



## Review Article

# ***Marchantia polymorpha* L.: An Emerging Model Plant System to Study Contemporary Plant Biology – A Review**

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## Abstract

The liverwort, *Marchantia polymorpha* L., one of the species of first land plants is a promising model plant system for the analysis of diverse facets of contemporary plant biology. The unique characteristics of the plant such as dominant haploid gametophytic generation enables the isolation and disruption of mutant for genetic analysis, rapid sexual and asexual reproduction can be induced under controlled conditions which leads to the formation of genetically homogeneous lines and also the complete organelle genome sequence of chloroplast and mitochondria has been established. In addition, the ongoing whole genome sequencing of *M. polymorpha* by the community sequencing plan at the Joint Genome Institute specifies the conservation of several mechanisms of biological science that are instituted in other terrestrial plants in a smaller extent of intricacy. Thus, with the development of several feasible and reliable genetic transformation strategies, *in vitro* cell culture, gene silencing, targeted gene modification and its critical evolutionary position make this plant as a potential model plant to study evolutionary and developmental biology in detail.

## Keywords

Bryophyta; Evolution; Liverworts; Molecular Genetics; Transformation

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## Introduction

For nearly 200 years, *Marchantia polymorpha* L. is intensively used as an investigational organism to study several physiological and morphological changes in a response to environmental factors (Shimamura, 2015; Bowman, 2016). But now it is gaining importance as a model plant system for contemporary plant science due to availability of several molecular genetics tools such as transformation techniques which can be utilized to understand the several aspects of evolutionary and developmental biology of plants in detail.

Based on the morphological, fossil record and molecular analysis, liverworts are thought as the

earliest land plant to grow and inhabit the primordial landscape (Mishler and Churchill, 1984; Kenrick and Crane, 1997a; Qui *et al.*, 2006; Qiu *et al.*, 2008; Kato, 2010). Further, the genome analysis showed that the a lot of the regulatory gene families are conserved (Floyd and Bowman, 2007; Rensing *et al.*, 2008; Banks *et al.*, 2011; Nystedt *et al.*, 2013). Therefore, along with mosses and hornworts, liverworts are a key group in comparative genomics to understand the genetic basis of evolutionary and developmental biology of land plants.

*M. polymorpha* is dioecious in sexuality. The gametophytic (haploid) generation is dominant in the life cycle, which gives remarkable benefits over

# Modern Plant Biology

**Howard J Dittmer**



## Modern Plant Biology:

**Modern Plant Biology** Dittmer H. J.,1981      **Modern Plant Biology** Howard J Dittmer,1972      Modern Plant Biology Dittmer H. J.,2010      *Modern Plant Biology* Howard James Dittmer,1972      Plant Biology F (Francis) 1876-1936

Cavers,2023-07-18 This essential textbook provides a comprehensive introduction to the science of plant biology With clear explanations and helpful illustrations it covers topics such as the structure and function of plant cells photosynthesis plant growth and development and the classification of plants Whether you are a student a teacher or simply someone interested in the natural world this book is an indispensable guide to the study of botany This work has been selected by scholars as being culturally important and is part of the knowledge base of civilization as we know it This work is in the public domain in the United States of America and possibly other nations Within the United States you may freely copy and distribute this work as no entity individual or corporate has a copyright on the body of the work Scholars believe and we concur that this work is important enough to be preserved reproduced and made generally available to the public We appreciate your support of the preservation process and thank you for being an important part of keeping this knowledge alive and relevant      **Plant Biology and Biotechnology Volume - I** Mr. Rohit Manglik,2024-01-23 EduGorilla Publication is a trusted name in the education sector committed to empowering learners with high quality study materials and resources Specializing in competitive exams and academic support EduGorilla provides comprehensive and well structured content tailored to meet the needs of students across various streams and levels      **A Textbook of Plant Biology** William Neilson-Jones,Mabel Cheveley Rayner,1920      *The Biology of Plants* Terri Grodzicker,2012 Plants are integral to human wellbeing and many species have been domesticated for over ten thousand years Evidence of plant scientific investigation and classification can be found in ancient texts from cultures around the world Chinese Indian Greco Roman Muslim etc while early modern botany can be traced to the late 15th and early 16th centuries in Europe During the past several decades plant biology has been revolutionized first by molecular biology and then by the genomic era The model organism *Arabidopsis thaliana* has proved an invaluable tool for investigation into fundamental processes in plant biology many of which share commonalities with animal biology Plant specific processes from reproduction to immunity and second messengers have also yielded to extensive investigation With the genomes of more than thirty plant species now available and many more planned in the near future the impact on our understanding of plant evolution and biology continues to grow Our increased ability to engineer plant species to a variety of ends may provide novel solutions to ensure adequate and reliable food production and renewable energy even as climate change impacts our environment The decision to focus the 2012 Symposium on plant science reflects the enormous research progress achieved in recent years and is intended to provide a broad synthesis of the current state of the field setting the stage for future discoveries and application This is the first Symposium in this historic series focused exclusively on the botanical sciences Plants are integral to human wellbeing and many species have been domesticated for

over ten thousand years Evidence of plant scientific investigation and classification can be found in ancient texts from cultures around the world Chinese Indian Greco Roman Muslim etc while early modern botany can be traced to the late 15th and early 16th centuries in Europe During the past several decades plant biology has been revolutionized first by molecular biology and then by the genomic era The model organism *Arabidopsis thaliana* has proved an invaluable tool for investigation into fundamental processes in plant biology many of which share commonalities with animal biology Plant specific processes from reproduction to immunity and second messengers have also yielded to extensive investigation With the genomes of more than thirty plant species now available and many more planned in the near future the impact on our understanding of plant evolution and biology continues to grow Our increased ability to engineer plant species to a variety of ends may provide novel solutions to ensure adequate and reliable food production and renewable energy even as climate change impacts our environment The decision to focus the 2012 Symposium on plant science reflects the enormous research progress achieved in recent years and is intended to provide a broad synthesis of the current state of the field setting the stage for future discoveries and application This is the first Symposium in this historic series focused exclusively on the botanical sciences

**Botany: An Introduction to Plant Biology** James D. Mauseth, 2019-11-25 Botany An Introduction to Plant Biology Seventh Edition provides a modern and comprehensive overview of the fundamentals of botany while retaining the important focus of natural selection analysis of botanical phenomena and diversity

**Plant Biology and Biotechnology** Bir Bahadur, Manchikatl Venkat Rajam, Leela Sahijram, K.V. Krishnamurthy, 2015-07-02 This volume offers a much needed compilation of essential reviews on diverse aspects of plant biology written by eminent botanists These reviews effectively cover a wide range of aspects of plant biology that have contemporary relevance At the same time they integrate classical morphology with molecular biology physiology with pattern formation growth with genomics development with morphogenesis and classical crop improvement techniques with modern breeding methodologies Classical botany has been transformed into cutting edge plant biology thus providing the theoretical basis for plant biotechnology It goes without saying that biotechnology has emerged as a powerful discipline of Biology in the last three decades Biotechnological tools techniques and information used in combination with appropriate planning and execution have already contributed significantly to economic growth and development It is estimated that in the next decade or two products and processes made possible by biotechnology will account for over 60% of worldwide commerce and output There is therefore a need to arrive at a general understanding and common approach to issues related to the nature possession conservation and use of biodiversity as it provides the raw material for biotechnology More than 90% of the total requirements for the biotechnology industry are contributed by plants and microbes in terms of goods and services There are however substantial plant and microbial resources that are waiting for biotechnological exploitation in the near future through effective bioprospection In order to exploit plants and microbes for their useful products and processes we need to first understand their basic structure

organization growth and development cellular process and overall biology We also need to identify and develop strategies to improve the productivity of plants In view of the above in this two volume book on plant biology and biotechnology the first volume is devoted to various aspects of plant biology and crop improvement It includes 33 chapters contributed by 50 researchers each of which is an expert in his her own field of research The book begins with an introductory chapter that gives a lucid account on the past present and future of plant biology thereby providing a perfect historical foundation for the chapters that follow Four chapters are devoted to details on the structural and developmental aspects of the structures of plants and their principal organs These chapters provide the molecular biological basis for the regulation of morphogenesis of the form of plants and their organs involving control at the cellular and tissue levels Details on biodiversity the basic raw material for biotechnology are discussed in a separate chapter in which emphasis is placed on the genetic species and ecosystem diversities and their conservation Since fungi and other microbes form an important component of the overall biodiversity special attention is paid to the treatment of fungi and other microbes in this volume Four chapters respectively deal with an overview of fungi arbuscularmycorrhizae and their relation to the sustenance of plant wealth diversity and practical applications of mushrooms and lichens associated with a photobiont Microbial endosymbionts associated with plants and phosphate solubilizing microbes in the rhizosphere of plants are exhaustively treated in two separate chapters The reproductive strategies of bryophytes and an overview on Cycads form the subject matter of another two chapters thus fulfilling the need to deal with the non flowering Embryophyte group of plants Angiosperms the most important group of plants from a biotechnological perspective are examined exhaustively in this volume The chapters on angiosperms provide an overview and cover the genetic basis of flowers development pre and post fertilization reproductive growth and development seed biology and technology plant secondary metabolism photosynthesis and plant volatile chemicals A special effort has been made to include important topics on crop improvement in this volume The importance of pollination services apomixes male sterility induced mutations polyploidy and climate changes is discussed each in a separate chapter Microalgalnutra pharmaceuticals vegetable oil based nutraceuticals and the importance of alien crop resources and underutilized crops for food and nutritional security form the topics of three other chapters in this volume There is also a special chapter on the applications of remote sensing in the plant sciences which also provides information on biodiversity distribution The editors of this volume believe the wide range of basic topics on plant biology that have great relevance in biotechnology covered will be of great interest to students researchers and teachers of botany and plant biotechnology alike

### **Modern Plant**

**Physiology** R. K. Sinha, 2004 In this book new developments in tissue culture stress physiology secondary metabolites are discussed Subjective and objective questions have been provided at the end of each chapter and tabulated differences

between allied processes like Fluorescence and Phosphorescence provided

### **Essentials of Plant Anatomy** Ameyatma

Mahajan, 2025-02-20 Essentials of Plant Anatomy is a comprehensive guide to understanding the intricate structure and

organization of plant tissues and organs This book delves into the fundamental principles of plant anatomy exploring diverse cell types tissue systems and anatomical adaptations that enable plants to grow develop and thrive in various environments We embark on a journey through the microscopic world of plant cells learning about the specialized functions and interactions of different cell types within tissues such as epidermis parenchyma collenchyma and sclerenchyma The book illuminates the role of these tissues in supporting plant growth providing structural support storing nutrients and facilitating essential metabolic processes like photosynthesis and gas exchange Furthermore we delve into the complex organization of plant organs such as roots stems leaves and flowers unraveling anatomical adaptations that enable plants to absorb water and nutrients from the soil transport fluids and nutrients throughout the plant and engage in reproductive processes like pollination and seed dispersal Through detailed illustrations diagrams and explanatory text *Essentials of Plant Anatomy* provides readers with a deeper understanding of the developmental processes that shape plant morphology and anatomy from meristematic tissue activity to the formation of specialized structures such as stomata trichomes and vascular bundles This book serves as an invaluable resource for students educators researchers and plant enthusiasts seeking to deepen their knowledge of plant structure and function Whether used as a textbook for academic courses or as a reference guide for botanical research it offers a rich and insightful exploration of the fascinating world of plant anatomy

Issues in Life Sciences—Botany and Plant Biology Research: 2012 Edition, 2013-01-10 *Issues in Life Sciences Botany and Plant Biology Research 2012 Edition* is a ScholarlyEditions eBook that delivers timely authoritative and comprehensive information about Plant Nutrition and Soil Science The editors have built *Issues in Life Sciences Botany and Plant Biology Research 2012 Edition* on the vast information databases of ScholarlyNews You can expect the information about Plant Nutrition and Soil Science in this eBook to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of *Issues in Life Sciences Botany and Plant Biology Research 2012 Edition* has been produced by the world's leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com>

Bulletin MLSA University of Michigan. College of Literature, Science, and the Arts, 2007

*Botany: An Introduction To Plant Biology* Dr. Smriti Kukshal, Dr. R.P. Kuksal, 2023-03-30 Botany is a subfield of biology that focuses on the study of plant life and growth from a scientific standpoint It is an expansive scientific field that studies a wide range of topics related to plants i.e algae fungi Pteridophytes Gymnosperm etc These topics include growth reproduction metabolism development illnesses chemical qualities and the evolutionary links between the many groups of organisms Botany is one of the oldest disciplines and its origins may be traced back to early human efforts to identify which plants were safe to eat which were useful for medicine and which were harmful to humans The study of botany

has expanded to include more than 550000 species at this point in time This significance may be seen via a variety of lenses such as the influence that it has on farming medicine and efforts to preserve the natural world The use of botany in agricultural settings is among its most significant uses Research in botany has resulted in the creation of new and better crop types that are more resistant to invasive organisms infectious illnesses and the effects of environmental stress This has significantly contributed to an increase in global food security as well as a reduction in poverty in a number of developing nations

**Plant Biology** Francis Cavers,1907      **A Long-range Plan for the Multinational Coordinated Arabidopsis Thaliana Genome Research Project** ,1990      **Annual Plant Reviews, Biochemistry of Plant Secondary Metabolism**

Michael Wink,2011-06-13 This brand new Annual Plant Reviews volume is the second edition of the highly successful and well received Annual Plant Reviews Volume 2 This exciting new volume provides an up to date survey of the biochemistry and physiology of plant secondary metabolism The volume commences with an overview of the biochemistry physiology and function of secondary metabolism followed by detailed reviews of the major groups of secondary metabolites alkaloids and betalains cyanogenic glucosides glucosinolates and nonprotein amino acids phenyl propanoids and related phenolics terpenoids cardiac glycosides and saponins A final chapter discusses the evolution of secondary metabolism This carefully compiled new edition brings together chapters from some of the world s leading experts in plant secondary metabolism Completely revised and brought right up to date with much new information this volume is an essential purchase for advanced students researchers and professionals in biochemistry physiology molecular biology genetics plant sciences agriculture medicine pharmacology and pharmacy working in the academic and industrial sectors including those working in the pesticide and pharmaceutical industries Libraries in all universities and research establishments where these subjects are studied and taught will need copies of this excellent volume on their shelves A companion volume Annual Plant Reviews Volume 39 Functions and Biotechnology of Plant Secondary Metabolites Second Edition Edited by M Wink is also available

Handbook of Plant Science, 2 Volume Set Keith Roberts,2007-12-10 Plant Science like the biological sciences in general has undergone seismic shifts in the last thirty or so years Of course science is always changing and metamorphosing but these shifts have meant that modern plant science has moved away from its previous more agricultural and botanical context to become a core biological discipline in its own right However the sheer amount of information that is accumulating about plant science and the difficulty of grasping it all understanding it and evaluating it intelligently has never been harder for the new generation of plant scientists or for that matter established scientists And that is precisely why this Handbook of Plant Science has been put together Discover modern molecular plant sciences as they link traditional disciplines Derived from the acclaimed Encyclopedia of Life Sciences Thorough reference of up to the minute reliable self contained peer reviewed articles cross referenced throughout Contains 255 articles and 48 full colour pages written by top scientists in each field The Handbook of Plant Science is an authoritative source of up to date practical information for all teachers students and

researchers working in the field of plant science botany plant biotechnology agriculture and horticulture      **Plant  
Epigenetics Coming of Age for Breeding Applications** ,2018-11-21 Epigenetics and Breeding Volume 88 the latest release in the Advances in Botanical Research series brings together the experiences and critical information teachers researchers and managers must consider from both scientific and legal points of view as they relate to biotechnology New chapters in this updated volume include sections on Epigenetic Mechanisms in Plants Epigenomic Diversity and Applications to Breeding Epigenetics in Breeding EpiRILs Lessons from Arabidopsis Transposable Elements as a Tool for Plant Improvement Epigenome Editing Epigenetics and Grafting Sexual and Non sexual reproduction Epigenetics in Cereals and more Encompasses various aspects of botanical research including its historical background current status recent research outcomes and potential future developments Written by highly competent authors from all continents Provides data that is based on facts and written in a dispassionate and non polemical tone



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