



## 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

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**Plant Biology** Andrew Lack,David Evans,2001-06-15 Instant Notes in Plant Biology covers all aspects of modern plant biology The scope and depth of this text are suitable for a first and second year undergraduate student of plant biology including molecular biologists and biotechnologists **Plant Biology and Biotechnology** Bir Bahadur,Manchikatla 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 Microalgaenutra 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

*A Textbook of Plant Biology* M. C. Rayner,W. Neilson Jones,2018-03-06

This is a classic textbook on the subject of plant biology first published in 1920 It offers the reader an elementary course on the scientific method while exploring the relationship between plant life and general biological knowledge Originally intended for use in schools and universities this comprehensive textbook is a great place to start for readers with an interest in botany and related subjects Contents include The Plant as a Machine The Cell Respiration The Water Relations of Plants Absorption of Mineral Salts Carbon Assimilation The Assimilation of Nitrogen by Plants The Nutrition of Heterophic Plants Enzymes Reproduction Reproductions Reproductions continued etc Many vintage books such as this are increasingly scarce and expensive It is with this in mind that we are republishing this volume now in an affordable modern high quality edition complete with a specially commissioned new introduction on botany

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Ahmad Parray,Mohammad Yaseen Mir,Nowshen Shameem,2019-11-06 This book will be of immense helpful to the students of plant biotechnology Agricultural sciences Microbiology of both undergraduate and postgraduate levels in universities colleges and Research institutes Besides the book will be quite supportive researchers who work in the field of plant biotechnology and agricultural sciences In this book the main focus will be on advanced genome editing approaches for the production of GM crops besides their socioeconomic ethical and risk biosafety assessments Nanotechnology is the new emerging and fascinating field of science finds its application in almost all the major research areas and its uses in agriculture and food sectors are incipient The books seems to be first in summarizing the two way interactive approach in the field of plant biotechnology and setting of a new arena in shaping the new bio techniques towards the sustainable cause

Plant Biology Alison M. Smith,George Coupland,Liam Dolan,Nicholas Harberd,Jonathan Jones,Cathie Martin,Robert

Sablowski, Abigail Amey, 2009-04-30 Plant Biology is a new textbook written for upper level undergraduate and graduate students. It is an account of modern plant science reflecting recent advances in genetics and genomics and the excitement they have created. The book begins with a review of what is known about the origins of modern day plants. Next the special features of plant genomes and genetics are explored. Subsequent chapters provide information on our current understanding of plant cell biology, plant metabolism and plant developmental biology with the remaining three chapters outlining the interactions of plants with their environments. The final chapter discusses the relationship of plants with humans: domestication, agriculture and crop breeding. Plant Biology contains over 1 000 full color illustrations and each chapter begins with Learning Objectives and concludes with a Summary. 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. **Agricultural Biotechnology in China** Valerie J. Karplus, Xing Wang Deng, 2007-12-17 Agricultural Biotechnology in China: Origins and Prospects is a comprehensive examination of how the origins of biotechnology research agendas along with the effectiveness of the seed delivery system and biosafety oversight help to explain current patterns of crop development and adoption in China. Based on firsthand insights from China's laboratories and farms, Valerie Karplus and Dr Xing Wang Deng explore the implications of China's investment for the nation's rural development, environmental footprint as well as its global scientific and economic competitiveness.

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## **Table of Contents Modern Plant Biology**

1. Understanding the eBook Modern Plant Biology
  - The Rise of Digital Reading Modern Plant Biology
  - Advantages of eBooks Over Traditional Books
2. Identifying Modern Plant Biology
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Modern Plant Biology
  - User-Friendly Interface
4. Exploring eBook Recommendations from Modern Plant Biology
  - Personalized Recommendations
  - Modern Plant Biology User Reviews and Ratings
  - Modern Plant Biology and Bestseller Lists

5. Accessing Modern Plant Biology Free and Paid eBooks
  - Modern Plant Biology Public Domain eBooks
  - Modern Plant Biology eBook Subscription Services
  - Modern Plant Biology Budget-Friendly Options
6. Navigating Modern Plant Biology eBook Formats
  - ePub, PDF, MOBI, and More
  - Modern Plant Biology Compatibility with Devices
  - Modern Plant Biology Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Modern Plant Biology
  - Highlighting and Note-Taking Modern Plant Biology
  - Interactive Elements Modern Plant Biology
8. Staying Engaged with Modern Plant Biology
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Modern Plant Biology
9. Balancing eBooks and Physical Books Modern Plant Biology
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Modern Plant Biology
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Modern Plant Biology
  - Setting Reading Goals Modern Plant Biology
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Modern Plant Biology
  - Fact-Checking eBook Content of Modern Plant Biology
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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