead to serious food shortages by 2050 The situation may worsen due to predicated climatic changes that may increase the frequency duration and severity of droughts Hence there is an urgent need to improve our understanding of the complex mechanisms associated with drought tolerance and to develop modern crop varieties that are more resilient to drought Identification of the genes responsible for drought tolerance in plants will contribute to our understanding of the molecular mechanisms that could enable crop plants to respond to drought The discovery of novel drought related genes the analysis of their expression patterns in response to drought and determination of the functions these genes play in drought adaptation will provide a base to develop effective strategies to enhance the drought tolerance of crop plants Plant breeding efforts to increase crop yields in dry environments have been slow to date mainly due to our poor understanding of the molecular and genetic mechanisms involved in how plants respond to drought In addition when it comes to combining favourable alleles there are practical obstacles to developing superior high yielding genotypes fit for drought prone environments Drought Tolerance in Plants Vol 2 Molecular and Genetic Perspectives combines novel topical findings regarding the major molecular and genetic events associated with drought tolerance with contemporary crop improvement approaches This volume is unique as it makes available for its readers not only extensive reports of existing facts and data but also practical knowledge and overviews of state of the art technologies across the biological fields from plant breeding using classical and molecular genetic information to the modern omic technologies that are now being used in drought tolerance research to breed drought related traits into modern crop varieties This book is useful for teachers and researchers in the fields of plant breeding molecular biology and biotechnology

Genomics Assisted Breeding of Crops for Abiotic Stress Tolerance, Vol. II Vijay Rani Rajpal, Deepmala Sehgal, Avinash Kumar, S.N. Raina, 2019-07-01 The abiotic stresses like drought temperature cold salinity heavy metals etc affect a great deal on the yield performance of the agricultural crops To cope up with these challenges plant breeding programs world wide are focussing on the development of stress tolerant varieties in all crop species Significant genomic advances have been made for abiotic stress tolerance in various crop species in terms of availability of molecular markers QTL mapping genome wide association studies GWAS genomic selection GS strategies and transcriptome profiling The broad range of articles involving genomics and breeding approaches deepens our existing knowledge about complex traits The chapters are written by authorities in their respective fields This book provides comprehensive and consolidated account on the applications of the most recent findings and the progress made in genomics assisted breeding for tolerance to abiotic stresses in many important major crop species with a

focus on applications of modern strategies for sustainable agriculture The book is especially intended for students molecular breeders and scientists working on the genomics assisted genetic improvement of crop species for abiotic stress tolerance

*Abiotic Stress in Crop Plants* Mirza Hasanuzzaman, Kamrun Nahar, 2024-07-17 In the era of climate change the resilience of crop plants is vital for global food security *Abiotic Stress in Crop Plants Ecophysiological Responses and Molecular Approaches* addresses the challenges posed by stressors like extreme temperatures drought salinity and flooding This comprehensive volume features 13 chapters that explore ecophysiology and plant responses to environmental stress adaptation mechanisms strategies plants use to survive under adverse conditions and genetic and molecular bases of stress tolerance By integrating these areas the book offers a holistic view of plant responses to abiotic stress compiling recent advancements and cutting edge research It is an essential resource for scientists researchers and students dedicated to enhancing crop resilience and promoting sustainable agriculture

**Nanotechnology for Abiotic Stress Tolerance and Management in Crop Plants** Ramesh Namdeo Pudake, Ravi Mani Tripathi, Sarvajeet Singh Gill, 2024-03-13 *Nanotechnology for Abiotic Stress Tolerance and Management in Crop Plants* reviews the most recent literature on the role of nanomaterials in achieving sustainability in crop production in stressful environments This book explores the adverse conditions caused by abiotic stress to crop plants and the methods by which these conditions can be potentially overcome through developments in nanoscience and nanotechnology Abiotic stresses such as drought salinity temperature stress excessive water heavy metal stress UV stress etc are major factors which may adversely affect the growth development and yield of crops While recent research for ways of overcoming the physiological and biochemical changes brought on by these stresses has focused on genetic engineering of plants additional research continues into alternative strategies to develop stress tolerant crops including the use of nanoscience and nanotechnology Providing an in depth summary of research on nanomaterials and nano based devices for field monitoring of crops this book will serve as an ideal reference for academics professionals researchers and students working in the field of agriculture nanotechnology plant science material science and crop production Presents advancements in our understanding of molecular and physiological interactions between nanoparticles and crop plants Includes figures and illustrations to help readers visualize and easily understand the role of nanomaterials Serves as an ideal reference for those studying smart nanomaterials biosensors and nanodevices for real time plant stress measurement

**Priming-Mediated Stress and Cross-Stress Tolerance in Crop Plants** Mohammad Anwar Hossain, Fulai Liu, David Burritt, Masayuki Fujita, Bingru Huang, 2020-01-22 *Priming Mediated Stress and Cross Stress Tolerance in Crop Plants* provides the latest in depth understanding of the molecular mechanisms associated with the development of stress and cross stress tolerance in plants Plants growing under field conditions are constantly exposed either sequentially or simultaneously to many abiotic or biotic stress factors As a result many plants have developed unique strategies to respond to ever changing environmental conditions enabling them to monitor their surroundings and adjust their metabolic systems to maintain

homeostasis Recently priming mediated stress and cross stress tolerance i.e greater tolerance to a second stronger stress after exposure to a different milder primary stress have attracted considerable interest within the scientific community as potential means of stress management and for producing stress resistant crops to aid global food security Priming Mediated Stress and Cross Stress Tolerance in Crop Plants comprehensively reviews the physiological biochemical and molecular basis of cross tolerance phenomena allowing researchers to develop strategies to enhance crop productivity under stressful conditions and to utilize natural resources more efficiently The book is a valuable asset for plant and agricultural scientists in corporate or government environments as well as educators and advanced students looking to promote future research into plant stress tolerance Provides comprehensive information for developing multiple stress tolerant crop varieties Includes in depth physiological biochemical and molecular information associated with cross tolerance Includes contribution from world leading cross tolerance research group Presents color images and diagrams for effective communication of key concepts

Genetic Enhancement of Crops for Tolerance to Abiotic Stress: Mechanisms and Approaches, Vol. I Vijay Rani Rajpal, Deepmala Sehgal, Avinash Kumar, S.N. Raina, 2019-04-24 Abiotic stresses such as drought water deficit extreme temperatures cold frost and heat salinity sodicity and mineral metal and metalloids toxicity limit productivity of crop plants worldwide and are big threats to global food security With worsening climate change scenarios these stresses will further increase in intensity and frequency Improving tolerance to abiotic stresses therefore has become a major objective in crop breeding programs A lot of research has been conducted on the regulatory mechanisms signaling pathways governing these abiotic stresses and cross talk among them in various model and non model species Also various omics platforms have been utilized to unravel the candidate genes underpinning various abiotic stresses which have increased our understanding of the tolerance mechanisms at structural physiological transcriptional and molecular level Further a wealth of information has been generated on the role of chromatin assembly and its remodeling under stress and on the epigenetic dynamics via histone modifications The book consolidates outlooks perspectives and updates on the research conducted by scientists in the abovementioned areas The information covered in this book will therefore interest workers in all areas of plant sciences The results presented on multiple crops will be useful to scientists in building strategies to counter these stresses in plants In addition students who are beginners in the areas of abiotic stress tolerance will find this book handy to clear their concepts and to get an update on the research conducted in various crops at one place

Advances in Plant Breeding Strategies: Agronomic, Abiotic and Biotic Stress Traits Jameel M. Al-Khayri, Shri Mohan Jain, Dennis V. Johnson, 2016-03-29 The basic concept of this book is to examine the use of innovative methods augmenting traditional plant breeding towards the development of new crop varieties under different environmental conditions to achieve sustainable food production This book consists of two volumes Volume 1 subtitled Breeding Biotechnology and Molecular Tools and Volume 2 subtitled Agronomic Abiotic and Biotic Stress Traits This is volume 2 which contains 18 chapters highlighting breeding strategies for specific

plant traits including improved nutritional and pharmaceutical properties as well as enhanced tolerance to insects diseases drought salinity and temperature extremes expected under predicted global climate change **Improving Abiotic Stress Tolerance in Plants** M. Iqbal R. Khan, Amarjeet Singh, Péter Poór, 2020-05-13 Abiotic stresses such as drought flooding high or low temperatures metal toxicity and salinity can hamper plant growth and development **Improving Abiotic Stress Tolerance in Plants** explains the physiological and molecular mechanisms plants naturally exhibit to withstand abiotic stresses and outlines the potential approaches to enhance plant abiotic stress tolerance to extreme conditions Synthesising developments in plant stress biology the book offers strategies that can be used in breeding genomic molecular physiological and biotechnological approaches that hold the potential to develop resilient plants and improve crop productivity worldwide Features **Comprehensively** explains molecular and physiological mechanism of multiple abiotic stress tolerance in plants Discusses recent advancements in crop abiotic stress tolerance mechanism and highlights strategies to develop abiotic stress tolerant genotypes for sustainability Stimulates synthesis of information for plant stress biology for biotechnological applications Presents essential information for large scale breeding and agricultural biotechnological programs for crop improvement Written by a team of expert scientists this book benefits researchers in the field of plant stress biology and is essential reading for graduate students and researchers generating stress tolerant crops through genetic engineering and plant breeding It appeals to individuals developing sustainable agriculture through physiological and biotechnological applications **In vitro Plant Breeding towards Novel Agronomic Traits** Manoj Kumar, Annamalai Muthusamy, Vivek Kumar, Neera Bhalla-Sarin, 2019-11-23 This book presents a comprehensive overview of plant stresses caused by salt drought extreme temperatures oxygen and toxic compounds which are responsible for huge losses in crop yields It discusses the latest research on the impact of salinity and global environment changes and examines the advances in the identification and characterization of the mechanisms that allow plants to tolerate biotic and abiotic stresses Further it presents our current understanding of metabolic fluxes and the various transporters that collectively open the possibility of applying in vitro technology and genetic engineering to improve stress tolerance Exploring advanced methods that augment traditional plant tissue culture and breeding techniques toward the development of new crop varieties that can tolerate biotic and abiotic stresses to achieve sustainable food production this book is a valuable resource for plant scientists and researchers

**Molecular Plant Abiotic Stress** Aryadeep Roychoudhury, Durgesh Kumar Tripathi, 2019-06-13 A close examination of current research on abiotic stresses in various plant species The unpredictable environmental stress conditions associated with climate change are significant challenges to global food security crop productivity and agricultural sustainability Rapid population growth and diminishing resources necessitate the development of crops that can adapt to environmental extremities Although significant advancements have been made in developing plants through improved crop breeding practices and genetic manipulation further research is necessary to understand how genes and metabolites for stress

tolerance are modulated and how cross talk and regulators can be tuned to achieve stress tolerance

**Molecular Plant Abiotic Stress Biology and Biotechnology** is an extensive investigation of the various forms of abiotic stresses encountered in plants and susceptibility or tolerance mechanisms found in different plant species In depth examination of morphological anatomical biochemical molecular and gene expression levels enables plant scientists to identify the different pathways and signaling cascades involved in stress response This timely book Covers a wide range of abiotic stresses in multiple plant species Provides researchers and scientists with transgenic strategies to overcome stress tolerances in several plant species Compiles the most recent research and up to date data on stress tolerance Examines both selective breeding and genetic engineering approaches to improving plant stress tolerances Written and edited by prominent scientists and researchers from across the globe **Molecular Plant Abiotic Stress Biology and Biotechnology** is a valuable source of information for students academics scientists researchers and industry professionals in fields including agriculture botany molecular biology biochemistry and biotechnology and plant physiology

**From Gene Discovery to Climate-resilient Crops** Saurabh Pandey,Ashutosh Singh,Mithilesh Kumar Singh,2025-11-03 Climate change and population growth have led to a global need for improved crop plants that are resistant tolerant to climate induced stresses and provide greater yields This book comprehensively and coherently reviews the various aspects of omics research methods as they apply to crop plant improvement including genomics transcriptomics proteomics metabolomics epigenomics ionomics and interomics These multiple omics approaches to crop science have already played an important role in the rapid creation of improved crop plants particularly in rice wheat maize and millets and are set to provide greater advances in the future The book also describes the various bioinformatics techniques that are utilized as tools for the analysis of omics data Integrating systems biology with multi omics datasets that can enhance our understanding of molecular regulatory networks for crop improvement is also covered This book is essential reading for researchers and graduate students of plant breeding crop science molecular biology and agricultural science

**Genetic Engineering of Crop Plants for Abiotic Stress** ,2002 *Salinity and Water Stress* M. Ashraf,M. Ozturk,Habib-ur-Rehman Athar,2008-12-26 Salinity and water stress limit crop productivity worldwide and generate substantial economic losses each year yet innovative research on crop and natural resource management can reveal cost effective ways in which farmers can increase both their productivity and their income Presenting recent research findings on salt stress water stress and stress adapted plants this book offers insights into new strategies for increasing the efficiency of crops under stressful environments The strategies are based on conventional breeding and advanced molecular techniques used by plant physiologists and are discussed using specific case studies to illustrate their potential The book emphasizes the effects of environmental factors on specific stages of plant development and discusses the role of plant growth regulators nutrients osmoprotectants and antioxidants in counteracting their adverse affects Synthesising updated information on mechanisms of stress tolerance at cell tissue and whole plant level this book provides a useful reference text



for post graduate students and researchers involved in the fields of stress physiology and plant physiology in general with additional readership amongst researchers in horticulture agronomy crop science conservation environmental management and ecological restoration

**Water Stress and Crop Plants** Parvaiz Ahmad, 2016-06-08 Plants are subjected to a variety of abiotic stresses such as drought temperature salinity air pollution heavy metals UV radiations etc To survive under these harsh conditions plants are equipped with different resistance mechanisms which vary from species to species Due to the environmental fluctuations agricultural and horticultural crops are often exposed to different environmental stresses leading to decreased yield and problems in the growth and development of the crops Drought stress has been found to decrease the yield to an alarming rate of some important crops throughout the globe During last few decades lots of physiological and molecular works have been conducted under water stress in crop plants

**Water Stress and Crop Plants A Sustainable Approach** presents an up to date in depth coverage of drought and flooding stress in plants including the types causes and consequences on plant growth and development It discusses the physiobiochemical molecular and omic approaches and responses of crop plants towards water stress Topics include nutritional stress oxidative stress hormonal regulation transgenic approaches mitigation of water stress approaches to sustainability and modern tools and techniques to alleviate the water stress on crop yields This practical book offers pragmatic guidance for scientists and researchers in plant biology and agribusinesses and biotechnology companies dealing with agronomy and environment to mitigate the negative effects of stress and improve yield under stress The broad coverage also makes this a valuable guide enabling students to understand the physiological biochemical and molecular mechanisms of environmental stress in plants

**Plant Breeding for Biotic Stress Resistance** Roberto Fritsche-Neto, Aluizio Borém, 2012-10-02 Experience shows that biotic stresses occur with different levels of intensity in nearly all agricultural areas around the world The occurrence of insects weeds and diseases caused by fungi bacteria or viruses may not be relevant in a specific year but they usually harm yield in most years Global warming has shifted the paradigm of biotic stresses in most growing areas especially in the tropical countries sparking intense discussions in scientific forums This book was written with the idea of collecting in a single publication the most recent advances and discoveries concerning breeding for biotic stresses covering all major classes of biotic challenges to agriculture and food production Accordingly it presents the state of the art in plant stresses caused by all microorganisms weeds and insects and how to breed for them

**Complementing Plant Breeding for Abiotic Stress Tolerance** this book was written for scientists and students interested in learning how to breed for biotic stress scenarios allowing them to develop a greater understanding of the basic mechanisms of resistance to biotic stresses and develop resistant cultivars

**Plant Biotechnology and Agriculture** Arie Altman, Paul Michael Hasegawa, 2012 As the oldest and largest human intervention in nature the science of agriculture is one of the most intensely studied practices From manipulation of plant gene structure to the use of plants for bioenergy biotechnology interventions in plant and agricultural science have been rapidly developing

over the past ten years with immense forward leaps on an annual basis This book begins by laying the foundations for plant biotechnology by outlining the biological aspects including gene structure and expression and the basic procedures in plant biotechnology of genomics metabolomics transcriptomics and proteomics It then focuses on a discussion of the impacts of biotechnology on plant breeding technologies and germplasm sustainability The role of biotechnology in the improvement of agricultural traits production of industrial products and pharmaceuticals as well as biomaterials and biomass provide a historical perspective and a look to the future Sections addressing intellectual property rights and sociological and food safety issues round out the holistic discussion of this important topic Includes specific emphasis on the inter relationships between basic plant biotechnologies and applied agricultural applications and the way they contribute to each other Provides an updated review of the major plant biotechnology procedures and techniques their impact on novel agricultural development and crop plant improvement Takes a broad view of the topic with discussions of practices in many countries

**Managing Salt Tolerance in Plants** Shabir Hussain Wani, Mohammad Anwar Hossain, 2015-10-05 Salinity stress currently impacts more than 80 million hectares of land worldwide and more arable land is likely to be impacted in the future due to global climate changes Managing Salt Tolerance in Plants Molecular and Genomic Perspectives presents detailed molecular and genomic approaches for the development of crop plants tolerant to salinity

**Breeding for drought and nitrogen stress tolerance in maize: From theory to practice** M. Bänzinger, 2000 Introduction why breed for drought and low N tolerance Conceptual framework breeding Conventional approaches to improving the drought and low N tolerance of maize Conventional approaches challenged The challenge of breeding for drought and low N tolerance Maize under drought and low N stress Conceptual framework physiology Water and the maize plant Nitrogen and the maize plant Maize under drought and low N stress consequences for breeding Stress management Drought Low N stress Statistical designs and layout of experiments Increasing the number of replicates Improved statistical designs Field layout Border effects from alleys Secondary traits Why use secondary traits How do we decide on the value of secondary traits in a drought or low N breeding program Secondary traits that help to identify drought tolerance Secondary traits that help to identify low N tolerance Selection indices Combining information on secondary traits with grain yield Combining information from various experiments Breeding strategies Choice of germplasm Breeding schemes Biotechnology potential and constraints for improving drought and low N tolerance The role of the farmer in selection What is farmer participatory research and why is it important What is new about farmer participatory research Participatory methodologies

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