

Protocol for Somatic Embryogenesis in Woody Plants

S. Mohan Jain and Pramod K. Gupta
editors



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Protocol for Somatic Embryogenesis in Woody Plants Shri Mohan Jain, Pramod K. Gupta, 2005-05-23 World population is increasing at an alarming rate and this has resulted in increasing tremendously the demand for tree products such as wood for construction materials fuel and paper fruits oils and medicines etc This has put immense pressure on the world's supplies of trees and raw material to industry and will continue to do so as long as human population continues to grow Also the quality of human diet especially nutritional components is adversely affected due to limited genetic improvement of most of fruit trees Thus there is an immediate need to increase productivity of trees Improvement has been made through conventional breeding methods however conventional breeding is very slow due to long life cycle of trees A basic strategy in tree improvement is to capture genetic gain through clonal propagation Clonal propagation via organogenesis is being used for the production of selected elite individual trees However the methods are labour intensive costly and produce low volumes Genetic gain can now be captured through somatic embryogenesis Formation of embryos from somatic cells by a process resembling zygotic embryogenesis is one of the most important features of plants In 1958 Reinert in Germany and Steward in USA independently reported somatic embryogenesis in carrot cultures Since then tremendous progress in somatic embryogenesis of woody and non woody plants has taken place It offers a potentially large scale propagation system for superior clones

Somatic Embryogenesis in Woody Plants S.M. Jain, P.K. Gupta, R.J. Newton, 2013-11-11 The quality of human life has been maintained and enhanced for generations by the use of trees and their products In recent years ever rising human population growth has put a tremendous pressure on trees and tree products growing awareness of the potential of previously unexploited tree resources and environmental pollution have both accelerated the development of new technologies for tree propagation breeding and improvement Biotechnology of trees may be the answer to solve the problems which can not be solved by conventional breeding methods The combination of biotechnology and conventional methods such as plant propagation and breeding may be a novel approach to improving and multiplying a large number of the trees and woody plants So far plant tissue culture technology has largely been exploited by commercial companies in propagation of ornamentals especially foliage house plants Gene rally tissue culture of woody plants has been recalcitrant However limited success has been achieved in tissue culture of angiosperm and gymnosperm woody plants A number of recent reports on somatic embryogenesis in woody plants such as Norway spruce *Picea abies* Loblolly pine *Pinus taeda* Sandalwood *Santalum album* Citrus mango *Mangifera indica* etc offer a ray of hope of a inexpensive clonal propagation for large scale production of plants or emblings or somatic seedlings b protoplast work c cryopreservation d genetic transformation and e synthetic or artificial or manufactured seed production

Step Wise Protocols for Somatic Embryogenesis of Important Woody Plants Shri Mohan Jain, Pramod Gupta, 2018-05-30 World population is increasing at an alarming rate and this has resulted in increasing tremendously the demand for tree products

such as wood for construction materials fuel and paper fruits oils and medicines etc This has put immense pressure on the world's supplies of trees and raw material to industry and will continue to do so as long as human population continues to grow Also the quality of human diet especially nutritional components is adversely affected due to limited genetic improvement of most of fruit trees Thus there is an immediate need to increase productivity of trees Improvement has been made through conventional breeding methods however conventional breeding is very slow due to long life cycle of trees A basic strategy in tree improvement is to capture genetic gain through clonal propagation Clonal propagation via organogenesis is being used for the production of selected elite individual trees However the methods are labour intensive costly and produce low volumes Genetic gain can now be captured through somatic embryogenesis Formation of embryos from somatic cells by a process resembling zygotic embryogenesis is one of the most important features of plants In 1958 Reinert in Germany and Steward in USA independently reported somatic embryogenesis in carrot cultures Since then tremendous progress in somatic embryogenesis of woody and non woody plants has taken place It offers a potentially large scale propagation system for superior clones

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Date Palm Biotechnology Shri Mohan Jain, Jameel M. Al-Khayri, Dennis V. Johnson, 2011-08-13 This important reference book is the first comprehensive resource worldwide that reflects research achievements in date palm biotechnology documenting research events during the last four decades current status and future outlook This book is essential for researchers policy makers and commercial entrepreneurs concerned with date palm The book is invaluable for date palm biotechnology students and specialists This monument is written by an international team of experienced researchers from both academia and industry It consists of five sections

covering all aspects of date palm biotechnology including A Micropropagation B Somaclonal Variation Mutation and Selection C Germplasm Biodiversity and Conservation D Genetics and Genetic Improvement and E Metabolites and Industrial Biotechnology The book brings together the principles and practices of contemporary date palm biotechnology Each chapter contains background knowledge related to the topic followed by a comprehensive literature review of research methodology and results including the authors own experience including illustrative tables and photographs

Plant Cell Culture Protocols Víctor Loyola-Vargas, Neftalí Ochoa-Alejo, 2024-07-10 This fifth edition provides new and updated protocols on plant cell tissue and organ cultures Chapters are divided into five parts that cover topics from general methodologies statistical analysis and contamination control highly specialized techniques and laborious process of measuring the epigenetics changes in tissue cultures Written in the highly successful Methods in Molecular Biology series format chapters include introductions to their respective topics lists of the necessary materials and reagents step by step readily reproducible laboratory protocols and key tips on troubleshooting and avoiding known pitfalls Authoritative and cutting edge Plant Cell Culture Protocols Fifth Edition aims to ensure successful results in the further study of this vital field

Protocols for Micropropagation of Woody Trees and Fruits S.Mohan Jain, H. Häggman, 2007-09-18 Micropropagation has become a reliable and routine approach for large scale rapid plant multiplication which is based on plant cell tissue and organ culture on well defined tissue culture media under aseptic conditions A lot of research efforts are being made to develop and refine micropropagation methods and culture media for large scale plant multiplication of several number of plant species However many forest and fruit tree species still remain recalcitrant to in vitro culture and require highly specific culture conditions for plant growth and development The recent challenges on plant cell cycle regulation and the presented potential molecular mechanisms of recalcitrance are providing excellent background for understanding on totipotency and what is more development of micropropagation protocols For large scale in vitro plant production the important attributes are the quality cost effectiveness maintenance of genetic fidelity and long term storage The need for appropriate in vitro plant regeneration methods for woody plants including both forest and fruit trees is still overwhelming in order to overcome problems facing micropropagation such as somaclonal variation recalcitrant rooting hyperhydricity polyphenols loss of material during hardening and quality of plant material Moreover micropropagation may be utilized in basic research in production of virus free planting material cryopreservation of endangered and elite woody species applications in tree breeding and reforestation

Somatic embryogenesis: 60 years of research applied to plant cloning to unravel plant totipotency, volume II Jorge M. Canhoto, Paloma Moncaleán, Sandra Isabel Correia, 2023-06-05

Embryogenesis Ken-Ichi Sato, 2012-04-20 The book Embryogenesis is a compilation of cutting edge views of current trends in modern developmental biology focusing on gametogenesis fertilization early and or late embryogenesis in animals plants and some other small organisms Each of 27 chapters contributed from the authorships of world wide 20 countries provides an introduction as well as an in depth review

to classical as well as contemporary problems that challenge to understand how living organisms are born grow and reproduce at the levels from molecule and cell to individual

Physiology of Growth and Development in Horticultural Plants N. R. Bhat, Arvind Bhatt, M. K. Suleiman, 2024-09-16 The development of a plant is a multifaceted dynamic phenomenon Due to their immobility plants respond not only to internal developmental cues but also to changes in the prevailing environmental conditions Climate change has increased vulnerability in plants due to increasing concentrations of CO₂ and other pollutants and fluctuations in the growing environment These changes affect crop growth and productivity thereby posing a major risk to global food security Physiology of Growth and Development in Horticultural Plants contains 22 chapters organized into six sections beginning with an introduction on basic concepts of plant growth and development followed by genetic basis of plant development quantification of growth and sensing and response of plants to various environmental signals It also explores plant growth hormones and their role either singly or in combination in controlling various aspects of plant growth and development and hormonal regulation of physiological and developmental processes The book highlights intricate aspects of growth and development in horticultural plants with classic examples from the real world Features Presents information on plant growth and development structure and genetic basis of plant development with quantification of growth sensing and response of plants to various environmental signals and various phytohormones and their role in controlling aspects of plant growth and development Provides key scientific and technical advances issues and challenges in various areas of growth and development of horticultural plants Demonstrates how the response of various plants to internal and external stimuli can be commercially exploited Physiology of Growth and Development in Horticultural Plants encourages the development of new techniques technologies and innovative practices and is an ideal reference for students of advanced plant sciences courses researchers and commercial horticultural practitioners

Plant Tissue Culture Zahid Hameed Siddiqui, Khalid Rehman Hakeem, 2025-09-23 Plants are sessile and constantly exposed to changing environmental conditions Seasonal cues govern plant growth development and reproduction In this era of climate change the environment is unstable and takes a toll on the productivity of plants This new book explores this unique area of plant tissue culture in relation to climate change showing how tissue culture techniques can be utilized to create tolerance to disease and stress increase growth and raise yield in plants This book discusses the use of plant tissue culture for producing superior material for planting and creating new elite varieties of different kinds of crops in response to changing climatic conditions It draws attention to the issues and dangers posed by climate change for plants and offers guidance for sustainable development utilizing tissue culture technology In addition it focuses on some fundamental ideas of plant tissue culture presents studies that address climate change and offers sustainable development alternatives The book looks at important topics such as the benefits of synthetic seed technology the impact of phytohormones and growth regulators on plant tissue culture the impact of supplementing culture medium with organic substances various plant tissue culture techniques and

more This book will prove beneficial for plant biotechnologists environmentalists ecologists and scientists in enhancing their understanding of the complexities of climate change under in vitro conditions

Plant Tissue Culture: Propagation, Conservation and Crop Improvement Mohammad Anis,Naseem Ahmad,2016-10-08 This book presents basic concepts methodologies and applications of biotechnology for the conservation and propagation of aromatic medicinal and other economic plants It caters to the needs and challenges of researchers in plant biology biotechnology the medical sciences pharmaceutical biotechnology and pharmacology areas by providing an accessible and cost effective practical approach to micro propagation and conservation strategies for plant species It also includes illustrations describing a complete documentation of the results and research into particular plant species conducted by the authors over the past 5 years Plant Biotechnology has been a subject of academic interest for a considerable time In recent years it has also become a useful tool in agriculture and medicine as well as a popular area of biological research Current economic growth is globally projected in a highly positive manner but the challenges many countries face with regard to food feed malnutrition infectious diseases the newly identified life style diseases and energy shortages all of which are worsened by an ever deteriorating environment continue to pull the growth digits back The common thread that connects all of the above challenges is biotechnology which could provide many answers Molecular biology and biotechnology have now become an integral part of tissue culture research The tremendous impact generated by genetic engineering and consequently of transgenics now allows us to manipulate plant genomes at will There has indeed been a rapid development in this area with major successes in both developed and developing countries The book introduces several new and exciting areas to researchers who are unfamiliar with plant biotechnology and also serves as a review of ongoing research and future directions for scholars The book highlights numerous methods for in vitro propagation and utilization of techniques in raising transgenics to help readers reproduce the experiments discussed

Plant Cell Culture Michael R. Davey,Paul Anthony,2010-05-20 The ability to culture cells is fundamental for mass propagation and as a baseline for the genetic manipulation of plant nuclei and organelles The introduction to *Plant Cell Culture Essential Methods* provides a general background to plant cell culture including basic principles technologies and laboratory practices that underpin the more detailed techniques described in subsequent chapters Whilst each chapter provides a background to the topic area and methodology a crucial aspect is the provision of detailed protocols with emphasis on trouble shooting describing common problems and detailed advice for their avoidance *Plant Cell Culture Essential Methods* provides the reader with a concise overview of these techniques including micropropagation mutagenesis cryopreservation genetic and plastid transformation and somatic cell technologies This book will be an essential addition to any plant science laboratory s bookshelf Highlights the best and most up to date techniques for working on plant cell culture Explains clearly and precisely how to carry out selected techniques in addition to background information on the various approaches Chapters are written by leading international authorities in the field and

cover both well known and new tried and tested methods for working in plant cell culture An essential laboratory manual for students and early career researchers

Tropical Plant Species and Technological Interventions for Improvement Muhammad Sarwar Khan,2023-01-25 This book provides a precise and meticulous overview of the production technologies involved in the cultivation of tropical plants Technological advances have transformed the cultivation of fruit and ornamental plants from agronomic to value added plants The book highlights the essentials for developing tropical plants with increased nutritive nutraceutical and aesthetic value

Genome Size and Genetic Homogeneity of Regenerated Plants: Methods and Applications A. Mujib,2023-09-13 This reference is a timely compilation of studies of genome size and genetic stability of regenerated plants It presents 13 book chapters that cover recent advancements in CRISPR Cas based genome editing the use of molecular markers to analyze somaclonal variation in tissue culture and genetic stability assessment in various plant species including medicinally valuable plants like Valeriana and Coffea The book also highlights the role of flow cytometry in investigating polyploidy and provides valuable insights into genetic fidelity assessment of micropropagated woody plants and orchids The contributors have shed light on the intra specific and inter specific genome and chromosome number variation with reference to gene duplication and DNA sequence loss Molecular techniques for detecting ploidy levels and genetic homogeneity in regenerated plantlets are also discussed Additional highlights of the book include brief guidelines for experimental protocols for flow cytometry and molecular markers coverage of a wide range of plants and supporting references This is an excellent reference for biologists geneticists and plant scientists exploring genetic homogeneity and genome size variation in diverse plant groups

Tree Biotechnology Kishan Gopal Ramawat,Jean-Michel Méridon,M. R. Ahuja,2014-04-01 Forest trees cover 30% of the earth s land surface providing renewable fuel wood timber shelter fruits leaves bark roots and are source of medicinal products in addition to benefits such as carbon sequestration water shed protection and habitat for 1 3 of terrestrial species However the genetic analysis and breeding of trees has lagged behind that of crop plants Therefore systematic conservation sustainable improvement and pragmatic utilization of trees are global priorities This book provides comprehensive and up to date information about tree characterization biological understanding and improvement through biotechnological and molecular tools

Synthetic Seeds Mohammad Faisal,Abdulrahman A. Alatar,2019-11-23 This book introduces the reader to synthetic or artificial seeds which refer to alginate encapsulated somatic embryos vegetative buds or any other micropropagules that can be used as seeds and converted into plantlets after propagating under in vitro or in vivo conditions Moreover synthetic seeds retain their potential for regeneration even after low temperature storage The production of synthetic or artificial seeds using micropropagules opens up new vistas in agricultural biotechnology Encapsulated propagules could be used for in vitro regeneration and mass multiplication at reasonable cost In addition these propagules may be used for germplasm preservation of elite plant species and the exchange of plant materials between national and international laboratories This book offers state of the art findings on methods

applications and prospects of synthetic or artificial seeds

Mutation Breeding in Coffee with Special Reference to

Leaf Rust Ivan L.W. Ingelbrecht, Maria do Céu Lavado da Silva, Joanna Jankowicz-Cieslak, 2023-09-30 This open access book provides a comprehensive overview of current methodologies for improving resistance to leaf rust in coffee one of the world's most important cash crops and beverages *Coffea arabica* L. Arabica accounts for about 60% of the world's coffee production. Coffee leaf rust (CLR) caused by the fungus *Hemileia vastatrix* is the major disease affecting Arabica coffee, resulting in losses of over 1 billion annually. The geographical distribution of CLR is expanding due to climate change. Moreover, the genetic improvement of Arabica coffee is constrained due to its very narrow genetic base. This protocol book introduces essential concepts of mutation breeding as an efficient tool to increase the genetic diversity of Arabica coffee and presents practical methods on mutation induction and screening for resistance to CLR. Current breeding approaches, challenges, and opportunities for Arabica coffee improvement are briefly reviewed, and a survey of common coffee diseases with emphasis on CLR is presented. Practical protocols for mutation induction and screening for resistance to CLR are described, including novel methods for single cell mutagenesis using in vitro cell and tissue culture techniques and for genome-wide screening of induced mutations using genomics tools. Each protocol chapter has an introduction and is supported by example results. Given the impact of recent CLR epidemics on Arabica coffee production in Latin America, the book is intended to serve as a timely reference and guide for students and researchers in the agricultural sciences, plant pathologists and breeders, as well as growers and end users interested in producing novel coffee genotypes for genetic studies, breeding, and commercial applications.

Zygotic and Non-Zygotic Embryogenesis: Evolutionary, Developmental and Practical Aspects

Jorge M. Canhoto, Paloma Moncaleán, Sandra Isabel Correia, Víctor M. Loyola-Vargas, Jonny E. Scherwinski-Pereira, 2023-03-28

Coconut Biotechnology: Towards the Sustainability of the 'Tree of Life' Steve Adkins, Mike Foale, Roland Bourdeix, Quang Nguyen, Julianne Biddle, 2020-06-24 Widely known as the tree of life, coconut (*Cocos nucifera* L.) provides a bountiful source for making a wide variety of healthy foods and industrial items. Its cultivation, however, has been encountering seriously destructive issues, including lethal diseases and natural adversities, which are currently distressing livelihoods of millions of small holder farmers around the world. There is an urgent mandate to resolve these issues by meeting sustainable seedling production, facilitating genetic conservation, as well as developing disease identification and modern breeding. This book introduces improvements in coconut biotechnology by covering the advances in micropropagation, germplasm conservation, and molecular pathogenic diagnosis. This comprehensive volume will be a useful source of information and references to researchers, graduate students, agricultural developers, and scholars in the plant sciences. In order to benefit general readers, the book also covers fundamental aspects of biology, diversity, and evolution of this marvelous palm species.

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