

# Protocol for Somatic Embryogenesis in Woody Plants

S. Mohan Jain and Pramod K. Gupta  
editors



# Protocol For Somatic Embryogenesis In Woody Plants

**Ken-Ichi Sato**



## **Protocol For Somatic Embryogenesis In Woody Plants:**

**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

**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

**Somatic Embryogenesis: Fundamental Aspects and Applications** Víctor M Loyola-Vargas, Neftalí Ochoa-Alejo, 2016-06-06 This book discusses basic and applied aspects of somatic embryogenesis one of the most powerful tools in plant biotechnology It is divided into three parts Part I includes topics such as the history of this research field how differentiated plant cells can re acquire totipotency molecular features as well as the epigenetics and proteomics of somatic embryogenesis Part II covers the somatic embryogenesis of different crops such as Agave spp maize Cocos nucifera Bixa orellana Capsicum spp Coffea spp Musa spp Pinus spp and Arabidopsis thaliana Various applications like scale up propagation and genetic engineering are discussed in detail in Part III The book will appeal to plant scientists plant breeders and experts working in industry

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.

Tree Biotechnology Kishan Gopal Ramawat, Jean-Michel Méryllon, 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 a 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.

**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

*Breeding and Biotechnology of Tea and its Wild Species* Tapan Kumar Mondal, 2014-02-10 Tea is an important non alcoholic beverage plant of the world Cultivation of tea is very important as it earns revenue for the tea growing nations especially the developing countries such as India Although conventional breeding is well established and has contributed significantly for varietal improvement of this plant and other Camellia species with ornamental value yet applications of biotechnology are required to intervene some of the issues where conventional breeding is restricted particularly for woody plants such as tea It is note worthy to mention that some amounts of biotechnology works in several facets of tea and its wild species have also been done In the present book a state of the art on various aspects of breeding and biotechnology has been complied in eight chapters They are i Origin and descriptions of health benefits as well as morphological classification as first chapter ii Breeding and cytogenetics that comprise with various conventional approaches of varietal improvement of tea along with their genetic resources iii Micropropagation which deals with in depth study of clonal propagation iv Somatic embryogenesis along with alternative techniques such as suspension culture cry preservation etc v Molecular breeding that deals with application of various DNA based markers linkage map etc vi Genetic transformation and associated factors vii Stress physiology complied with various works done in tea along with its wild relatives on abiotic as well as biotic stress and viii Functional genomics that describe the various works of molecular cloning and characterizations differential gene expression high throughput sequencing bioinformatics etc Importantly the author has made exclusive tables in most of the chapters that include the summary of the works in particular topic In a nutshell the book compiles the work already been done identifies the problems analyzes the gaps on breeding and biotechnological works of tea as well as its wild species and discusses the future scope as conclusion Every effort has been made to include all the published works till June 2013 The book will be a useful resource for post graduate doctoral as well post doctoral students working on tea as well as other woody plants This will also be useful for the scientists working in the areas of life sciences genomics biotechnology and molecular biology

*The Genus Citrus* Manuel Talon, Marco Caruso, Fred G. Gmitter jr., 2020-01-21 The Genus Citrus presents the enormous amount of new knowledge that has been generated in recent years on nearly all topics related to citrus Beginning with an overview of the fundamental principles and understanding of citrus biology and behavior the book provides a comprehensive view from Citrus evolution to current market importance Reporting on new insights supported by the elucidation of the citrus genome sequence it presents groundbreaking theories and fills in previous knowledge gaps Because citrus is among the most difficult plants to improve through traditional breeding citrus researchers institutions and industries must quickly learn to adapt to new developments knowledge and technologies to address the biological constraints of a unique fruit tree such as citrus Despite the challenges of working with citrus tremendous progress has been made mostly through advances in molecular biology and genomics This book is valuable for all

those involved with researching and advancing producing processing and delivering citrus products

**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 Plant Tissue Culture: New Techniques and Application in Horticultural Species of Tropical Region Duong Tan Nhut, Hoang Thanh Tung, Edward Chee-Tak YEUNG, 2022-04-05 This book presents latest work in the field of plant biotechnology regarding high efficiency micropropagation for commercial exploitation at low labor and equipment costs The book consists of 18 chapters on establishing advanced culture systems techniques as well as latest modification protocols on a variety of crops It also discusses new methods such as nylon film culture system light emitting diode and wireless light emitting diode system stem elongation wounding manipulation and shoot tip removal in vitro hydroponic and microponic culture system thin cell layer culture system etc Plant cell tissue has been developed more than fifty years ago Since then applications of in vitro plant propagation expanded rapidly all around the world and played as an important role in agricultural and horticultural systems This book will be of interest to teachers researchers scientists capacity builders and policymakers Also the book serves as additional reading material for undergraduate and graduate students of agriculture forestry ecology soil science and environmental sciences *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 CO<sub>2</sub> 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 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

Mechatronics Engineering, Computing and Information Technology X.D. Xu, Bin Li, Q.M. Lu, X.Y. Yan, J.L. Li, 2014-05-23 Selected peer reviewed papers from the 2014 International Conference on Mechatronics Engineering and Computing Technology ICMECT 2014 April 9 10 2014 Shanghai China

**Medicinal Spice and Condiment Crops** Azamal Husen, 2024-04-22 Spices are used in small quantities to add flavor aroma color and texture in food preparation However spices and condiments have also been recognized as having medicinal value They have been used traditionally as curative and preventive agents the bioactive compounds obtained from these plants are used in herbal drug formulations in modern times Medicinal Spice and Condiment Crops provides a comprehensive overview on the medicinal properties of spices and condiments with focus on various phytochemicals derived from them KEY FEATURES Examines spices and condiments with respect to their biology diversity distribution and pharmacological values Explores the scientific validations of the therapeutic potentials of spice and condiment plant species Discusses the bioactive agents involved in alleviating symptoms of cardiovascular disease cancer diabetes ulcers skin disorders and neurodegenerative diseases Explains specific medicinal features of spice and condiment producing plant species inspiring research discovery and safe herbal drug formulation A volume in the Exploring Medicinal Plants series this book is useful for plant scientists



economic botanists those who work with herbal and complementary medicine as well as people working in the pharmaceutical industry      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      *Agricultural, Forestry and Bioindustry Biotechnology and Biodiscovery* Pablo A. Chong, David J. Newman, Douglas A. Steinmacher, 2020-08-29 Food security crop protection biodiversity and human and environmental health are among the main needs and concerns of society Modern biotechnology and life sciences represent a constantly evolving area that is key for the rational use of natural resources resources that in turn are indispensable for societal development This book features the outcomes of the IV International Biotechnology and Biodiversity Congress held in Guayaquil Ecuador 2018 It includes extensive reviews of the trends in agricultural and forestry biotechnology molecules and materials biodiscovery ethnomedicine environmental impact and bioindustry research describing many of these topics from the Latin America perspective and showing how the biodiversity and ancient knowledge of these countries are vital for worldwide sustainable development      *Improvement Strategies of Leguminosae Biotechnology* Pawan K. Jaiwal, Rana P. Singh, 2013-03-09 Legumes include many very important crop plants that contribute critical protein to the diets of many around the world Many important forages and green manure crops are legumes Legumes are also large contributors to the vegetable oil and animal feed protein sectors One characteristic of legumes that could become even more important as world energy sources decline and nitrogen fertilizer prices increase is nitrogen fixation something few other plants can do Thus legumes have a unique and important niche in agriculture While some of the small seeded forage legumes have been relatively easy to work with in tissue culture as far as culture initiation plant regeneration and transformation are concerned most large seeded legumes like soybean have been recalcitrant Today however many laboratories are inserting genes into soybean and producing unique plants for both commercial and scientific uses These advancements have taken a large amount of research effort and still require time and labour

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