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Legumes in the Omic Era

 Springer

Legumes In The Omic Era

**Sanjeev Gupta, Nagasamy
Nadarajan, Debjyoti Sen Gupta**



Legumes In The Omic Era:

Legumes in the Omic Era Sanjeev Gupta, Nagasamy Nadarajan, Debjyoti Sen Gupta, 2013-11-19 Legumes in the Omic Era provides a timely review of recent advances in legume genomics research and application. In this post-genomic era, enormous amount of biological information is available which could be of huge potential use for crop improvement applications. This aspect of genomics-assisted plant breeding is focused throughout the book for all the important grain legume crops. Role of functional genomics and importance of bioinformatics tools in present-day genomics and molecular breeding research is also discussed in detail. Use of molecular tools for nutritional fortification of grain legume is briefly presented. A chapter also been contributed on fungal disease resistance to elucidate potential application of genomic tools in molecular breeding of grain legume species. The book contains fifteen chapters contributed by 50 scientists from different countries who are actively involved in analyzing and improving particular legume genome. This book will serve as reference resource to legumes researchers for use of genome information in improvement of major legume crops. Dr Sanjeev Gupta is Principal Scientist, Project Coordinator, All India Coordinated Research Project on Vigna Crops at Indian Institute of Pulses Research (IIPR), Kanpur. He has more than two decades of research experience in grain legume breeding and developed a number of high-yielding cultivars in grain legumes. He is authored numerous research papers published in peer-reviewed journals and edited several books in plant breeding aspects. He was the Organizing Secretary of the International Grain Legume Conference 2009 held in the Indian Institute of Pulses Research, Kanpur, India. He has travelled across the continents to present his research several times. He is recipient of several awards for his research and literary contributions. Dr Nagasamy Nadarajan is the Director of the Indian Institute of Pulses Research (IIPR), Kanpur. He has more than three decades of teaching and research experience and developed more than fifteen legume and cereal cultivars. He has to his credits more than 200 peer-reviewed research publications. He has guided several graduate students for Masters and Doctoral degrees in food legume breeding and genetics research. He has authored a book in biometrics which is one of the most popular books among the agriculture graduate students in India. He is the recipient of three international and six national awards and honours for his outstanding contributions. Mr Debjyoti Sen Gupta is the ICAR International Fellow and Ph.D. candidate at North Dakota State University (NDSU), Fargo, USA. Recently he visited Department of Crop and Soil Sciences, Washington State University, Pullman, USA for high-throughput genotyping work. Before joining at NDSU, he was serving as the Scientist in the Indian Institute of Pulses Research (IIPR). He has authored several research articles, review articles and book chapters in the peer-reviewed journals and books from reputed publishers like Springer, CABI etc. He is recipient of several fellowships like CSIR-JRF, New Delhi, ICAR-JRF, New Delhi throughout his graduate study programs. **Legumes Research** Jose C. Jimenez-Lopez, Alfonso Clemente, 2022-10-12 This book is a collection of updated studies related to current improvements in legume traits and their agricultural benefits. It discusses the physiological functions, genetics and genomics of legume crops. Chapters address such

topics as genetics and biological insights of seed traits in the context of climate change improving quality and yields of legume seeds new genetic resources from diverse germplasms and agricultural benefits of legumes in agroecosystems

Smart Plant Breeding for Field Crops in Post-genomics Era Devender Sharma, Saurabh Singh, Susheel K.

Sharma, Rajender Singh, 2023-04-28 This book emphasizes on cutting edge next generation smart plant breeding approaches for maximizing the use of genomic resources generated by high throughput genomics in the post genomic era Through this book the readers would learn about the recent development in the genomic approaches such as genotype by sequencing GBS for genomic analysis SNPs Single Nucleotide Polymorphism whole genome re sequencing WGRS and RNAseq for transcriptomic analysis DEGs Differentially Expressed Genes To maximize the genetic gains in the cereal food crops the book covers topics on transgenic breeding genome editing high throughput phenotyping reliable precision phenotyping and genomic information based analysis In the era of climate change and the ever increasing population food security and nutritional security are the primary concern of plant breeders growers and policymakers to address the UN's sustainable development goals Chapters of this book cohere around these goals and covers techniques such as QTL mapping association studies candidate gene identification omics RNAi through micro RNA miRNA small interfering RNA siRNA and artificial micro RNA amiRNA It also covers other genomic techniques like antisense technology genome editing CRISPR cas9 base editing and epigenomics that assist the crop improvement programmes to fulfil the UN's sustainable development goals It explores the influence of rapidly available sequencing data assisting in the next generation breeding programmes This volume is a productive resource for the students researchers scientists teachers public and private sector stakeholders involved in the genetic enhancement of cereal crops

Legumes under Environmental Stress Parvaiz Ahmad, 2015-02-16

Legumes under Environmental Stress Legumes under Environmental Stress Yield Improvement and Adaptations Leguminous crops have been found to contribute almost 27% of the world's primary crop production However due to environmental fluctuations legumes are often exposed to different environmental stresses leading to problems with growth and development and ultimately decreased yield This timely review explains the transcriptomics proteomics genomics metabolomics transgenomics functional genomics and phenomics of a wide range of different leguminous crops under biotic and abiotic stresses and their genetic and molecular responses Amongst others the text describes the effect of nutrient deficiency pesticides salt and temperature stress on legumes Importantly the book explores the physiobiochemical molecular and omics approaches that are used to overcome biotic and abiotic constraints in legumes It looks at the exogenous application of phytoprotectants the role of nutrients in the alleviation of abiotic stress and the microbial strategy for the improvement of legume production under hostile environments Key features demonstrates how to mitigate the negative effect of stress on leguminous crops and how to improve the yield under stress the most up to date research in the field written by an international team of active researchers and practitioners across academia industry and non profit organisations This volume

is a valuable and much needed resource for scientists professionals and researchers working in plant science breeding food security crop improvement and agriculture worldwide In universities it will educate postgraduate and graduate students in plant science and agriculture it will also benefit those in scientific institutions and in biotech and agribusiness companies who deal with agronomy and environment **Legumes Biofortification** Muhammad Azhar Nadeem, Faheem Shehzad Baloch, Sajid Fiaz, Muhammad Aasim, Ephrem Habyarimana, Osman Sönmez, Nusret Zencirci, 2023-11-08 Sustainable food production is vital to ensure food and nutritional security to growing human population Recently there has been a shift in agricultural production system crop production is not only considering yield as primary interest to produce higher number of calories for reducing hunger but also more nutrient rich food to reduce malnutrition or hidden hunger Micronutrient malnutrition is a continuing and serious public health problem in many countries various Interventions to alleviate this problem have been implemented Biofortification the process of breeding nutrients into food crops provides a comparatively cost effective sustainable and long term means of delivering more micronutrients Legumes have higher protein content than most plant foods approximately twice than cereals and are rich in the key micronutrients folate niacin thiamine calcium iron and zinc This book summarizes the biofortification of legumes Detailed information through contributed chapters shed light on legumes research relevant to human health with key topics that include genomic and genetic resources for food security conventional and modern breeding approaches for improving nutrition agronomic traits and biotechnological interventions

Fundamentals of Legume Breeding Girish Prasad Dixit, Harsh Kumar Dikshit, Gyan Prakash Mishra, Muraleedhar S. Aski, 2025-08-12 Many advances have been made in plant breeding during the last few decades which has added an altogether new dimension to legume breeding This book explains theoretical as well as latest advances in plant breeding practices tools and techniques including developments in genomics It describes crop origin reproduction biology genetic principles and other developments applicable in plant breeding It also covers descriptions of well established and novel plant breeding techniques and discussions on crop specific plant breeding objectives with emphasis on market oriented variety development The chapters describe focused breeding procedures for the major legumes as per their economic importance This book provides knowledge of modern breeding tools for developing climate resilient and micronutrient rich varieties of different pulse crops The chapters also describe both conventional and non conventional breeding approaches adopted by the plant breeders for each crop This book serves as a reference for the post graduate plant breeding students as well as plant breeders *Genomics-aided Breeding Strategies for Biotic Stress in Grain Legumes* Ashok Kumar Parihar, Abhishek Bohra, Amrit Lamichaney, R.K. Mishra, Rajeev K. Varshney, 2024-08-13 This contributed volume explores the latest breakthroughs in genetic and genomic resources for enhancing biotic stress responses in grain legumes including minor ones It covers the advances made to date including gene identification transcriptomics proteomics transgenics genome editing genomic selection epigenetic breeding and speed breeding related to different biotic stresses Authored by crop specific

experts the chapters in this book are essential resources for those directly involved in improving grain legume crops. Legumes play a vital role in ensuring food and nutritional security, enhancing soil quality and promoting environmental sustainability. Rich in protein, they are essential in preventing hunger and malnutrition while adding to dietary diversity. However, as these crops are commonly grown in marginal lands with poor inputs, they are highly susceptible to biotic stresses such as diseases and pests which can cause significant yield losses. This book consolidates all available knowledge about genetic and genomic aspects of biotic stress responses in various grain legumes. It is a must-have resource for all stakeholders involved in grain legume improvement. Whether you are a breeder, pathologist, biotechnologist, seed production specialist, market manager, graduate or post graduate student or any other industry professional, this book serves as an excellent guide to help you stay at the forefront of grain legume improvement.

Broadening the Genetic Base of Grain Legumes Mohar Singh, Ishwari Singh Bisht, Manoranjan Dutta, 2014-10-28 Grain legumes play a significant and diverse role in the farming systems and provide nutrition security to the largely vegetarian and relatively poorer people around the world. These are ideal crops for achieving three simultaneous developmental goals viz. reducing poverty, improving human health and nutrition, and enhancing ecosystem resilience. Globally, grain legumes are the second most important crop group next only to cereals, but a large proportion of area of it is under rainfed low input systems as compared to cereals, contributing to lower yields. The other important factor responsible for reduced yield in grain legumes is the narrow genetic base of the present-day pulse varieties. In order to break the yield barriers of these cultivars, new sources of genes/alleles need to be identified and suitably incorporated into the adapted background. The information on various aspects of grain legume improvement, although has been considerable in the recent past, these information are highly scattered and not available at one place. The present book consists of comprehensive and latest crop-wise information on important grain legumes of the world including their distribution, gene pool, systematics, status of genetic and genomic resources, production constraints, traits of importance, crop improvement methodologies, both conventional as well as contemporary, and future strategies to be adopted for comprehensive grain legume improvement in various agro-ecological target areas of the globe. The chapters have been contributed by eminent crop experts from across the world engaged in research in their respective crops for the past several years, thus providing a rare insight into the crop-specific constraints and prospects, drawing from their rich overall experience. The book therefore will be a useful source of information to the grain legume researchers, students, policy planners, and developmental experts alike.

Legume Crop Wild Relatives Uday Chand Jha, Harsh Nayyar, Kamal Dev Sharma, Eric J. Bishop, von Wettberg, Kadambot H. M. Siddique, 2024-11-04 Grain legume crops are an important component of global food and nutritional security and help in maintaining agro-ecological systems. They fix atmospheric nitrogen via the root-inhabiting rhizobacteria, thereby minimising the harmful effects caused by the excessive application of synthetic nitrogenous fertilizers in the soil environment. There has been less focus on legume crop wild relatives for harnessing their

potential traits and novel genes to incorporate them into the cultivated legumes for developing climate resilient grain legumes. In this edited book we will highlight the importance of various potential traits of crop wild relatives which are yet to be properly harnessed for designing future climate resilient grain legumes. We also update how advances in molecular genetics and genomics have enabled the underpinning of several candidate genes/genomic regions in various crop wild relatives harbouring adaptive traits that confer climate resilience in grain legumes. Readers will benefit from new information on various crop wild relatives in grain legumes and how these wild relatives could be explored for novel climate resilience genes for developing future climate resilient legume crops. They will gain an understanding of how genomic advances/genome sequence pan-genomes have uncovered the novel genomic regions attributed to climate resilience in various grain legumes. Finally, the critical role of these wild relatives in maintaining the lost genes due to the domestication process will be discussed. Comprehensive information on conventional breeding, advanced breeding and recent advances in genomics covering all the major crop wild relatives of legumes is not available in a single book. Thus, this book will provide readers with the latest updates on various information covering all aspects of wild species of legumes.

Advances in Legumes for Sustainable Intensification Ram Swaroop Meena, Sandeep Kumar, 2022-06-29. *Advances in Legume based Agroecosystem for Sustainable Intensification* explores current research and future strategies for ensuring capacity growth and socioeconomic improvement through the utilization of legume crop cultivation and production in the achievement of sustainability development goals (SDGs). Sections cover the role of legumes in addressing issues of food security, improving nitrogen in the environment, environmental sustainability, economically optimized systems, the importance and impact of nitrogen, organic production and biomass, potential legume production, biology, breeding, improvement, cropping systems and the use of legumes for eco-friendly weed management. This book is an important resource for scientists, researchers and advanced students interested in championing the effective utilization of legumes for agronomic and ecological benefit. Focuses on opportunities for agricultural impact and sustainability. Presents insights into both agricultural sustainability and eco-intensification. Includes the impact of legume production on societal impacts such as health and wealth management.

Sustainable Utilization and Conservation of Plant Genetic Diversity Jameel M Al-Khayri, Shri Mohan Jain, Suprasanna Penna, 2024-03-28. This book collates a wide spectrum of topics relevant to contemporary research achievement in sustainable utilization of plant genetic resources and conservation of plant genetic diversity within the framework of different crop systems. It introduces the status of crop genetic diversity and provides prospects for conservation of crop genetic diversity for sustainable agriculture. Plant genetic diversity is crucial for food security and agroecosystem maintenance, paving ways to achieve sustainable agriculture development. This necessitates consciously and judiciously the conservation of all existing plant genetic resources for sustainable use in a variety of applications for human welfare. The wild and traditional landraces have generated an increased interest as a repertoire of valuable traits for breeding and improvement of cultivated

germplasm Internationally concerted actions and policies toward for the conservation and management of plant genetic diversity are mounting from the organization levels to national policies as deemed appropriate for the sustainable development goals This needs an understanding of genetic diversity of different crops ecological drivers and the structural changes within genetic diversity due to climate change It is also equally important to evolve knowledge on what how and where to conserve the existing plant genetic resources for present and future use Assessment of the genetic diversity presents in a wild and traditional agro ecosystem is another step towards effective utilization In the past few years advanced breeding tools have been developed which have offered great promise for efficient modification of targeted traits This book consolidates current knowledge in the above core areas of plant genetic diversity and conservation It is an essential reference for professionals researchers policy makers and commercial entrepreneurs concerned with plant genetic diversity and breeding to achieve enhanced agricultural productivity and sustainability of food resources to ensure food security The book is also invaluable for graduate students involved in agriculture research

Disease and pest resistance in legume crops, 2023-04-10 *Biofortification of Grain and Vegetable Crops* Muhammad Tehseen Azhar, Muhammad Qadir Ahmad, Iqrar Ahmad Rana, Rana Muhammad Atif, 2023-11-28

Biofortification of Grain and Vegetable Crops Molecular and Breeding Approaches is a comprehensive overview of important food crops whose vitamin and mineral enhancement can contribute significantly to improved food and nutrition security Providing the latest information on crops including cereals oilseeds legumes and vegetables this book provides details of agronomic and molecular resources for enhanced mineral production Each chapter focuses on a specific food crop and the unique opportunities offered by each through breeding practices This will be a valuable resource for researchers academics and those in industry who are exploring biotechnological approaches as a powerful tool to combat malnutrition Presents the potential of a variety of food crops for increased bioavailability of micronutrients Enhances our understanding of agronomic and molecular mechanisms of biofortification Provides insights to mitigate hidden hunger

Accelerated Plant Breeding, Volume 3 Satbir Singh Gosal, Shabir Hussain Wani, 2020-09-09 Plant improvement has shifted its focus from yield quality and disease resistance to factors that will enhance commercial export such as early maturity shelf life and better processing quality Conventional plant breeding methods aiming at the improvement of a self pollinating crop such as wheat usually take 10 12 years to develop and release of the new variety During the past 10 years significant advances have been made and accelerated methods have been developed for precision breeding and early release of crop varieties This work summarizes concepts dealing with germplasm enhancement and development of improved varieties based on innovative methodologies that include doubled haploidy marker assisted selection marker assisted background selection genetic mapping genomic selection high throughput genotyping high throughput phenotyping mutation breeding reverse breeding transgenic breeding shuttle breeding speed breeding low cost high throughput field phenotyping etc It is an important reference with special focus on accelerated

development of improved crop varieties Faba Bean: Chemistry, Properties and Functionality Sneh Punia Bangar, Sanju Bala Dhull, 2022-11-18 Faba bean is a species of flowering plant in the Fabaceae family and the fourth most widely grown winter season legume after pea chickpea and lentil The nutritional profile of faba beans is excellent as they contain an adequate quantity of proteins carbohydrates vitamins minerals and various polyphenols Faba bean seeds are a rich source of carbohydrates and starch Because of higher amylose content than cereal starches legume starches provide distinctive properties such as high gelation temperature fast retro gradation high resistant starch and gel elasticity to food systems Faba bean has been a beneficial source of protein in food products worldwide for centuries and continues to be highly produced and consumed to this day Faba bean Chemistry Properties and Functionality studies the global status and production of faba bean food products plus their agronomy nutritional value and potential medicinal applications The agrarian conditions are studied in full as are postharvest practices The chemical makeup of faba bean is a major focus especially in relation to nutrient composition and quality Chapters in this text focus on anti nutritional attributes antioxidants and bioactive compounds plus the effects of processing storage and cooking on their nutritional value Starch and its modification structure properties and industrial applications are covered as is protein genetic improvement and functional product formulation The text also looks at the future perspectives of this valuable plant and food source To date no reference works have exclusively covered faba bean This book provides a much needed single source reference point for researchers looking to gain knowledge on this important plant and its use in high protein health beneficial food products

Fundamentals of Field Crop Breeding Devendra Kumar Yadava, Harsh Kumar Dikshit, Gyan Prakash Mishra, Shailesh Tripathi, 2022-05-05 This book is an advanced textbook and a reference book for the post graduate plant breeding students and the plant breeders It consolidates fundamental concepts and also the latest advances in plant breeding practices including development in crop genomics It contains crop wise explanation on origin reproduction genetics of yield contributing traits biotic and abiotic stresses nutritional improvement and crop specific plant breeding procedures and techniques The chapters are planned to describe crop focused breeding procedure for the major crop plants as per their economic importance The recent developments in breeding of field crops have been reported The recent progress made in mapping traits of economic importance has been critically reviewed for each crop The progress made in markers assisted selected in few crops has been summarized This book bridges the knowledge gap and bring to the researchers and students information on modern breeding tools for developing biotic and abiotic stress tolerant climate resilient and micronutrient rich varieties of field crops The chapters in book are contributed by experienced Plant Breeders **Biofortification of Staple Crops** Shiv Kumar, Harsh Kumar Dikshit, Gyan Prakash Mishra, Akanksha Singh, 2022-03-09 This edited book brings together comprehensive information on various aspects of the biofortification of staple crops It addresses the present status of food and nutritional security and highlights the importance of micronutrients in human health a historical account of

biofortification current approaches and challenges crop specific biofortification efforts and various breeding approaches including conventional and genomics enabled improvement It also explains the efficacy of biofortification bioavailability and future thrust It is an inclusive source of information on different aspects of micronutrients in crops of global importance Malnutrition is a serious global issue with millions of people being undernourished several suffering from micronutrient deficiencies and the adult population struggling with obesity Despite significant economic progress South Asia and Sub Saharan Africa are still home to an undernourished population Nutrition related health problems are related to hidden hunger and are widespread in the developing world Women and preschool children are more vulnerable Even though global food production has increased manifolds estimates indicate that over 60% of the world s population is deficient in essential micronutrients such as iron zinc iodine and selenium often causing health problems and developmental delays Linking agricultural production with human nutrition and health is crucial for ensuring nutrition security Much research has been carried out to assess genetic diversity related to micro nutrients in staple crops their bioavailability and the efficacy of biofortified germplasm Biofortified varieties developed in different crops through conventional breeding are being up scaled for reducing the micronutrient deficiencies in other countries This book is a ready reference for researchers academicians extension personnel policymakers students and value chain stakeholders engaged in agriculture nutrition and health sectors promoting nutrition sensitive diets

The Plant Family Fabaceae Mirza Hasanuzzaman, Susana Araújo, Sarvajeet Singh Gill, 2020-07-01 This book comprehensively introduces all aspects of the physiology stress responses and tolerance to abiotic stresses of the Fabaceae plants Different plant families have been providing food fodder fuel medicine and other basic needs for the human and animal since the ancient time Among the plant families Fabaceae have special importance for their agricultural importance and multifarious uses apart from the basic needs Interest in the response of Fabaceae plants toward abiotic stresses is growing considering the economic importance and the special adaptive mechanisms Recent advances and developments in molecular and biotechnological tools has contributed to ease and wider this mission This book provides up to date findings that will be of greater use for the students and researchers particularly Plant Physiologists Environmental Scientists Biotechnologists Botanists Food Scientists and Agronomists to get the information on the recent advances on this plant family in regard to physiology and stress tolerance

Genomic Designing for Biotic Stress Resistant Oilseed Crops Chittaranjan Kole, 2022-03-18 Biotic stresses cause yield loss of 31 42% in crops in addition to 6 20% during post harvest stage Understanding interaction of crop plants to the biotic stresses caused by insects bacteria fungi viruses and oomycetes etc is important to develop resistant crop varieties Knowledge on the advanced genetic and genomic crop improvement strategies including molecular breeding transgenics genomic assisted breeding and the recently emerging genome editing for developing resistant varieties in oilseed crops is imperative for addressing FPNEE food health nutrition energy and environment security Whole genome sequencing of these crops followed by genotyping by sequencing have

facilitated precise information about the genes conferring resistance useful for gene discovery allele mining and shuttle breeding which in turn opened up the scope for designing crop genomes with resistance to biotic stresses The eight chapters each dedicated to an oilseed crop in this volume elucidate on different types of biotic stress agents and their effects on and interaction with the crop plants enumerate on the available genetic diversity with regard to biotic stress resistance among available cultivars illuminate on the potential gene pools for utilization in interspecific gene transfer present brief on the classical genetics of stress resistance and traditional breeding for transferring them to their cultivated counterparts depict the success stories of genetic engineering for developing biotic stress resistant varieties discuss on molecular mapping of genes and QTLs underlying biotic stress resistance and their marker assisted introgression into elite varieties enunciate on different emerging genomics aided techniques including genomic selection allele mining gene discovery and gene pyramiding for developing resistant crop varieties with higher quantity and quality of yields and also elaborate some case studies on genome editing focusing on specific genes for generating disease and insect resistant crops

Crop Biofortification

Adnan Noor Shah,Sajid Fiaz,Muhammad Aslam,Javed Iqbal,Abdul Qayyum,2025-03-10 Develop more nutritious crops to aid in the fight against world hunger with this timely volume One in nine people worldwide suffer from hunger or food scarcity Massively increasing food production is one of the most urgent scientific projects in the modern world particularly as a changing climate places increasing pressure on the global food supply and on sustainable food production processes Biofortification is a process in which plant breeding improved agronomic practices and or modern biotechnology are employed to increase nutrient density of crops without sacrificing any of their desirable characteristics It s an essential tool in the global fight against hunger Crop Biofortification offers an up to the minute overview of this essential subject and its recent advances It covers all the latest methodologies and techniques deployed in biofortification as well as surveying plant responses to genetically induced biofortification and the effect of climate change on biofortified crops Designed to allow for the application of these techniques at the field level it s a significant contribution towards the search for a sustainable global food supply Crop Biofortification readers will also find Presentation of recent advances in omics particularly metabolomics which can decipher potential changes in plants caused by biofortification Detailed discussion of methods for increasing the nutritional content of edible plants to address specific nutritional deficiencies Contributions towards a road map for increasing global food production by 70% before the year 2050 Crop Biofortification is ideal for researchers policymakers and professionals interested in the potential biofortification of crop plants as well as graduate and advanced undergraduate students in agronomy plant physiology plant breeding and genetics agricultural biotechnology and related fields

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