

EDITORIAL

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Tomato molecular biology – special collection of papers for molecular horticulture

Graham B. Seymour^{1*} and Jocelyn K. C. Rose²

Tomato (*Solanum lycopersicum*) is the second most important vegetable crop globally, after potato, with about 100 million tons fresh fruit being grown on 3.7 million hectares (FAO 2021), and is of great importance in the human diet due to the large amount of fruit consumed. The fruit are eaten both fresh and, equally importantly, as a processed product in puree, soups and canned products. They provide an important dietary source of vitamins and minerals, such as K, Fe and Ca, and are known for the large number of health promoting secondary metabolites, including the carotenoid and flavonoid pigments that give the fruit a spectrum of yellow, red and orange colours.

Tomato commercial production and breeding is supported by a long history of research that has led to the identification of regions of the tomato genome that control a host of important traits including disease resistance, yield and fruit quality. The first tomato genome was sequenced a decade ago and the sequence is now in its fifth iteration with 100's of genome sequences from a wide spectrum of wild species crop relatives and cultivated varieties. The diploid nature of tomato, genomic resources and a wide range of single gene mutants make it an excellent model plant to study dicot crop species and especially those with fleshy fruits.

In this special collection, we bring together a range of papers to explore the latest developments and scientific insights in tomato molecular biology. This brief editorial summarises the key features of the papers

that collectively set the scientific discovery in the context of plant development and highlight relevance to horticulture.

Plant architecture is a critical determinant of crop productivity and influences, among other factors, the number of reproductive shoots. The hormonal control of plant architecture has been the subject of studies for well over 100 years, but recent advances in genomics have accelerated our understanding of its molecular basis. Tomato is an especially useful model to investigate the association between plant architectural features and their impact on crop performance. Side branching in tomato is undesirable and results in unwanted labour and management costs. Three main phytohormone classes are known to influence side branching: auxins, cytokinins (CKs) and strigolactones. Auxin inhibits the outgrowth of axillary buds and maintains apical dominance. CKs act antagonistically to auxin, suppressing apical dominance and allowing release of axillary buds from dormancy. Auxin modulates CK concentration by repressing its levels, while strigolactones affect bud inhibition by modulating auxin transport. In addition, there seems to be some interplay between CK and strigolactone levels, and the overall picture highly complex. In this special issue, Pino et al. (2022) report that tomato plants overexpressing the cytokinin-deactivating gene *CYTOKININ OXIDASE 2* (*CKX2*) showed excessive growth of axillary shoots, which is opposite to the phenotype expected of plants with reduced CK content. The authors suggest that CKs cause their paradoxical effects on branching by disturbing auxin status, and by altering the expression of genes associated with branching and CK homeostasis. The study highlights the intricacy of

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Molecular Biology Of Tomato

Arie Altman, Paul Michael Hasegawa



Molecular Biology Of Tomato:

Molecular Biology of the Tomato John I. Yoder, 1993-07-15 The ideal fresh market tomato Sunseeds the challenge of breeding processing tomatoes Specialised requirements for producing transgenic glasshouse tomatoes Development and application of a molecular linkage map in tomato Integration of the classical and molecular linkage maps of tomato chromosome Recombinant inbred populations for high resolution mapping in tomato Mapping quantitative genes involved in a trait assessed on an ordinal scale a case study with bacterial canker in *Lycopersicon peruvianum* Studies towards a genetic and molecular analysis of paramutation at the Sulfurea locus of *Lycopersicon esculentum* Mill Evaluation the prospects of transposon tagging in tomato by the use of endogenous genetic markers Transposon induced chromosomal rearrangements The role of HMGR reductase in tomato fruit development Plant hormone and photomorphogenic mutants of tomato Auxin perception and the regulation of tomato growth and development Self incompatibility in the solanaceae Molecular analysis of gene regulation and function during pollen development Tissue specific gene expression in tomato pistils Molecular mapping of flower development in tomato Genetic control of ethylene and carotenoid production in transgenic tomatoes Inhibition of ripening in transgenic tomato plants expressing ACC deaminase Regulation and function of the E8 fruit ripening gene from tomato Inhibition of fruit senescence Molecular biology of tomato yellow leaf curl virus TYLCV and potential ways to control disease International Conference, Molecular Biology of Tomato, Berkeley, 1996 Molecular Biology of Tomato, International Conference, 1996

The Molecular Biology and Biochemistry of Fruit Ripening Graham Seymour, Gregory A. Tucker, Mervin Poole, James Giovannoni, 2013-03-18 A comprehensive and mechanistic perspective on fruit ripening emphasizing commonalities and differences between fruit groups and ripening processes Fruits are an essential part of the human diet and contain important phytochemicals that provide protection against heart disease and cancers Fruit ripening is of importance for human health and for industry based strategies to harness natural variation or genetic modification for crop improvement This book covers recent advances in the field of plant genomics and how these discoveries can be exploited to understand evolutionary processes and the complex network of hormonal and genetic control of ripening The book explains the physiochemical and molecular changes in fruit that impact its quality and recent developments in understanding of the genetic molecular and biochemical basis for colour flavour and texture It is a valuable resource for plant and crop researchers and professionals agricultural engineers horticulturists and food scientists Summary Reviews the physiochemical and molecular changes in fruit which impact flavour texture and colour Covers recent advances in genomics on the genetic molecular and biochemical basis of fruit quality Integrates information on both hormonal and genetic control of ripening Relevant for basic researchers and applied scientists

Tomato Yellow Leaf Curl Virus Disease Henryk Czosnek, 2007-09-23 Ideally suited to horticulturalists and plant virologists this highly useful text offers a multidisciplinary view on one of the major diseases of tomato crops the tomato yellow leaf curl disease It deals with

epidemiological aspects of the disease as well as integrated pest management in the field Coverage discusses the efforts aimed at breeding tomato plants resistant to the virus by classical breeding by marker assisted breeding and by genetic engineering

Genetic Improvement of Tomato G. Kalloo, 2012-12-06 The esculent *Lycopersicon esculentum* long thought to be poisonous has become a major U S food crop and source of vitamins and minerals thanks largely to genetic modification and new production technology Rick 1978 Tomato *Lycopersicon esculentum* Mill is one of the most important solana ceous vegetable crops grown worldwide under outdoor and indoor conditions It has become an important commercial crop so far as the area production industrial values and its contribution to human nutrition is concerned During the past few decades tremendous developments have contributed to the knowledge and understanding of various areas of genetics breeding and biotechnology and voluminous literature has been generated The purpose of preparing this monograph is to give a comprehensive up to date treatment to the various aspects of genetic improvement of tomato The emphasis has been placed on cytology classical and molecular genetics reproductive biology germplasm resources hybrid seed production use of wild taxa selection breeding methods breeding for abiotic and biotic stresses processing and quality breeding improvement for mechanical harvesting and biotechnology tissue culture protoplast fusion and genetic transformation These topics are presented in 22 different chapters However a few aspects have been discussed in more than one chapter For example seed production is treated in chapters 1 4 and 8 molecular biology genetic engineering in chapters 3 and 22 and heterosis in chapters 8 and 16

Grapevine Viruses: Molecular Biology, Diagnostics and Management Baozhong Meng, Giovanni P. Martelli, Deborah A. Golino, Marc Fuchs, 2017-07-05 The domestication of grapes dates back five thousand years ago and has spread to nearly all continents In recent years grape acreage has increased dramatically in new regions including the United States of America Chile Asia China and India and Turkey A major limiting factor to the sustained production of premium grapes and wines is infections by viruses The advent of powerful molecular and metagenomics technologies such as molecular cloning and next generation sequencing allowed the discovery of new viruses from grapes To date grapevine is susceptible to 64 viruses that belong to highly diverse taxonomic groups The most damaging diseases include 1 infectious degeneration 2 leafroll disease complex and 3 rugose wood complex Recently two new disease syndromes have been recognized Syrah decline and red blotch Losses due to fanleaf degeneration are estimated at 1 billion annually in France alone Other diseases including leafroll rugose wood Syrah de cline and red blotch can result in total crop loss several years post infection This situation is further exacerbated by mixed infections with multiple viruses and other biotic as well as adverse abiotic environmental conditions such as drought and winter damage causing even greater destruction The book builds upon the last handbook written over twenty years ago on the part of diagnostics and extensively expands its scope by inclusion of molecular biology aspects of select viruses that are widespread and economically most important This includes most current information on the biology transmission genome replication transcription subcellular localization as well as

virus host interactions It also touches on several novel areas of scientific inquiry It also contains suggested directions for future research in the field of grapevine virology Sustainable Management of Arthropod Pests of Tomato Waqas Wakil, Gerald E Brust, Thomas Perring, 2017-11-19 Sustainable Management of Arthropod Pests of Tomato provides insight into the proper and appropriate application of pesticides and the integration of alternative pest management methods The basis of good crop management decisions is a better understanding of the crop ecosystem including the pests their natural enemies and the crop itself This book provides a global overview of the biology and management of key arthropod pests of tomatoes including arthropod vectored diseases It includes information that places tomatoes in terms of global food production and food security with each pest chapter including the predators and parasitoids that have specifically been found to have the greatest impact on reducing that particular pest In depth coverage of the development of resistance in tomato plants and the biotic and abiotic elicitors of resistance and detailed information about the sustainable management of tomato pests is also presented Provides basic biological and management information for arthropod pests of tomato from a global perspective encompassing all production types field protected organic Includes chapters on integrated management of tomato pests and specific aspects of tomato pest management including within protected structures and in organic production Presents management systems that have been tested in the real world by the authors of each chapter Fully illustrated throughout with line drawings and color plates that illustrate key pest and beneficial arthropods associated with tomato production around the world *Genetics, Genomics, and Breeding of Tomato* Barbara E. Liedl, Joanne A. Labate, John R. Stommel, Ann Slade, Chittaranjan Kole, 2013-01-17 This volume covers the advances in the study of tomato diversity and taxonomy It examines the mapping of simple and complex traits classical genetics and breeding association studies molecular breeding positional cloning and structural and comparative genomics The contributors also discuss transcriptomics proteomics metabolomics and bioinformatics The information in this book will be useful to researchers working on other Solanaceous crops as well as those interested in using the tomato as a model crop species *Molecular Biology of the Biological Control of Pests and Diseases of Plants* Muthukumaran Gunasekaran, Darrell Jack Weber, 2020-01-29 While many books are available on biological control this is the only book to detail the application of molecular biology to control of pests and diseases Each chapter deals with a different pathogen and the application of new molecular biological techniques to the biocontrol of the pathogen This new reference presents the most comprehensive list of organisms available Internationally respected experts discuss viruses bacteria fungi nematodes protozoa weeds and insects Types of control methods are described and techniques commonly used in molecular biology to identify the etiological agents diagnose diseases and develop control methods are reviewed Achieving sustainable cultivation of tomatoes Dr A. K. Mattoo, Prof. A. K. Handa, 2017-03-31 Discusses developments in good agricultural practice from crop growth models to improved water and nutrition management Reviews advances in understanding plant physiology and genetic diversity as well as their contribution

to improvements in breeding Summarises recent research on diseases and pests as well as their control through developing disease resistant varieties or integrated weed management *Fruit Quality and Its Biological Basis* Michael Knee, 2002 Fruit technology draws on biology and engineering to maintain quality during storage distribution and marketing This book focuses on the biological processes that determine appearance texture taste nutritional value and flavor of fleshy fruits It also focuses on the ways by which these biological processes can be manipulated to maximize quality for the consumer It discusses the advances in the understanding of these procedures at the molecular level and the mode of action and limitations of current technology for postharvest handling of fruits A concluding chapter examines prospects for the genetic control of fruit development composition and quality

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

Plant Nutrition – Molecular Biology and Genetics G. Gissel-Nielsen, A. Jensen, 2013-06-29 The sixth International Symposium on Genetics and Molecular Biology of Plant Nutrition was held in Elsinore Denmark from August 17-21 1998 and organised by the RISO National Laboratory in the year of its 40 anniversary The 98 participants represented 23 countries and 80 scientific contributions with 43 oral and 37 poster presentations The symposium addressed the molecular mechanisms physiology and genetic regulation of plant nutrition The Symposium brought together scientists from a range of different disciplines to exchange information and ideas on the molecular biology of mineral nutrition of plants The symposium emphasised Bridging the gap between molecular biology applied genetics plant nutrition and plant breeding The development of methodologies to improve the efficiency and effectiveness of nutrition of plants Quality of plant products With sessions on Nitrogen Phosphorous Micronutrients Symbiosis Membranes Stress Heavy Metals and Plant Breeding In comparison with the previous conferences in this series

more emphasis was placed on use of molecular techniques to clarify physiological mechanisms and processes gene expression and regulation as well as genetic marker assisted analysis Significant of molecular genetic markers and other progress was reported in exploitation biotechnologies in breeding programmes *The Molecular Biology of Tomato Leaf Abscission* Neil Harris,1994 *Transgenic Plant Research* Alan R. Lindsey,2022-01-26 This text is split into four main sections gene transfer techniques transgenic approaches to gene isolation manipulation of plant development biochemistry and physiology and predictability of transgene expression *The Biology of Nematodes* Donald L Lee,2002-01-10 The Biology of Nematodes synthesizes knowledge of the biology of free living plant parasitic and animal parasitic nematodes Contributed works by recognized researchers apply groundbreaking molecular techniques many of which resulted from work on *Caenorhabditis elegans* toward new approaches to the study of nematode worms Topics covered include Systematics and phylogeny Neuromuscular physiology Locomotion Sense organs Behavior Aging The nematode genome Survival strategies Immunology Epidemiology Structure and organization Gametes and fertilization Development Feeding digestion and metabolism Plant Transcription Factors Vikas Srivastava,Sonal Mishra,Shakti Mehrotra,Santosh Kumar Upadhyay,2022-11-09 Plant Transcription Factors Contribution in Development Metabolism and Environmental Stress provides comprehensive coverage of plant TFs and their various functions evaluating their crucial role in growth and development signaling stress management and other key plant processes Sections cover the significance of plant TFs in functional genomics the influence of phyto hormones on the modulation of plant TFs plant development and metabolism including shoot development flowering development and alkaloid biosynthesis The book s final section reviews the role of TFs in various plant stresses including temperature water and heavy metal stress Written by leading experts around the globe this book is an essential read to researchers interested in plant signaling and plant genomics Presents the latest advances in plant transcription factors and their functions Discusses the influence of phyto hormones on the modulation of plant transcription factors Highlights the relationship between plant TFs and plant development **Annual Plant Reviews, Plant Cell Separation and Adhesion** Jeremy A. Roberts,Zinnia Gonzalez-Carranza,2008-04-15 Cell separation is an important process that occurs throughout the life cycle of a plant It enables the radicle to emerge from the germinating seed vascular tissue to differentiate sculpturing of leaves and flowers to take place pollen to be shed from the mature anther fruit to soften senescent and non functional organs to be lost and seeds to be shed In addition to its intrinsic scientific interest many of the developmental processes to which it contributes have importance for agriculture and horticulture This is the first volume to focus exclusively on these processes and to link improvements in our scientific understanding with methods that may allow us to manipulate cell separation and adhesion to the benefit of the agricultural and horticultural industries It will therefore be of interest to the experimental scientist and to those who wish to apply these techniques commercially Micropropagation, Genetic Engineering, and Molecular Biology of Populus ,1997 Thirty four Populus biotechnology

chapters written by 85 authors are comprised in 5 sections 1 in vitro culture micropropagation somatic embryogenesis protoplasts somaclonal variation and germplasm preservation 2 transformation and foreign gene expression 3 molecular biology molecular genetic characterization 4 biotic and abiotic resistance disease insect and pollution and 5 biotechnological applications wood properties flowering phytoremediation breeding commercialization economics and bioethics **Fruit and Vegetable Biotechnology** V Valpuesta, 2002-03 The genetic modification of foods is one of the most significant developments in food processing and one of the most controversial This important collection reviews its application to fruit and vegetables Part 1 looks at techniques and their applications in improving production and product quality Part 2 discusses how genetic modification has been applied to specific crops whilst Part 3 considers safety and consumer issues

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