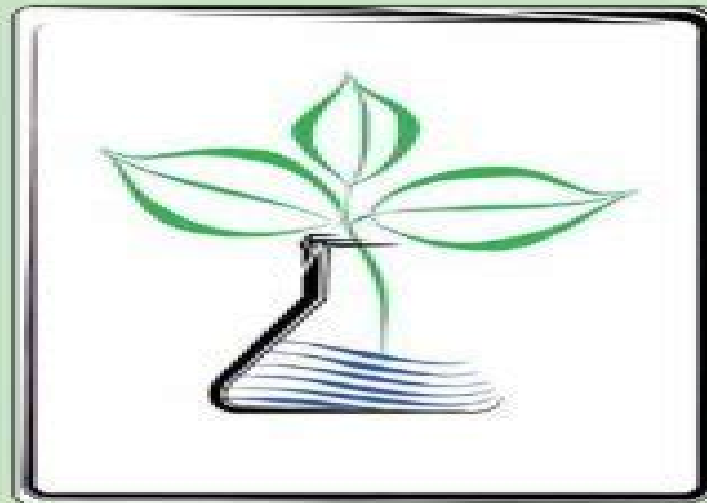


# Liquid Culture Systems for *in vitro* Plant Propagation

*Edited by*  
Anne Kathrine Hvoslef-Eide and Walter Preil



 Springer

# Liquid Culture Systems For In Vitro Plant Propagation

**Shri Mohan Jain, Pramod Gupta**



## **Liquid Culture Systems For In Vitro Plant Propagation:**

**Liquid Culture Systems for in vitro Plant Propagation** A.K. Hvorslev-Eide, W. Preil, 2005-06-15 High efficiency micropropagation with relatively low labour costs has been demonstrated in this unique book detailing liquid media systems for plant tissue culture. World authorities e.g. von Arnold, Curtis, Takayama, Ziv contribute seminal papers together with papers from researchers across Europe that are members of the EU COST Action 843. Advanced micropropagation systems. First hand practical applications are detailed for crops including ornamentals and trees using a wide range of techniques from thin film temporary immersion systems to more traditional aerated bioreactors with many types of explant shoots to somatic embryos. The accounts are realistic, balanced and provide a contemporary account of this important aspect of mass propagation. This book is essential reading for all those in commercial micropropagation labs as well as researchers worldwide who are keen to improve propagation techniques and lower economic costs of production. Undergraduate and postgraduate students in the applied plant sciences and horticulture will find the book an enlightened treatise.

**Disposable Bioreactors** Regine Eibl, Dieter Eibl, 2009-11-27 Over the past five years the immense financial pressure on the development and manufacturing of biopharmaceuticals has resulted in the increasing use and acceptance of disposables which are discarded after harvest and therefore intended only for single use. In fact such disposables are implemented in all the main bioprocess production stages today and an even higher growth than those in the biopharmaceutical market is predicted, reaching double figures. Alongside disposable filter capsules, membrane chromatography units, tubing connectors, flexible containers, processing or containing fluids, freezer systems, mixers and pumps and fully controlled disposable bioreactors of up to 2 000 L culture volume are already available on the market. Numerous studies highlight the advantages of disposable bioreactors and reveal their potential for simple, safe and fast seed inoculum production, process development and small as well as middle volume production e.g. bioactive substances, viruses for vaccines and gene therapies etc. They suggest that such disposable bioreactors, typically characterized by the cultivation chamber or bag from plastic materials, may be advantageous for plant, animal and microbial cells. Running industrial activities such as CFD modelling, development of single use process monitoring and control technology and standardized film formulations are attempting to resolve the limitations of the current disposable bioreactors. These achievements along with substantial improvements in product yield will reduce the use of stainless steel in the biomanufacturing facilities of the future.

**Plant Propagation by Tissue Culture** Edwin F. George, Michael A. Hall, Geert-Jan De Klerk, 2007-10-24 For researchers and students, George's books have become the standard works on in vitro plant propagation. For this the third edition of the classic work, authors with specialist knowledge have been brought on board to cover the hugely expanded number of topics in the subject area. Scientific knowledge has expanded rapidly since the second edition and it would now be a daunting task for a single author to cover all aspects adequately. However, this edition still maintains the integration that was characteristic of the previous editions. The first

volume of the new edition highlights the scientific background of in vitro propagation The second volume covers the practice of micropropagation and describes its various applications

**Nutraceuticals Production from Plant Cell Factory** Tarun Belwal, Milen I. Georgiev, Jameel M Al-Khayri, 2022-06-22 This book focuses on in vitro techniques and challenges of producing nutraceutical compounds from plant cells In addition it provides an overview of different biosynthesis pathways and their modulation through cell culture techniques for the production of nutraceutical compounds in high quantity and quality It also includes the assessment of the factors influencing production and advances in cell culture techniques including the scale up approach using bioreactors Lastly it provides valuable suggestion for future research

**Plant, Abiotic Stress and Responses to Climate Change** Violeta Andjelkovic, 2018-05-23 Climate change is a serious problem influencing agricultural production worldwide and challenging researchers to investigate plant responses and to breed crops for the changed growing conditions Abiotic stresses are the most important for crop production affecting about 96 5% of arable land worldwide These stress factors include high and low temperature water deficit drought and flooding salinity heavy metals UV radiation light chemical pollutants and so on Since some of the stresses occurred simultaneously such as heat and water deficit causing the interactions of physiological processes novel multidisciplinary solutions are needed This book provides an overview of the present state in the research of abiotic stresses and molecular biochemical and whole plant responses helping to prevent the negative impact of global climate change

***Biotechnological Production of Bioactive Compounds*** Madan L. Verma, Anuj K. Chandel, 2019-07-20 Biotechnological Production of Bioactive Compounds provides insights on the most recent innovations trends concerns solutions and practical challenges encountered in the fields of enzyme technology and nanobiotechnology for the production of bioactive materials with extra health benefits As nanobiotechnology has improved the bioactive extraction process significantly many bioactives including bioflavonoids omega 3 fatty acids biopigments and low calorie sugar substitutes are a pivotal part of the food industry The book highlights the production of extra health benefits bioactives from plants and microbes and explains how the extraction efficiency of bioactives molecules improves significantly with the recent advances in nanobiotechnology Researchers in the fields of biochemical engineering biotechnology bioremediation environmental sustainability and those in pharma industries will find the information in this book very helpful and illuminating Outlines technological advances in bioactives extraction Covers bioflavonoids biopigments omega 3 fatty acids and low sugar substitutes Explains the mechanisms of Green cargo biogenic nanoparticles for the delivery of bioactive molecules

***Proceedings of the Vth International Symposium on In Vitro Culture and Horticultural Breeding***, 2006

**The Future of Plant Protein** Kaiser Younis, Owais Yousuf, 2025-05-26 This book presents plant proteins as sustainable and healthy substitutes for animal proteins highlighting innovations challenges and opportunities Chapters cover emerging sources like duckweed microalgae quinoa and hemp comparing their nutritional aspects with traditional sources such as soybeans beans and nuts Further chapters not only discuss the environmental impact production methods

and potential applications of plant protein but also address barriers like consumer perception affordability and distribution The book provides solutions from plant based food companies to these challenges tackling the rising global demand driven by population growth income increase urbanization environmental awareness health consciousness and animal welfare concerns Overall it provides a summary of plant proteins exploring their nutritional environmental and consumer related aspects in the context of a shifting protein landscape The book is relevant for food scientists and technologists nutritionists policymakers and professionals alike providing insights into plant based diets and the future of food

**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

**The Gentianaceae - Volume 2: Biotechnology and Applications** Jan J. Rybczyński, Michael R. Davey, Anna Mikula, 2015-06-17 This book the second of two volumes on the Gentianaceae is devoted to aspects of biotechnology and their applications It consists of 18 chapters and covers micropropagation by means of organogenesis or somatic embryogenesis and single cell manipulation of various species belonging to the horticultural genera Blakstonia Centaurium Gentiana Gentianella and Swertia Furthermore the application of somatic cell hybridization haploidization and genetic variation arising from tissue and organ culture for the production of plants with new horticultural traits such as new flower colors or sizes or with special pharmaceutical values is treated in detail Also discussed are molecular markers that facilitate breeding and cultivar identification the preservation of genetic resources by cryopreservation the postharvest physiology of cut Gentian flowers and potted plants and different analytical methods for the evaluation of Gentians as sources of secondary metabolites such as xanthones and flavonoids secoiridoids and C glucan flavonoids and their positive impacts on human health This volume as well as the companion book The Gentianaceae Volume 1 Characterization and Ecology will serve as key reference works for scientists and students in the fields of botany plant breeding biotechnology and horticulture as well as professional gardeners

***Proceedings of ISPMF 2018 - Plant Molecular Farming*** Anneli Ritala, Heiko Rischer, Suvi Tuulikki Häkkinen, Jussi Joonas Joensuu, Kirsi-Marja Oksman-Caldentey, 2020-06-16

**Cell and Tissue Reaction Engineering** Regine Eibl, Dieter Eibl, Ralf Pörtner, Gerardo Catapano, Peter Czermak, 2008-09-30 The completion of the Human Genome Project and the rapid progress in cell biology and biochemical engineering are major forces driving the steady increase of approved biotech products especially biopharmaceuticals in the market Today mammalian cell products products from cells primarily monoclonals cytokines

recombinant glycoproteins and increasingly vaccines dominate the biopharmaceutical industry. Moreover, a small number of products consisting of in vitro cultivated cells as product for regenerative medicine have also been introduced in the market. Their efficient production requires comprehensive knowledge of biological as well as biochemical mammalian cell culture fundamentals e.g. cell characteristics and metabolism, cell line establishment, culture medium optimization and related engineering principles e.g. bioreactor design, process scale up and optimization. In addition, new developments focusing on cell line development, animal free culture media, disposables and the implications of changing processes, multi purpose facilities have to be taken into account. While a number of excellent books treating the basic methods and applications of mammalian cell culture technology have been published, only little attention has been afforded to their engineering aspects. The aim of this book is to make a contribution to closing this gap; it particularly focuses on the interactions between biological and biochemical and engineering principles in processes derived from cell cultures. It is not intended to give a comprehensive overview of the literature. This has been done extensively elsewhere.

**Thidiazuron: From Urea Derivative to Plant Growth Regulator** Naseem Ahmad, Mohammad Faisal, 2018-03-23

Plant biotechnology is a most interesting branch for academicians and researchers in recent past. Now days it becomes a very useful tool in agriculture and medicine and is regarded as a popular area of research especially in biological sciences because it makes an integral use of biochemistry, molecular biology and engineering sciences in order to achieve technological application of cultured tissues, cell and microbes. Plant tissue culture (PTC) refers to a technique of cultivation of plant cells and other parts on artificial nutrient medium in controlled environment under aseptic conditions. PTC requires various nutrients, pH, carbon source, gelling agent, temperature, photoperiod, humidity etc. and most importantly the judicious use of plant growth regulators. Various natural adenine and phenyl urea derivatives are employed for the induction and proliferation of different types of explants. Several phenyl urea derivatives were evaluated and it was observed that thidiazuron (n-phenyl N 1,2,3-thidiazol-5-ylurea) was found to be the most active among the plant growth regulators. Thidiazuron (TDZ) was initially developed as a cotton defoliant and showed high cytokinin like activity. In some examples its activity was 100 times more than BA in tobacco callus assay and produces more number of shoots in cultures than Zeatin and 2iP. TDZ also showed major breakthrough in tissue culture of various recalcitrant legumes and woody species. For the last two decades number of laboratories has been working on TDZ with different aspect and number of publications has come out. To the best of our knowledge there is no comprehensive edited volume on this particular topic. Hence the edited volume is a deed to consolidate the scattered information on role of TDZ in plant tissue culture and genetic manipulations that would hopefully prove informative to various researches.

**Thidiazuron: From Urea Derivative to Plant Growth Regulator** compiles various aspects of TDZ in Plant Tissue Culture with profitable implications. The book will provides basic material for academicians and researchers who want to initiate work in this fascinating area of research. The book will contain 26 chapters compiled by International dignitaries and thus giving a

holistic view to the edited volume      **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      **Ornamental Geophytes** Rina Kamenetsky, Hiroshi Okubo, 2012-09-17 Although a great deal of research on ornamental geophytes has been conducted since the beginning of the 1990s current information has not been comprehensively presented to researchers and horticulturalists Covering the latest advances in geophytes science Ornamental Geophytes From Basic Science to Sustainable Production provides up to date review      Plant Tissue Culture Roberta H. Smith, 2013 Plant Tissue Culture Third Edition builds on the classroom tested audience proven manual that has guided users through successful plant culturing A tumefaciens mediated transformation infusion technology the latest information on media components and preparation and regeneration and morphogenesis along with new exercises and diagrams provide current information and examples The included experiments demonstrate major concepts and can be conducted with a variety of plant material that are readily available throughout the year This book provides a diverse learning experience and is appropriate for both university students and plant scientists Provides new exercises demonstrating tobacco leaf infiltration to observe transient expression of proteins and subcellular location of the protein and information on development of a customized protocol for protoplast isolation for other experimental systems Includes detailed drawings that complement both introductions and experiments Guides reader from lab setup to supplies stock solution and media preparation explant selection and disinfection and experimental observations and measurement Provides the latest techniques and media information including A tumefaciens mediated transformation and infusion technology Fully updated literature      **Plant Science** Nabin Kumar Dhal, Sudam Charan Sahu, 2012-09-17 The book Plant Science consists of 12 chapters divided into three sections authored by many researchers from different parts of the Globe Section I Plant and Environment describes the relationship between plants and environment particularly enumerating species environment relationship and response of plants to different environmental stress conditions Section II Plant Microbe relation embodies broadly on both positive and negative aspects of microbes on plants

Section III Plant Biotechnology shed light on current biotechnological research to develop modern technology for producing biologicals and also increasing plant immunity in present environmental conditions The book Plant Science will be helpful to a wide group peoples readers scientists researchers and allied professionals We recommend it to you enjoy reading it save the plant and save life

**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

*Plant Tissue Culture Engineering* S. Dutta Gupta, Yasuomi Ibaraki, 2006-07-10 It is my privilege to contribute the foreword for this unique volume entitled Plant Tissue Culture Engineering edited by S Dutta Gupta and Y Ibaraki While there have been a number of volumes published regarding the basic methods and applications of plant tissue and cell culture technologies and even considerable attention provided to bioreactor design relatively little attention has been afforded to the engineering principles that have emerged as critical contributions to the commercial applications of plant biotechnologies This volume Plant Tissue Culture Engineering signals a turning point the recognition that this specialized field of plant science must be integrated with engineering principles in order to develop efficient cost effective and large scale applications of these technologies I am most impressed with the organization of this volume and the extensive list of chapters contributed by expert authors from around the world who are leading the emergence of this interdisciplinary enterprise The editors are to be commended for their skilful crafting of this important volume The first two parts provide the basic information that is relevant to the field as a whole the following two parts elaborate on these principles and the last part elaborates on specific technologies or applications

*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

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