As per ICAR New Syllabus

# पादप कार्यिकी के मूल सिद्धान्त

## [Fundamentals of Plant Physiology]

अनुराधा गोयल



KALYANI

# 6 Farm Management Principles

**Dr. Sumit B. Wasnik[1] and Dr. Sneha Pandey[2]**

[1]Assistant Professor (Guest Faculty), RSV CARS, Bemetara (CG)
[2]Assistant Professor (Guest Faculty), Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (MP)

## Abstract

Nobody can deny the fact that it is the endeavor of the farming community only that helps realize the higher farm production. Farm management, includes making and implementing of the decisions involved in organizing and operating a farm for maximum production and profit. Farm management draws on agricultural economics and fall under microeconomics. In this chapter we studied about eight principles of farm management viz., comparative advantage, opportunity cost, theory of cost, product substitution, factor substitution, diminishing marginal return, equi-marginal returns and time comparison. These principles provide the farmer to find the practical solution of farm related problems such as production, marketing as well as management of on farm resources. Along with efficient resource management these principles guide to achieve profit maximization level at farm. Thus, farm management tools help farmer in solving farm related problems for successful farm business.

**Keywords:** Costs, Diminishing Return, Farm management, Input, Principles, Rational, Output.

## Introduction

The prosperity of any country depends upon the prosperity of farmers, which in turn depends upon the rational allocation of resources among various uses and adopting

# Chapter - 9

# Farm Management and Efficiency Analysis

**Dr. Sumit B. Wasnik[1] and Dr. Sneha Pandey[2]**

[1]Assistant Professor (Guest Faculty), RSV CARS, Bemetara (CG)
[2]Assistant Professor (Guest Faculty), Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (MP)

## Abstract

The present chapter entitled 'Farm Management and Efficiency Analysis' is intended to present the management related decisions of the farm resources and farm efficiency measuring tools for sound farm planning by any individual. The chapter includes various farm related decisions to be achieved by the principles of farm managing at the most profitable levels, types of farm, farm resource management, farm production economics, risk and uncertainty in farming, and finally the various farm efficiency analysis tools. The theory of optimal decision making in the organization and management of a farm for profit maximization is the foundational theory of farm management. In the context of increased commercialization there is a greater need to improve the managerial abilities of the farmer. So far, the managers in general have responded admirably to the technological changes that accrued in Indian agriculture. All farm management tools as well as farm efficiency tools are helpful to the farmers in solving their managerial problems for successful operation on the farm business. In concluding that the farmers need of decision making to evaluate the farm businesses will definitely be achieved on the guidelines of resources management and efficiency measures for the profit maximization of farm.

**Keywords:** Efficiency, Farm, Farm Management, Production Economics, Risk and Uncertainty.

# Chapter - 19

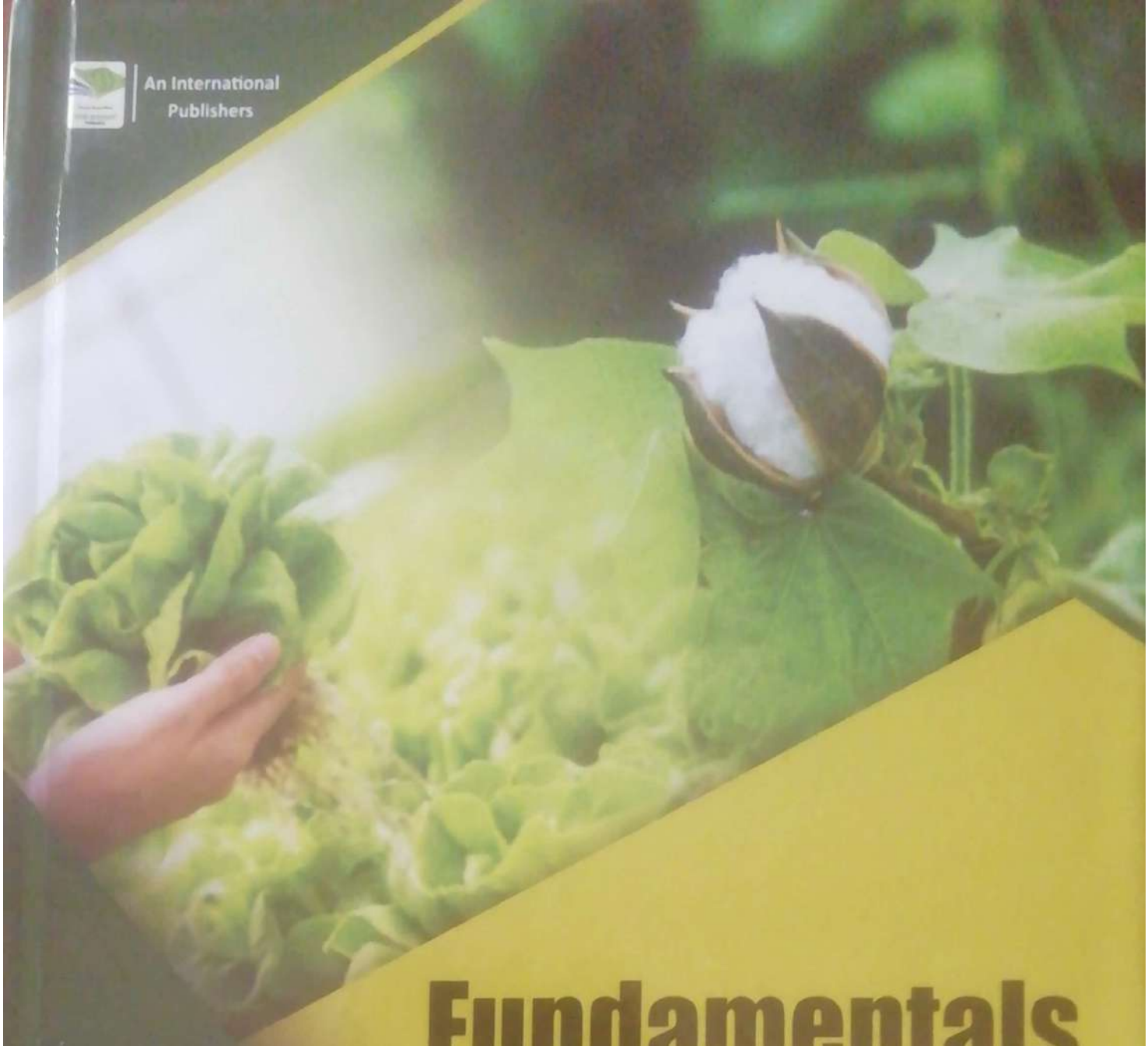
# Agricultural Marketing and Consumer Behaviour

**Dr. Sneha Pandey[1] and Dr. Sumit B. Wasnik[2]**

[1]Department of Agricultural Economics, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, (Madhya Pradesh)
[2]Department of Agricultural Economics, RSV CARS, Bemetara IGKV (Chhattisgarh)

**Abstract**

The interaction between buyers and sellers is called Market. A Market is an institution or a process that allows and sellers to interact. A market is not necessarily a **Marketplace,** which is a physical location where buyers and sellers go to exchange goods. In marketing, understanding consumer behavior has become very important for businesses. Consumer behavior refers to the study which analyzes how consumers make decisions about their wants, needs, buying or act with respect to a product, service or organization. It is very critical to understand the behavior of consumers to analyze the behavior of potential consumers towards a new product or service. It is also very useful for companies to identify opportunities which have not yet been met. In marketing, understanding consumer behavior has become very important for businesses. Consumer behavior refers to the study which analyzes how consumers make decisions about their wants, needs, buying or act with respect to a product, service or organization. It is very critical to understand the behavior of consumers to analyze the behavior of potential consumers towards a new product or service. It is also very useful for companies to identify opportunities which have not yet been met. In this chapter we are going to understand about agricultural marketing, Characteristics of market, classification of market, functions of market and market functionaries. This chapter also describes consumer behavior, types of consumer behavior, importance of consumer behavior and factors affecting consumer behavior.



An International Publishers

# Fundamentals of Agronomy


- Dr. Nisha Singh
- Dr. Janmejay Sharma
- Dr Ajay Singh
- Mr. Abhishek


VITAL BIOTECH PUBLICATION

# Fundamentals of Agronomy

**Dr. Nisha Singh**
Scientist (Agronomy) AICRP on Wheat and Barley, College of Agriculture, RVSKVV, Gwalior

**Dr. Janmejay Sharma**
Scientist (Agronomy) AINP Arid Legumes, Department of Agronomy, College of Agriculture RVSKVV, Gwalior

**Dr. Ajay Singh**
Block Technology Manager "ATMA" Farmer Welfare and Agricultural Morena (M.P.)

**Mr. Abhishek**
Department of Agronomy
College of Agriculture, CCS HAU, Hisar (Haryana) India

VITAL BIOTECH PUBLICATION
Kota, Rajasthan, India
http://www.vitalbiotech.org/bookpublication/

An International Publishers

VITAL BIOTECH get Accredited by following International organization

ITHAKA

https://www.portico.org/publishers/vital/
101 Greenwich Street, 18th Floor
New York, NY 10006

Published by Vital Biotech Publication

First Edition: 2023

---



**Product Form:**

Digital download, online and hard bound

**Edition:**

ISBN: 978-93-92953-90-3

**Head, Production (Higher Education and Professional) & Publishing Director**

Dr. Jitendra Mehta

**Product Manager**

Dr. K.S. Nama

**General Manager**

Jaya Mehta



Office Address:

**VITAL BIOTECH PUBLICATION**

772, Basant Vihar, Kota,

Rajasthan-324009 India

Visit us at: http://www.vitalbiotech.org

Contact No. +91-9784677044

Printed at: Vital Biotech Publication, Kota

# CONTENTS

# कृषि वानिकी का परिचय

## (INTRODUCTION TO AGROFORESTRY)

अमिता शर्मा
जन्मेजय शर्मा
एस. सी. श्रीवास्तव
लाखन सिंह मोहनिया

KALYANI

## लेखक-परिचय

**डॉ. अमिता शर्मा**, राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय ग्वालियर में वैज्ञानिक (कृषि वानिकी) के पद पर पदस्थ हैं। इन्हें शिक्षण, अनुसंधान एवं प्रसार में 20 वर्षों का अनुभव है। इन्होंने एम.एस.सी. व पीएच.डी. के शोध कार्य मे 20 से अधिक छात्रों का मार्गदर्शन किया। साथ ही 40 से अधिक शोध पत्र एवं 15 लोकप्रिय लेख प्रकाशित किए। इनके द्वारा 2 अन्य पुस्तकें भी प्रकाशित की गई हैं।

**डॉ. जन्मेजय शर्मा**, राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय ग्वालियर में वैज्ञानिक (सस्य विज्ञान) के पद पर पदस्थ हैं। इन्हें शिक्षण, अनुसंधान एवं प्रसार में 5 वर्षों से अधिक का अनुभव है। इन्होंने एम.एस.सी. व पीएच.डी. के शोध कार्य में 10 से अधिक छात्रों का मार्गदर्शन किया। साथ ही 18 से अधिक शोध पत्र एवं 10 लोकप्रिय लेख प्रकाशित किए हैं। इनके द्वारा 1 अन्य पुस्तक भी प्रकाशित की गई है।

**डॉ. शरद चंद्र श्रीवास्तव**, राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय ग्वालियर में वरिष्ठ तकनीकी अधिकारी (कृषि अर्थशास्त्र) के पद पर पदस्थ हैं। इन्हें शिक्षण, अनुसंधान एवं प्रसार में 20 वर्षों का अनुभव है। इन्होंने एम.एस.सी. व पीएच.डी के शोध कार्य मे 29 छात्रों का मार्गदर्शन किया। साथ ही 47 शोध पत्र प्रकाशित किए। इनके द्वारा 2 अन्य पुस्तकें भी प्रकाशित की गई हैं।

**लाखन सिंह मोहनिया**, राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय ग्वालियर में अनुसंधान विद्वान (पीएच.डी.) शोधार्थी के रूप में कार्यरत है। इन्होंने राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय ग्वालियर से कृषि में स्नातक और सस्य विज्ञान में स्नातकोत्तर किया। साथ ही कृषि वैज्ञानिक चयन मंडल द्वारा आयोजित होने वाला नेट क्वालीफाई किया एवं 7 शोध पत्र और 10 लोकप्रिय लेख प्रकाशित किए हैं। इनके द्वारा 2 अन्य पुस्तकें भी प्रकाशित की गई हैं।

T 39663 05 ₹ 195.00
ISBN: 978-93-5540-998-0
9 789355 409980
kalyani_delhi@kalyanipublishers.in
www.kalyanipublishers.co.in

## About the Book

***This book entitled "New Horizon in Climate Smart Agriculture" considers the most typical of the expected impacts of climate change on crop production, and the opportunities that exist for adapting to these changes and mitigating climate change through the sustainable intensification of crop production. This book aims to address post-graduate students and research scholars.***


**Dr. Shailendra** Singh has done M.Sc. (Ag) from University of Agricultural Sciences, Dharwad, Karnataka and Ph. D. from Maharana Pratap University of Agriculture and Technology, Udaipur Rajasthan in the discipline of Agronomy with ICAR fellowships. He has more than 8 years experience of research and teaching. He started his carrier as Assistant Professor in 2015 from Navsari Agricultural University, Gujarat. Presently he is serving S.K.N. Agriculture University, Jobner, Rajasthan. During his professional journey he has published 12 research papers, 2 books and several extension publications. He has guided two masters students and acted as minor advisor for five research scholars.

**Dr. Ajay Singh** is Presently Working as Block Technology Manager "ATMA" Farmer welfare and agriculture Development Morena (M.P.) Dr. Singh Passed M.Sc (Ag.) Agronomy from a JNKVV Jabalpur in the year 2010. He completed Ph.D with specialization in Agronomy from RVSKVV Gwalior.He qualified ICAR NET Exam in 2021. He has published 10 research papers, 8 Awards, 3Book Chapters, 1book, 6 Popular articles, 6 Folders, 4 leafled and 22 seminar symposium attended.

**Dr. Janmejay Sharma** is presently working as scientist in AINP Arid Legumes, Department of Agronomy College of Agriculture RVSKVV, Gwalior Dr. Sharma passed M.Sc (Ag) Agronomy from JNKVV Jabalpur in 2009. He completed Ph.D in Agronomy from RVSKVV, Gwalior. He has published 23 research paper 13 extension bulletins, 7 book chapters, 2 book, 1 practical manual and 8 popular articles so for He has guided 7 masters and 2 Ph.D students and also acting as minor advisor of masters and Ph.D students.

**Dr. Sudarshan Chicham** did his graduation, post graduation and doctorate in agronomy from RVSKVV, Gwalior (M.P). Ph.D. worked was completed ICAR- CPRI-RS (Central Potato Research Institute - Regional Station Gwalior (M.P.). He has research worked as a ""Evaluation of micro irrigation for improving Productivity and water use efficiency in Potato". He has published 6 research papers, 5 popular articles so for.



ISBN: 978-93-92953-99-6


**Price: ₹ 2050.00**


**VITAL BIOTECH PUBLICATION**

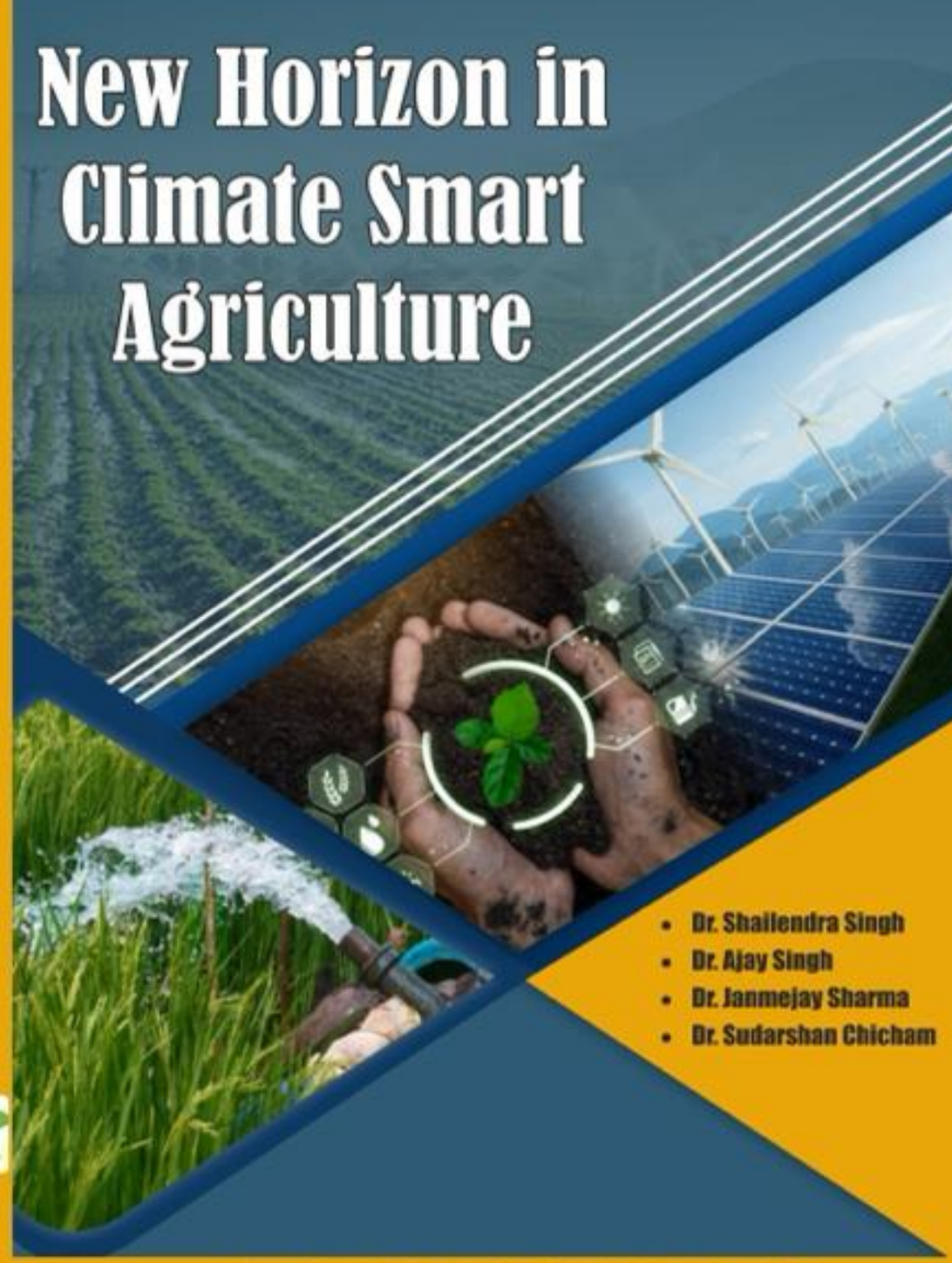
www.vitalbiotech.org | +91-9784677044 | Kota, Rajasthan, India


New Horizon in Climate Smart Agriculture

• Dr. Shailendra Singh • Dr. Janmejay Sharma • Dr. Ajay Singh • Dr. Sudarshan Chicham


An International Publishers


# New Horizon in Climate Smart Agriculture




- Dr. Shailendra Singh
- Dr. Ajay Singh
- Dr. Janmejay Sharma
- Dr. Sudarshan Chicham



**VITAL BIOTECH PUBLICATION**

Online Available
amazon.in Flipkart

# सस्य विज्ञान के मूल सिद्धांत

## Fundamentals of Agronomy

As Per the Dean's Committee of ICAR and New Education Policy (NEP)

लखन सिंह मोहनिया
जनमेजय शर्मा
अमिता शर्मा
रजनी सिंह सासौंडे
उमा शंकर बागरी

S.R. SCIENTIFIC PUBLICATION

# सस्य विज्ञान के मूल सिद्धांत

## [Fundamentals of Agronomy]

भारतीय कृषि अनुसंधान परिषद् (I.C.A.R) एवं राष्ट्रीय शिक्षा नीति
(N.E.P) द्वारा निर्देशित नवीन पाठ्यक्रम पर आधारित


लेखक

**लाखन सिंह मोहनिया**
पी.एच.डी.स्कॉलर सस्य विज्ञान
आर.वी.एस.के.वी.वी.ग्वालियर

**डॉ. अमिता शर्मा**
वैज्ञानिक कृषि वानिकी
आर.वी.एस.के.वी.वी.ग्वालियर

**डॉ. जनमेजय शर्मा**
वैज्ञानिक सस्य विज्ञान
आर.वी.एस.के.वी.वी.ग्वालियर

**डॉ. रजनी सिंह सासोड़े**
वैज्ञानिक पादप रोग विज्ञान
आर.वी.एस.के.वी.वी.ग्वालियर

**उमा शंकर बागरी**
पी.एच.डी.स्कॉलर सस्य विज्ञान
आर.वी.एस.के.वी.वी.ग्वालियर



S.R.S.Publication

एस.आर.साइन्टिफिक पब्लिकेशन

*प्रकाशक :*

**एस.आर.साइन्टिफिक पब्लिकेशन**

8, गाँधी नगर, निकट पालीवाल पार्क, आगरा-282003

फोन: +91-562-4042663, 09927426509

E-mail: srscientificpublication@gmail.com

Web: www.srscientificpublication.com



**ISBN: - 978-93-95182-10-2**

लेजर टाइपसेटिंग : *एस. के. ग्राफिक्स*, आगरा

प्रिन्टर : पूजा प्रिन्टर, देहली

भारत में मुद्रित, अनुज श्रीवास्तव द्वारा *"एस.आर. साइन्टिफिक पब्लिकेशन"* आगरा।

* सस्य विज्ञान के मूल सिद्धांत*

## *वैधानिक चेतावनी*

# विषय-सूची

Peer Reviewed & Refereed

# Advanced Research and Review in Agronomy

Chief Editor
Dr. Prabhat Kumar Chaturvedi

Volume - 4



Bright Sky Publications
New Delhi

**Published By:** Bright Sky Publications

Bright Sky Publications
Office No 3, 1st Floor,
Pocket - H34, SEC-3,
Rohini, Delhi, 110085, India
Phone: +91-9911215212, +91-9999779515
Email: brightskypublications@gmail.com

**Chief Editor:** Dr. Prabhat Kumar Chaturvedi



**Publication Year:** 2023

**Pages:** 109

**ISBN:** 978-93-92804-70-0

**Book DOI:** https://doi.org/10.22271/bs.book.89

**Price:** ₹ 719/-

# Contents

Peer Reviewed & Refereed

# Advanced Research and Review in Agronomy

Chief Editor
Dr. Prabhat Kumar Chaturvedi

Volume - 4



Bright Sky Publications
New Delhi

**Published By:** Bright Sky Publications

Bright Sky Publications
Office No 3, 1st Floor,
Pocket - H34, SEC-3,
Rohini, Delhi, 110085, India
Phone: +91-9911215212, +91-9999779515
Email: brightskypublications@gmail.com

**Chief Editor:** Dr. Prabhat Kumar Chaturvedi



**Publication Year:** 2023

**Pages:** 109

**ISBN:** 978-93-92804-70-0

**Book DOI:** https://doi.org/10.22271/bs.book.89

**Price:** ₹ 719/-

# Contents

Peer Reviewed & Refereed

# ADVANCES IN AGRONOMY

VOLUME - 26

Chief Editor
Dr. Anay Kumar Rawat

Co-editor
Uttam Kumar Tripathi

AKINIK PUBLICATIONS
NEW DELHI

**Published By:** AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No.: 9711224068, 9911215212
Website: www.akinik.com
Email: akinikbooks@gmail.com

**Chief Editor:** Dr. Anay Kumar Rawat
**Co-Editor:** Uttam Kumar Tripathi



**Publication Year:** 2023

**Pages:** 157

**ISBN:** 978-93-5570-816-8

**Book DOI:** https://doi.org/10.22271/ed.book.2317

**Price:** ₹ 767/-

**Registration Details**

- Printing Press License No.: F.1 (A-4) press 2016
- Trade Mark Registered Under
  - Class 16 (Regd. No.: 5070429)
  - Class 35 (Regd. No.: 5070426)
  - Class 41 (Regd. No.: 5070427)
  - Class 42 (Regd. No.: 5070428)

# Contents

An International Publishers

# ADVANCING INNOVATIONS IN SUSTAINABLE AGRICULTURE

3 Volume

Dr. Sanjay-Swami

VITAL BIOTECH PUBLICATION

Published by Vital Biotech Publication
First Edition: 2023



**Product Form:**
Digital download, online and Paperback

**Edition:**
ISBN: 978-93-92953-23-1

**Head, Production (Higher Education and Professional) & Publishing Director**
Dr. Jitendra Mehta

**Product Manager**
Dr. K.S Nama

**Graphic Designer**
Mukesh Kumar



Office Address:

**VITAL BIOTECH PUBLICATION**
772, Basant Vihar, Kota,
Rajasthan-324009 India
Visit us at: http://www.vitalbiotech.org
Contact No. +91-9784677044

Printed at: Vinayak Printers, Kota

Chapter 17

# Constraints and Prospect in Rainfed Region

**Balkrishan Singh[1], Nisha Singh[2], Janmejay Sharma[3], Ajay Bhadauria[4], Jaideep Singh Bhadauria[5] and Sudhir S. Bhadauria[6]**

[1]Soil Conservation Inspector under Department of Agriculture, Jhansi Uttar Pradesh
[2]Scientist Department of Agronomy under College of Agriculture RVSKVV, Gwalior
[3]Scientist Department of Agronomy under College of Agriculture RVSKVV, Gwalior
[4,5]Block Technological Manager ATMA Department of Agriculture M.P
[6]Deputy Commissioner Ministry of Agriculture, New Delhi

Rainfed farming is a significant agricultural practice globally, providing sustenance to millions of farmers in regions where irrigation is limited. However, it faces numerous challenges and offers both promising prospects and potential risks. The problem lies in its heavy reliance on rainfall, making crops vulnerable to erratic and insufficient precipitation patterns, leading to crop failures, food insecurity, and economic distress for farmers. Climate change exacerbates these challenges, causing unpredictable weather patterns, frequent droughts, and more intense storms. As a result, farmers struggle to adapt their traditional practices to cope with the changing climate, hindering agricultural productivity and income stability.

Despite these issues, rainfed farming also holds prospects. Implementing sustainable water management practices, such as rainwater harvesting and conservation techniques, could mitigate water scarcity. Additionally, embracing climate-resilient crop varieties and modern agricultural technologies can enhance productivity and income. Furthermore, governmental support, infrastructural investments, and farmer training programs can create a conducive environment for rainfed farming's growth. In brief, addressing the challenges through sustainable practices and technological advancements could unlock the potential of rainfed farming,

# Emerging Trends in Agriculture Sciences

Kaptan Baboo

Dr. Vishuddha Nand

Dr. Vishnoo Omar

Dr. Vijay Kumar

Dr. Shiv Kant Singh Chandel

VITAL BIOTECH PUBLICATION

Kota, Rajasthan, India

http://www.vitalbiotech.org/bookpublication/

An International Publishers

VITAL BIOTECH get Accredited by following International organization

ITHAKA

https://www.portico.org/publishers/vital/

101 Greenwich Street, 18th Floor

New York, NY 10006

Published by Vital Biotech Publication
First Edition: 2023



**Product Form:**
Digital download, online / Paperback / hard bound

**Edition:**
ISBN: 978-93-92953-74-3

**Head, Production (Higher Education and Professional) & Publishing Director**
Dr. Jitendra Mehta

**Product Manager**
Dr. K.S. Nama

**General Manager**
Jaya Mehta



Office Address:

**VITAL BIOTECH PUBLICATION**
772, Basant Vihar, Kota,
Rajasthan-324009 India
Visit us at: http://www.vitalbiotech.org
Contact No. +91-9784677044

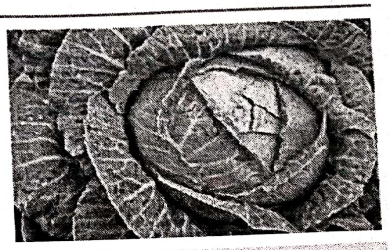
Printed at: Vital Biotech Publication, Kota

Chapter 15

# Production Technology of Cabbage (*Brassica oleracea* var. Capitata)

**Balkrishan Singh[1], Nisha Singh[2], Ritu Sharma[3], Shweta Sharma[4]**
[1]Technical Assistant, Agriculture Department, Jhansi
[2]Scientist, College of Agriculture, RVSKVV, Gwalior
[3]RHEO Gwalior, [4]M.Sc. Agronomy, RVSKVV, Gwalior

Botanical name: *Brassica oleracea* var. capitata
Family : Brassicaceae/ Cruciferae
Origin: Mediterranean region
Chromosome no. 2n=2x:18
Type of fruit: Siliqua



## INTRODUCTION

It is an important Cole crop. From nutrition point of view, it ranks very high. It is used alone or mixed with other vegetables like pea or potato etc. Young green heads contain more vitamin A than old ones. The peculiar flavour in cabbage head is because of a glycoside sinigrin, which carries sulphur. Cabbage contains vitamin U, which is very useful in ulcer in stomach.

The word cabbage is introduced from the French word *Cobache* meaning head. The head of cabbage is ended with various thick overlapping smooth leaves, which envelop a smooth terminal bud. Sometimes-small heads of 5 or 7.5 cm diameter are formed, which are known as cabbage sprouts, having no commercial importance. The heads of cabbage are classified as round or ball head, flat or drumhead and conical head *etc.*

## Climatic requirement:

It grows generally in cool and moist weather, and is very hardy to frost. In hot and dry weather, its quality becomes poor due to the enlargement of fibres and bitter taste, and much of the flavour is lost due to excessive high temperature. The cabbage plants do not form heads at a temperature above 30°C. Germination is best at a soil temperature of 13-16°C. Well-hardened seedlings tolerate -2 to -5°C temperature.

# A GLOSSARY OF SOIL SCIENCE

PRIYADARSHANI A. KHAMBALKAR SHASHI S. YADAV
AKHILESH SINGH S.K. TRIVEDI

**NIPA GENX ELECTRONIC**
**RESOURCES & SOLUTIONS P. LTD.**

101, 103, Vikas Surya Plaza, CU Block
L.S.C.Market, Pitam Pura, New Delhi-110 034
Ph : +91 11 27341616, 27341717, 27341718
E-mail: newindiapublishingagency@gmail.com
www: www.nipabooks.com

***For customer assistance, please contact***
Phone: + 91-11-27 34 17 17
Fax: + 91-11-27 34 16 16
E-Mail: feedbacks@nipabooks.com



ISBN: 978-93-91383-29-9



Composed and Designed by NIPA.

# Contents

# A Practical Manual on Soil Testing

*Priyadarshani A. Khambalkar*
*(Smt.) Shashi S. Yadav*
*Akhilesh Singh*
*S.K. Trivedi*
*Narendra S. Gurjar*

*Published by :*

**International Books & Periodical Supply Service**

*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com



ISBN : 978-93-94023-03-1
E-ISBN : 978-93-94023-04-8



Composed, Designed & Printed in India

# Contents

## About the Book

***The book "Climate Smart Approaches Towards Sustainable Crop Production" is designed to highlight the climate-smart approaches that farmers and policymakers can adopt to enhance crop production while minimizing environmental degradation. These approaches encompass a range of strategies to address the potential benefits of climate-smart practices in terms of increased resilience, improved livelihoods, and enhanced adaptive capacity.***


**Mr. Parmeswar Dayal** is pursuing Ph.D. in Agronomy at ICAR- Indian Agricultural Research Institute, New Delhi. He has been rewarded with ICAR- Junior Research as well as Senior Research Fellowship. He has also published various research papers, book chapters, popular articles, review papers etc. in many reputed peer reviewed journals and magazines.

**Ms. Shivani Ranjan** is a Ph.D. Scholar at Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. She has qualified ICAR-NET, UGC-NET and is a recipient of NFOBC fellowship. She is one of the authors of two textbook and also editor of two books. She has received several national awards and published 15 research/review articles, 33 popular articles and 20 book chapters.

**Mr. Sumit Sow** is currently pursuing Ph.D. in Agronomy with ICAR-SRF at Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. He has qualified ICAR-NET and UGC-NET. Two textbook and two edited book has been authored by him. He has published 16 research/review articles, 34 popular articles, 19 book chapters and received various national awards.

**Dr. Ram Pyare** is Director Students' Welfare of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh. In his 25 years of academic experience, he has guided 20 M.Sc. and 4 Ph.D. students. He has number of publications to his credit including 58 research papers, 3 edited/authored books, 5 practical manuals, 20 popular articles and many more.

**Dr. Arun Kumar** is Assistant Professor (Agronomy) at Banda University of Agriculture & Technology, Banda, U.P. He has an experience for over 8 years in teaching, research and extension. He guided 3 M.Sc. students of Agronomy. He has published 10 research papers, 5 popular articles, 5 book chapters and participated in many seminars and conferences.

**Mr. Abhishek Kumar** is pursuing Ph.D. in Genetics and Plant Breeding at Dr. Rajendra Prasad Central Agricultural University. He has qualified ICAR-NET and also published various review/research papers, book chapters, popular articles etc. in many journals and magazines.



**Price: ₹ 2050.00**

ISBN: 978-93-92953-87-3

9 789392 953873



**VITAL BIOTECH PUBLICATION**

www.vitalbiotech.org | +91-9784677044 | Kota, Rajasthan, India


**Climate Smart Approaches towards Sustainable Crop Production**

• Parmeswar Dayal
• Ram Pyare
• Shivani Ranjan
• Arun Kumar
• Sumit Sow
• Abhishek Kumar


An International Publishers


# CLIMATE SMART APPROACHES TOWARDS SUSTAINABLE CROP PRODUCTION


• Parmeswar Dayal
• Ram Pyare
• Shivani Ranjan
• Arun Kumar
• Sumit Sow
• Abhishek Kumar



**VITAL BIOTECH PUBLICATION**

# Climate Smart Approaches towards Sustainable Crop Production

## Edited by


- **Parmeswar Dayal**
- **Shivani Ranjan**
- **Sumit Sow**
- **Ram Pyare**
- **Arun Kumar**
- **Abhishek Kumar**




**VITAL BIOTECH PUBLICATION**

Kota, Rajasthan, India

http://www.vitalbiotech.org/bookpublication/

An International Publishers

VITAL BIOTECH get Accredited by following International organization

ITHAKA ARTSTOR ITHAKA S|R JSTOR PORTICO

https://www.portico.org/publishers/vital/

101 Greenwich Street, 18th Floor

New York, NY 10006

Published by Vital Biotech Publication
First Edition: 2023



**Product Form:**
Digital download, online / Paperback / hard bound

**Edition:**
ISBN: 978-93-92953-87-3

**Head, Production (Higher Education and Professional) & Publishing Director**
Dr. Jitendra Mehta

**Product Manager**
Dr. K.S. Nama

**General Manager**
Jaya Mehta



Office Address:

**VITAL BIOTECH PUBLICATION**
772, Basant Vihar, Kota,
Rajasthan-324009 India
Visit us at: http://www.vitalbiotech.org
Contact No. +91-9784677044

Printed at: Vital Biotech Publication, Kota

# CONTENTS

Chapter 10

# Climate Smart Agriculture and Carbon Sequestration

**Priyadarshani A Khambalkar[1], Murlidhar Sadawarti[2], Ekta Joshi[1] and Shashi Yadav[1]**

[1]Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, M.P. 474005, India

[2]ICAR-Central Potato Research Institute, Regional Station, Gwalior, M.P. 474020, India

Climate change has become the known fact witnessing all over the world and its impact is been seen in very severe way in recent years which is becoming threat to lives and livelihoods. The climate change mainly driven by increase in atmospheric $CO_2$ concentration which is triggered by the combustion of fossil fuels, deforestation and bad agricultural practices. Agriculture is most vulnerable to global climate change due to their direct dependence on climatic factors such as devastating floods, cyclones, droughts, storms, heat waves, melting of glaciers, changes in pattern and rate of precipitation severly affecting crop productivity leading to the yield loss. Climate smart agriculture is the statigic farming which is sustainable, economical viable and envoirnmaent friendly, includes known techniques like mulching, intercropping, conservation agriculture, crop rotation, integrated crop-livestock management, agroforestry, improved grazing and improved water management and innovative practices like more dependable weather forecasting, early-warning systems and climate-risk insurance. Climate-smart agriculture practices like conservation tillage, cover crops, biochar applications, bioenergy cropping and balance supply of nutrients helps to enhance soil organic carbon (SOC) sequestration and to reduce greenhouse gas emissions while ensuring crop productivity which plays major role in enhancing soil biomass. Adaptation methods like resource-conservation technologies, cropping-system technologies, and socio-economic or policy interventions imparts significant positive impact in sequestering C in soil and helps to develop suitable mitigation options to reduce the production of GHGs

*Futuristic Trends in Agriculture and Allied Sciences*
*ISBN: 978-93-100-0218-8*

**Chapter- 20**

# Status of DTPA-Extractable Micronutrient Cations in Major Rapeseed-Mustard Growing Area of Madhya Pradesh

**Brajkishor Rajput**
Senior Research Fellow, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

**Neha Singh Kirar**
Senior Research Fellow, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

**Ravi Yadav**
Senior Research Fellow, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

**Neelum Bunkar**
Senior Research Fellow, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

---

In balanced plant nutrition, the role of micronutrients is well established. However, exploitive nature of modern agriculture involving use of high analysis NPK fertilizers coupled with limited use of organic manures and less recycling of crop residues are important factors contributing accelerated exhaustion of micronutrients from soil. Enhanced removal of micronutrients as a consequence of adoption of high yielding varieties and intensive cropping together with a shift towards high analysis NPK fertilizers coupled with limited use of organic manures and less recycling of crop residues are important factors contributing accelerated exhaustion of micronutrients from the soils and resulted in the depletion of micronutrient cations from the soil reserves (Dhane and Shukla 1995). Deficiency of micronutrients may either be primary, due to their low total contents or secondary, caused by soil factors reducing their availability to plants. The emergence of micronutrients deficiency has generally been considered as secondary. The availability of micronutrient cations are influenced by several factors such as pH, $CaCO_3$, organic matter, soluble salts, cation exchange capacity and texture of soils. For an effective correction of a micronutrient deficiency in the field, it is necessary to understand the reasons of its deficiency in the soil.

Mustard (*Brassica juncea* L.) is one of the major *rabi* season oil seed crops. In Madhya Pradesh, it is cultivated in 7.57 million hectare with corresponding production of 7.37 million tonnes and an average productivity of 1035 kg/ha. More than 70 percent of this area lies in northern Madhya Pradesh, particularly in the district of Morena, Bhind and Gwalior. (Anonymous, 2009).There are reports of reduction in yield even due to constant use of NPK fertilizers. The reduction in the yield is generally traced due to deficiency of secondary and micronutrients. The micronutrient deficiencies which were sparse and sporadic initially (Takkar and Randhawa, 1980) are now widespread. Inventory of the available

# Advances in Agricultural Biotechnology

**Volume - 8**


**Chief Editor**

**Dr. Sweta Mishra**

Professor, Department of Genetics & Plant Breeding, PG College of Agriculture, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

**Co-Editor**

**Dr. Shailesh Kumar**

Assistant Professor-cum Scientist, Department of Botany and Plant Physiology, FBS & H, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India



**AkiNik Publications** ®

**New Delhi**

**Published By:** AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No.: 9711224068, 9911215212
Website: www.akinik.com
Email: akinikbooks@gmail.com

**Chief Editor:** Dr. Sweta Mishra
**Co-Editor:** Dr. Shailesh Kumar



**Publication Year:** 2023

**Pages:** 171

**ISBN:**

**Book DOI:**

**Price:** ₹ 781/-

**Registration Details**

- Printing Press License No.: F.1 (A-4) press 2016
- Trade Mark Registered Under
  - Class 16 (Regd. No.: 5070429)
  - Class 35 (Regd. No.: 5070426)
  - Class 41 (Regd. No.: 5070427)
  - Class 42 (Regd. No.: 5070428)

# Contents

# Chapter - 5
# *In vitro* Morphogenesis in Gladiolus (*Gladiolus hybridus* Hort.) From Corm Slice


**Authors**

**M.K. Tripathi**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Ram Kanya Malviya**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

**Deepa Bhatt**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**P.N. Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

# Chapter - 5

## *In vitro* Morphogenesis in Gladiolus (*Gladiolus hybridus* Hort.) From Corm Slice

**M.K. Tripathi, Sushma Tiwari, Niraj Tripathi, Ram Kanya Malviya, Deepa Bhatt, P.N. Tiwari and Sharad Tiwari**

**Abstract**

Corm slice explant of gladiolus (*Gladiolus hybridus*) was inoculated on MS medium supplemented with different auxins and cytokinins in variable concentrations as alone in addition to in diverse combinations. Inoculation medium MS2B.5D (MS + 2.0 $mgl^{-1}$ BAP + 0.5 $mgl^{-1}$ 2,4-D) evidenced fine for callus initiation. While MS medium augmented with BA in range of 2.0-3.0 $mgl^{-1}$ in amalgamation with 0.5 $mgl^{-1}$ NAA revealed higher shoot proliferating competence, numbers of shoot (s) per explant along with shoot of higher length. In terms of *in vitro* rooting response, higher root proliferating efficacy was recognized on rooting medium MS.5IB.5Kn (MS + 0.5 $mgl^{-1}$ IBA + 0.5 $mgl^{-1}$ Kinetin), whereas numbers of root (s) with higher length were recovered on rooting medium MS.5IB (MS+0.5 $mgl^{-1}$ IBA). Phenotypically usual plantlets were developed and afterward shifted to pots and hardened in Environmental Growth Cabinet and Net House during initial bearing period and relocated to field efficaciously.

**Keywords:** *Gladiolus hybridus*, corm slice, direct and indirect organogenesis, plantlet regeneration

**Abbreviations:** $B_5$: Gamborg's medium; MS: Murashige and Skoog's medium; Wh: White's medium; BA: 6-benzylaminopurine; TDZ: Thidiazuron; Zea: Zeatin;Kn-Kinetin; NAA: α-Naphthalene acetic acid;2, 4-D: 2, 4-dichlorophenoxyacetic acid;2, 4, 5-T: 2, 4, 5 trichlorophenoxyacetic acid;$GA_3$: Gibberellic acid and IBA: Indole-3-butyric acid

### Introduction

Gladiolus (*Gladiolus hybridus* Hort.) belonging to the family Iridaceae is one of the most imperative bulbous marketable decorative plants cultivated for cut flowers [1-2]. Owing to its wonderful inflorescence with various colours brands it gorgeous for use in herbaceous borders, beddings,

*horticulturae*

MDPI

*Article*

# Optimization of Different Factors for Initiation of Somatic Embryogenesis in Suspension Cultures in Sandalwood (*Santalum album* L.)

**Manoj Kumar Tripathi [1,2,*], Niraj Tripathi [3], Sushma Tiwari [2], Gyanendra Tiwari [1,4], Nishi Mishra [2,5], Dilip Bele [1], Rajesh Prasad Patel [6], Swapnil Sapre [5] and Sharad Tiwari [5]**

1 Horticultural Biotechnology Laboratory, College of Horticulture, Mandsaur-458001, RVS Agricultural University, Gwalior 474002, India; drgyanendratiwari@gmail.com (G.T.); dilipbele2021@gmail.com (D.B.)
2 Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior 474002, India; sushma2540@gmail.com (S.T.); nishimishra554@gmail.com (N.M.)
3 Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India; tripathi.niraj@gmail.com
4 Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India
5 Biotechnology Centre, JN Agricultural University, Jabalpur 482004, India; Swapnil.spr@gmail.com (S.S.); shtiwari@gmail.com (S.T.)
6 Department of Plant Pathology, College of Horticulture, Mandsaur–458001, RVS Agricultural University, Gwalior 474002, India; rajeshpatel179@gmail.com
* Correspondence: drmanojtripathi64@gmail.com

**Abstract:** *Santalum album* (L.) is a prized tropical tree species of high therapeutic and industrial importance. The wood of these naturally grown plants is extensively harvested to acquire therapeutically important metabolite santalol and be used for additional functions such as in wood statuette industries. Due to high demand, it is crucial to maintain a sufficient plant population. An easy protocol for establishing cell suspension culture initiated from the loose embryogenic callus mass of sandalwood was realized by shifting 6–8-week-old morphogenic calli acquired from the mature embryonic axis and cotyledon explant cultures in fluid media. The asynchronous embryogenic cultures were sloughed with clumps of flourishing cell clumps and embryos of various progressive phases along with diffident non-embryogenic tissues. The frequency of embryo proliferation was evidenced to determinethe expansion pace of embryogenic masses under diverse conditions. The intonation of initiation and creation of cell suspension was under the directive of the influence of exogenous plant growth regulators amended in the nutrient medium at different concentrations and combinations. Maximum relative growth rate (386%) and clumps/embryoids in elevated integers (321.44) were accomplished on MS nutrient medium fortified with 2.0 mg $L^{-1}$ 2,4-D in association with 0.5 mg $L^{-1}$ BA and 30.0 g $L^{-1}$ sucrose raised from mature embryonic axis-derived calli. Plantlet regeneration in higher frequency (84.43%) was evidenced on MS medium amended with 1.0 mg $L^{-1}$ each of TDZ and $GA_3$ in conjunction with 0.5 mg $L^{-1}$ NAA and 20.0 g $L^{-1}$ sucrose. Mature embryonic axis-derived calli were found to be constantly better than mature cotyledon-derived calli for raising profitable and reproducible cell suspension cultures. Regenerants displayed normal growth and morphology and were founded successfully in the external environment after hardening.

**Keywords:** cell clumps; cell suspension culture; plantlet regeneration; *Santalum album*; somatic embryogenesis



**Citation:** Tripathi, M.K.; Tripathi, N.; Tiwari, S.; Tiwari, G.; Mishra, N.; Bele, D.; Patel, R.P.; Sapre, S.; Tiwari, S. Optimization of Different Factors for Initiation of Somatic Embryogenesis in Suspension Cultures in Sandalwood (*Santalum album* L.). *Horticulturae* **2021**, *7*, 118. https://doi.org/10.3390/horticulturae7050118

Academic Editor: Kin-Ying To

Received: 16 April 2021
Accepted: 17 May 2021
Published: 19 May 2021



## 1. Introduction

*Santalum album* (L.) is a prized tropical tree species belonging to Santalaceae [1]. It is an occupant of the Indian subcontinent. synonymous with prehistoric Indian culture and convention [2]. Santalol, a secondary metabolite in *S. album*, is identified as sandalwood oil, being exceedingly priced in the perfumery traffic owing to its sugary, constant perfume and

# Effect of Plant Growth Regulators on in vitro Morphogenesis and Regeneration of Amaryllis belladonna L

**Chapter** · September 2023

DOI: 10.22271/ed.book.2356

CITATION
1

READS
1,147

**3 authors:**

Manoj Tripathi
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**253** PUBLICATIONS **3,057** CITATIONS
SEE PROFILE

Niraj Tripathi
Jawaharlal Nehru Krishi Vishwavidyalaya
**172** PUBLICATIONS **2,168** CITATIONS
SEE PROFILE

Sushma Tiwari
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**200** PUBLICATIONS **2,115** CITATIONS
SEE PROFILE

# Chapter - 5
# Effect of Plant Growth Regulators on *in vitro* Morphogenesis and Regeneration of *Amaryllis belladonna* L.


**Authors**

**M.K. Tripathi**

Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Niraj Tripathi**

Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Sushma Tiwari**

Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

# Chapter - 5

## Effect of Plant Growth Regulators on *in vitro* Morphogenesis and Regeneration of *Amaryllis belladonna* L. from Different Explants Cultures

**M.K. Tripathi, Niraj Tripathi, Sushma Tiwari, Devendra K. Payasi, Deepa Bhatt, Yashi Singh Tomar and Sharad Tiwari**

**Abstract**

Bulb scale, leaf disc and mature embryos explants *viz*., were inoculated on diverse fortifications of MS medium to accomplish the best *in vitro* response. For bulb scale explant culture, induction medium MS2N.5B evidenced better for callus initiation. Nutrient medium MS.4Td displayed higher shoot proliferating competence, while number of shoot (s) per explants and shoot of higher length were recognized on culture media MS2N.5B/ MS3N.5B. In respect to leaf disc culture, induction medium MS2D.5B/ MS3D.5B encouraged higher degree of callus induction. Whereas, higher morphogenic calli formation was showed by inoculation medium MS2N.5B/MSN.5B. However, plantlets in higher frequencies were attained on regeneration medium MS.5Td/MSB. Cultured mature embryos initiated calli in higher frequencies on culture medium MS2D.5B, while nutrient medium MSN.5B revealed higher number of shoot proliferating explants. While, number of shoots per explant in higher proportions were attained on nutrient medium MSN.5B/MSB. Nevertheless, shoot of higher length was recovered on culture medium MSB. Higher *in vitro* rooting response (root proliferating efficiency, number(s) of roots and mean root length) was investigated on rooting medium MS2IB. The plantlets were transferred to pots and hardened in Environmental Growth Cabinet followed by Net House during initially weaning period and subsequently transferred to field efficaciously. Phenotypic normal plants were obtained.

**Keywords:** Amaryllis belladonna, bulb scale, mature embryo, leaf disc, organogenesis, somatic embryogenesis and plantlet regeneration

**Abbreviations:** MS-Murashige and Skoog medium; Wh-White's medium; $B_5$: Gamborg's medium; NAA-α-Naphthalene acetic acid; 2,4-D-2,4-dichlorophenoxyacetic acid; 2,4,5-T-2,4,5-trichlorophenoxyacetic acid;

# Plant Regeneration from Cultured Cormel Explants in Gladiolus (Gladiolus hybridus Hort.)

**Chapter** · September 2023

CITATIONS
0

READS
1,011

**6 authors**, including:

Manoj Tripathi
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**253** PUBLICATIONS **3,057** CITATIONS
SEE PROFILE

Niraj Tripathi
Jawaharlal Nehru Krishi Vishwavidyalaya
**172** PUBLICATIONS **2,168** CITATIONS
SEE PROFILE

Sushma Tiwari
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**200** PUBLICATIONS **2,115** CITATIONS
SEE PROFILE

Prakash Narayan Tiwari
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**22** PUBLICATIONS **65** CITATIONS
SEE PROFILE

# Chapter - 6
# Plant Regeneration from Cultured Cormel Explants in Gladiolus (*Gladiolus hybridus* Hort.)


**Authors**

**MK Tripathi**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Ram Kanya Malviya**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

**PN Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

# Chapter - 6

## Plant Regeneration from Cultured Cormel Explants in Gladiolus (*Gladiolus hybridus* Hort.)

**MK Tripathi, Niraj Tripathi, Sushma Tiwari, Ram Kanya Malviya, PN Tiwari and Sharad Tiwari**

**Abstract**

Cormel of gladiolus (*Gladiolus hybridus*) was inoculated on diverse modifications of MS medium supplemented with various auxins and cytokinins in different concentrations as alone along with in diverse combinations. Regarding *in vitro* response, culture medium MS2D.5B/MS2N.5B (MS + 2.0 $mgl^{-1}$ 2,4-D + 0.5 $mgl^{-1}$ BA + 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar/MS + 2.0 $mgl^{-1}$ NAA + 0.5 $mgl^{-1}$ BA + 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar) encouraged higher callus initiation. Inoculation medium MS2N.5B/MSN.5B(MS + 2.0 $mgl^{-1}$ NAA+ 0.5 $mgl^{-1}$ BA+ 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar/MS + 1.0 $mgl^{-1}$ NAA+ 0.5 $mgl^{-1}$ BA+ 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar) displayed higher shoot proliferating efficiency and shoot of higher length, Whilst, higher number of shoot (s) per explant showed by regeneration medium MS3B/MS2B (MS + 3.0 $mgl^{-1}$ BA+ 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar/MS + 2.0 $mgl^{-1}$ BA+ 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar). For *in vitro* rooting, higher root proliferating ability was recognized with rooting medium MS.5IB.5Kn (MS + 0.5 $mgl^{-1}$ IBA + 0.5 $mgl^{-1}$ Kinetin + 15.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$agar), whereas number of root (s) with higher length were convalesced on rooting medium MS.5IB (MS+0.5 $mgl^{-1}$ IBA+15.0 $gl^{-1}$ sucrose+ 7.5 $gl^{-1}$ agar). Phenotypically normal plantlets were attained and subsequently transferred to pots and hardened in Environmental Growth Cabinet and Net House and transferred to field efficaciously.

**Keywords:** *Gladiolus hybridus*, cormel, direct organogenesis, indirect organogenesis, plantlet regeneration, cormlet formation

**Abbreviations**

MS: Murashige and Skoog's medium; $B_5$: Gamborg's medium; Wh: White's medium; BA: 6-benzylaminopurine; TDZ: Thidiazuron; 2-ip: N-isopentenyl amino purine; Kn-Kinetin; NAA: α-Naphthalene acetic acid; 2,

# Effect of Diverse Plant Growth Regulator Concentrations and Amalgamations in Plantlet Regeneration in Rauvolfi....

**Chapter** · February 2023

DOI: 10.22271/ed.book.2087

CITATIONS
4

READS
1,735

**7 authors**, including:

Manoj Tripathi
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**253** PUBLICATIONS **3,057** CITATIONS
SEE PROFILE

Gyanendra Tiwari
Jawaharlal Nehru Krishi Vishwavidyalaya
**39** PUBLICATIONS **522** CITATIONS
SEE PROFILE

Sushma Tiwari
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalay…
**200** PUBLICATIONS **2,115** CITATIONS
SEE PROFILE

Niraj Tripathi
Jawaharlal Nehru Krishi Vishwavidyalaya
**172** PUBLICATIONS **2,168** CITATIONS
SEE PROFILE

# Chapter - 8

## Effect of Diverse Plant Growth Regulator Concentrations and Amalgamations in Plantlet Regeneration in *Rauvolfia serpentina* (L.) Benth from Cell Suspension Culture


**Authors**

**M.K. Tripathi**

Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior Madhya Pradesh, India

**G. Tiwari**

Department of Medicinal & Aromatic Plants, KNK-College of Horticulture, Mandsaur, RVS Agricultural University, Gwalior, Madhya Pradesh, India

Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Sushma Tiwari**

Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior Madhya Pradesh, India

# Chapter - 8

## Effect of Diverse Plant Growth Regulator Concentrations and Amalgamations in Plantlet Regeneration in *Rauvolfia serpentina* (L.) Benth from Cell Suspension Culture

**M.K. Tripathi, G. Tiwari, Sushma Tiwari, Niraj Tripathi, Mohini Sharma, Nishi Mishra and Sharad Tiwari**

**Abstract**

Institution of embryogenic cell suspension culture from the embryogenic callus culture of *Rauvolfia serpentina* (L.) was endeavored by shifting 4-6 weeks-old asynchronous embryogenic calli raised from mature embryo and cotyledon explants cultures in liquid culture. The cultures acquired were swamped frequently with clumps of proliferating globular embryos with modest non-embryogenic tissues. The number and size of somatic embryos/clumps was documented to compute growth of embryogenic tissues under numerous conditions. Initiation and proliferation of embryogenic suspension culture was prejudiced by different exogenous plant growth regulators supplemented to the nutrient medium at changing extent. For the establishment of suspension cultures, MS medium amended with 2.0 mg $l^{-1}$ 2,4-D in association with 0.5 mg $l^{-1}$ BAP was found to be the most operative. For succeeding subculturing, the abridged level of 2,4-D (1.0 mg $l^{-1}$) in association with 0.5 mg $l^{-1}$ BAP encouraged somatic embryogenesis at a faster proportion. Frequent and efficient plantlet regeneration attained on MS medium fortified with 0.5 mg $l^{-1}$, each of BAP, TDZ and NAA. Higher *in vitro* rooting (root proliferating efficiency, numbers of roots and root of higher length) was displayed by rooting medium amended MS basal medium with 0.1 mg $l^{-1}$ IBA. An arrangement of 65% relative humidity and 28 °C temperature regime revealed higher survival of regenerants (~95%) tracked by 60% RH and 30 $^{o}$C (~90%). Later about 85% plants survived after transplantation under the field conditions.

**Keywords:** *Rauwolfia serpentina* L, mature embryo and cotyledon, cell suspension cultures, cell clumps, relative growth rate and plantlet regeneration

***Chapter 7***
Print ISBN: 978-81-19217-40-3, eBook ISBN: 978-81-19217-41-0

# Biotechnological Approaches for Genetic Improvement of Crops

**Tinee Adlak [a], Sushma Tiwari [a*], Madhurjit Singh Rathore [a], Niraj Tripathi [b], Prakash Narayan Tiwari [a] and M. K. Tripathi [a]**

DOI: 10.9734/bpi/cerb/v7/5376C

## ABSTRACT

Biotechnological approaches are being used widely in modern plant breeding for genetic improvement of crops for targeted traits and yield. The conventional breeding methods are mostly based on hybridization and selection of advance breeding lines. Advance biotechnological methods are rapidly being employed for achieving improved varieties in less span of time with desirable traits. These methods include plant tissue culture, molecular breeding, and transgenic methods. Plant tissue culture is helpful in getting somaclonal variants, embryo rescue, and for mass propagation of plants through micropropagation, while molecular breeding is being applied for marker assisted selection, varietal characterization, foreground and background selection and transgenics approaches are being used to transfer gene from different background in genome of crop plants. High throughput genotyping, next generation sequencing and genome editing are some of the recent biotechnological tools being applied for successful crop improvement programme. Current book chapter focused on overview of some of the important biotechnological tools being applied for crop improvement.

*Keywords: Crop improvement programme; plant breeding; genetic improvement; molecular breeding.*

## 1. INTRODUCTION

Crop improvement techniques have a long history and they had been applied since the beginning of domestication of the first agricultural plants. Since then, various new techniques have and are being developed to further increase the commercial value and yield of crops. End of the year 2050 the world population is anticipated to reach up to 10 billion. In this situation, increasing food crop production by 60% over the following decades is necessary to ensure global food

[a] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India.*
[b] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur-482004, India.*
**Corresponding author: E-mail: sushma2540@gmail.com;*

# Seed Technological Innovations *for* Self-Sufficiency in Oilseeds and Pulses

*Authors:*

**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College of Agriculture, Sehore

**International Books & Periodical Supply Service**
*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com

## Contents

# Seed Technological Innovations *for* Self-Sufficiency in Oilseeds and Pulses

*Authors:*

**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College of Agriculture, Sehore

**International Books & Periodical Supply Service**
*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com

## Contents

# Seed Technological Innovations *for* Self-Sufficiency in Oilseeds and Pulses

*Authors:*

**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College of Agriculture, Sehore

**International Books & Periodical Supply Service**
*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com

## Contents

# Seed

## Technological Innovations for Self-Sufficiency in Oilseeds and Pulses

S.K. Rao
S.K. Sharma
R.R. Hanchinal
M. Yasin

# Seed Technological Innovations *for* Self-Sufficiency in Oilseeds and Pulses

*Authors:*

**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College of Agriculture, Sehore

**International Books & Periodical Supply Service**
*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com

# Seed Technological Innovations *for* Self-Sufficiency in Oilseeds and Pulses

*Authors:*

**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College of Agriculture, Sehore

**International Books & Periodical Supply Service**
*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com

*Published by :*

**International Books & Periodical Supply Service**

*(Publisher of Scientific Books)*
38, NISHANT KUNJ, PITAM PURA MAIN ROAD
DELHI-110034 (India)
Phone : 011-27352078, Mobile : 09810146811, E-mail : hkjain1975@yahoo.com



ISBN 978-81-19105-24-3
E-ISBN 978-81-19105-25-0



Composed, Designed & Printed in India

## Contents

# Seed

## Technological Innovations for Self-Sufficiency in Oilseeds and Pulses

Seed is the basic and crucial input for sustained growth in agricultural production. Seeds are not only the repository of the genetic potential of crop species, but are also the carrier of other technologies. Quality seed acts as a catalyst for realizing the potential of all other inputs in agriculture. In order to ensure the availability of high-quality seeds of the improved varieties, considerable progress has been made with respect to development of technologies relevant to seed production, processing, testing, quality control, seed treatment, storage, etc. However, farmers' access to quality seed is still a challenge. This necessitates to bring together the seed scientists, state govt. officials, extension personnel, policy makers and seed industry leaders of the country as well as farmers to review the progress made in seed sector and discuss the new leads, novel technologies in seed multiplication, testing, processing, storage, quality assurance, marketing and distribution; seed policies and legislations, problems and opportunities in the domestic seed supply and export markets, IPR and seed trade issues. In this regard, 11th National Seed Congress on "Recent Advances in Research on Quality Seeds for Self-sufficiency in Oilseeds and Pulses" provided a unique forum for the formulation of policies and technology strategies to ensure the welfare and economic prosperity of the farmers though seed-based interventions. This edited book is a compilation of all lead papers which includes recent advances in seed research which may be highly useful for scientists, extension workers, seed growers, and students for achieving self-sufficiency in oilseeds and pulses. The book focuses on the major themes of quality seed productions and covers the topics like genetic resource management, maintenance and protection; crop diversification and utilization of rice fallows for quality seed production; innovative cropping systems and management; seed production technologies; development, validation and management of seed systems; innovative approaches in seed quality assistance; maintenance of seed quality during storage; seed quality enhancement for improved seed delivery; recent advancements in seed health management; institutions of effective partnerships for augmenting seed availability; seed industry, challenges and remedies; role of seed extension system and farmers expectation; seed development schemes, policies and regulatory issues, etc.


**Dr. S.K. Rao**
Vice Chancellor
RVSKVV, Gwalior

**Dr. R.R. Hanchinal**
Ex-Vice Chancellor
UAS, Dharwad

**Dr. S.K. Sharma**
Director, Research Services
RVSKVV, Gwalior

**Dr. M. Yasin**
Principal Scientist
RVSKVV, RAK College



**International Books and Periodicals Supply Service**
38 Nishant Kunj, Main Road Pitampura, Delhi-110 034 (India)
Phone No. 011 – 27352078, 9810146811
E-mail : hkjain1975@yahoo.com
*Exclusive Distributed by :*
*Satish Serial Publishing House, Delhi-110 033*
Website : www.satishserial.com

ISBN 9788119105243

Rs. : 5950.00

# TRENDS IN AGRICULTURAL SCIENCES

**Mangi Lal Jat**
M.Sc. Research scholar, Department of Extension Education,
College of Agriculture, JNKVV, Jabalpur, MP

**Vijay Kumar**
PhD Research Scholar,
Department of Agronomy,
College of Agriculture
JNKVV, Jabalpur, MP

**Narendra Jat**
PhD Research Scholar,
Department of Agronomy,
Rajasthan College of Agriculture
MPUAT, Udaipur, Rajasthan

**Ram Narayan Kumhar**
M.Sc. Research scholar,
Department of Nematology,
Rajasthan College of Agriculture
MPUAT, Udaipur, Rajasthan

**Kunal Narwal**
Ph.D. Research scholar,
Department of Agronomy,
CSK Himachal Pradesh Agriculture
University Palampur, HP

**VITAL BIOTECH PUBLICATION**
Kota, Rajasthan, India
http://www.vitalbiotech.org/bookpublication/

An International Publishers

VITAL BIOTECH get Accredited by following International organization

ITHAKA
https://www.portico.org/publishers/vital/
101 Greenwich Street, 18th Floor
New York, NY 10006

Published by Vital Biotech Publication
Second Edition: 2022



**Product Form:**
Digital download, online and Paperback

**Edition:**
ISBN: 978-93-92953-04-0

**Head, Production (Higher Education and Professional) & Publishing Director**
Dr. Jitendra Mehta

**Product Manager**
Dr. K.S Nama

**Graphic Designer**
Mukesh Kumar



Office Address:

**VITAL BIOTECH PUBLICATION**
772, Basant Vihar, Kota,
Rajasthan-324009 India
Visit us at: http://www.vitalbiotech.org
Contact No. +91-9784677044

Printed at: Vinayak Printers, Kota

Chapter 19

# Integrated Farming System (IFS) for Sustainable Livelihood Security

**Nisha Singh[1*] and Balkrishan Singh[2]**

[1]Scientist Department of Agronomy under College of Agriculture, RVSKVV, Gwalior

[2]Soil Conservation Inspector under Department of Agriculture, Jhansi Uttar Pradesh

## INTRODUCTION

Integrated farming systems (IFS) is an eco-friendly approach in which waste of one enterprise becomes the input of another thus its make more efficient use of resources from the farm. IFS as a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises. IFS helps in improving the soil health, weed and pest control, increase water use efficiency and maintains water quality. In integrated farming system the use of harmful chemical fertilizers, weed killers and pesticides should be minimized and also provide safeguards to the environment from the adverse effects. Integrated farming system improves economic condition of the small and marginal farmers which enhanced the education, health and social obligations and overall improvement in livelihood security. Though IFS approach the use of chemicals (fertilizers and pesticides) can be reduced to provide chemical free healthy food to the society.

To meet the multiple objectives of poverty reduction, food and nutritional security, competitiveness and sustainability, several researchers have recommended the farming systems approach to research and development. A farming system is the result of complex interactions among a number of inter-dependent components, where an individual farmer allocates certain quantities and qualities of four factors of production, namely land, labour, capital and management to which he has access (Mahapatra, 1994). Farming systems research is considered as a powerful tool for natural and human resource management in developing countries including India. This

# TRAINING COMPENDIUM

## ICAR WINTER SCHOOL

## ON

## Entrepreneurial Development in Agriculture for Sustainable Growth and Reliance

**Feb. 24 - March 16, 2022**


**COLLEGE OF AGRICULTURE**

**Department of Agricultural Extension & communication**

**Gwalior 474005 (M.P.) India**

CHAPTER - 14

# Natural Resource Management in terms of Crop Germplasm in India

*Jaya Rathore, Pramod Kumar and R.S. Sikarwar*

## INTRODUCTION:

The sums total of hereditary material i.e. all the alleles of various genes, present in a crop species and its wild relatives are referred to as germplasm. This is also known as genetic resources or gene pool or genetic stock. Germplasm can be a seed or another parts of the plant e.g., a leaf, a piece of stem, pollen or even just a few cells that can be turned into a whole plant. Germplasm contains the information for a species, genetic makeup a valuable natural resource of plant diversity which plays a vital role for sustainable crop production.

## NEED FOR MANAGEMENT/CONSERVATION OF CROP GERMPLASM:

A wide genetic base is essential for the development of new genotypes capable of surviving under heterogeneous environment. Selecting, collecting, exchanging, and preserving crop germplasm resources are not new activities or issues. They are in fact as old as agriculture itself, as old as our knowledge of growing crops for food. But what is new, and pressing, is how to make national and international decisions about managing these activities for the future.

There is a global recognition that biodiversity at all levels e.g., gene pools, species and biotic communities is important for many reasons but it is being rapidly diminished by habitat destruction and other damaging influences resulting from human population growth, climate change, pollution and economic expansion. Habitat destruction, genetic homogeneity in farming systems and alien species invasion are some of the causes of genetic erosion. Loss of genetic diversity has serious implications on economic and social development of any nation.

Therefore, conservation, management and sustainable use of crop germplasm are the fundamental to ecologically sustainable development and food security of a nation.

## STRATEGIES FOR CONSERVATION OF CROP GERMPLASM

There are two broad strategies for conservation of crop germplasm

1. **IN-SITU CONSERVATION-**

   In in-situ conservation, crop germplasm is maintained in the natural habitats where they occur, whether as uncultivated plant communities or in farmer's fields as part of existing agro-ecosystems. Development of natural park, biosphere reserves, or gene sanctuaries are the methods for achieving in situ conservation of natural biodiversity. NBPGR, New Delhi, established gene

# Chapter - 6
# *In vitro* Regeneration of Sandalwood *(Santalum album* Linn.) Employing Different Explants


**Authors**

**M.K. Tripathi**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, Madhya Pradesh, India
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**G. Tiwari**
Department of Medicinal & Aromatic Plants, KNK-College of Horticulture, Mandsaur 458001, RVS Agricultural University, Gwalior, Madhya Pradesh, India
Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

**Devendra K. Payasi**
Regional Agricultural Research Station, Sagar, Madhya Pradesh, India

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur, Madhya Pradesh, India

# Chapter - 6

## *In vitro* Regeneration of Sandalwood *(Santalum album* Linn.) Employing Different Explants

**M.K. Tripathi, G. Tiwari, Sushma Tiwari, Niraj Tripathi, Devendra K. Payasi and Sharad Tiwari**

**Abstract**

Sandalwood belonging to family Santalaceae is one of the imperative tree species of the tropical forests known for its essential oil employed extensively in perfumery. Three explants *viz*., mature cotyledons, hypocotyls and mature embryos of sandalwood were inoculated on diverse supplementation of MS medium to investigate its *in vitro* response. *In vitro* morphogenesis (somatic embryogenesis and/or organogenesis) leading to plantlet regeneration was prejudiced suggestively owing to various plant growth regulators. Induction media (MS + 2.0 mg $l^{-1}$ 2,4-D) evidenced suitable for callus induction. Nutrient media (MS + 0.5 mg $l^{-1}$ 2,4-D+0.5 mg $l^{-1}$ BA/MS + 1.0 mg $l^{-1}$ 2,4-D+0.5 mg $l^{-1}$BA) induced direct somatic embryogenesis and average number of somatic embryos per explant in higher proportion. Whilst, Induction media (MS + 1.0 $mgl^{-1}$ 2,4-D+0.5 $mgl^{-1}$ BA/MS + 2.0 mg $l^{-1}$ 2,4-D+0.5 $mgl^{-1}$ BA) boosted the frequency of indirect somatic embryogenesis. Culture media (MS + 2.0 mg $l^{-1}$ NAA+0.5 mg $l^{-1}$ TDZ) encourages direct organogenesis and plantlet regeneration *via* direct organogenesis and nutrient medium MS + 1.0 mg $l^{-1}$ NAA+0.5 mg $l^{-1}$ TDZ) supported indirect organogenesis. Regeneration medium (MS + 2.0 mg $l^{-1}$ TDZ+1.0 mg $l^{-1}$ $GA_3$) regenerated plantlets in higher occurrences acquired from somatic embryos, whereas plantlet regeneration *via* indirect organogenic mode was obtained in higher ratio on regeneration medium (MS +1.0 $mgl^{-1}$ TDZ+1.0 $mgl^{-1}$ $GA_3$ +0.5 NAA) for the most of the explants cultures. The plantlets were transferred to pots and hardened in Environmental Growth Cabinet and Net House during initial weaning period and transferred to field efficaciously.

**Keywords:** Santalum album, mature cotyledon and embryo, hypocotyls, organogenesis, somatic embryogenesis, plantlet regeneration

**Abbreviations:** MS-Murashige and Skoog medium; BA-6-benzylaminopurine; TDZ-Thidiazuron; Kn-Kinetin; NAA-α-Naphthalene

***Chapter 7***
Print ISBN: 978-93-5547-791-0, eBook ISBN: 978-93-5547-792-7

# Influence of Plant Growth Regulators on *In vitro* Morphogenesis in *Plumbago Zeylanica* Linn.

**M. K. Tripathi [a, b*], G. Tiwari [c, d], Sushma Tiwari [b], Niraj Tripathi [e], Mohini Sharma [b], Shashank Bhargav [b], S. L. Patidar [c] and Sharad Tiwari [f]**

DOI: 10.9734/bpi/rabs/v7/3679A

## ABSTRACT

The Present investigation was aimed to recognize the most responding explants, plant growth regulators and calculate their optimal concentrations and other physical aspects unveiling *in vitro* morphogenesis in higher rates *via* culturing nodal sections and leaf discs explants. Leaf disc and nodal section explants of *Plumbago zeylanica* were inoculated on basal media amended with diverse concentrations and combinations of different auxins and cytokinins as alone as well as in amalgamations. For inoculated nodal section, nutrient medium MS2N.5B (MS+2. 0 $mgl^{-1}$ NAA+ 0. 5$mgl^{-1}$BA) evidenced appropriate for higher degree of callus initiation (91.69%), whereas culture medium MS2B (MS+2.0 mg $l^{-1}$ BA) displayed higher shoot proliferating competence (84.14%). While, nutrient medium MS2B.5N (MS+2.0 mg $l^{-1}$ BA+0.5 $mgl^{-1}$NAA) formed shoot(s) in higher numbers (11.12) along with of bigger length (7.11 cm). For cultured leaf disc, inoculation medium MS2N (MS+ 2.0 $mgl^{-1}$NAA) induced callus in higher percentage (91.12%), nevertheless greater morphogenic calli formation (45.58%) and plantlets regeneration were attained on culture medium MSN.5Td (MS+1.0$mgl^{-1}$NAA + 0.5 $mgl^{-1}$ TDZ). In current investigation, MS medium amended with either IBA or NAA at the concentration of 0.1 mg $l^{-1}$ was proved to be optimal for inducing higher *in vitro* rooting response *i.e*., root proliferation, number(s) of roots and root length. Regenerants were established efficaciously under the field conditions after hardening with normal phenotypic characters.

---

[a] *Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[b] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
[c] *Department of Medicinal & Aromatic Plants, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[d] *Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[e] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[f] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 8***
Print ISBN: 978-93-5547-791-0, eBook ISBN: 978-93-5547-792-7

# Plant Regeneration in *Rauvolfia serpentina* (L.) Benth *via* Organogenic Mode

**M. K. Tripathi [a, b*], G. Tiwari [c, d], Sushma Tiwari [b], Niraj Tripathi [e], Nishi Mishra [b], Yashi Singh Tomar [b], D. S. Uikey [c] and Sharad Tiwari [f]**

DOI: 10.9734/bpi/rabs/v7/3678A

## ABSTRACT

An effectual protocol for rapid propagation of *Rauvolfia serpentina* has been standardized in present investigation. Leaf discs and nodal segments were inoculated on MS medium supplemented with diverse auxins and cytokinins in variable concentrations as individual along with in different amalgamations. to recognize the most responding explants, plant growth regulators and calculate their optimum concentrations and other culture conditions revealing *in vitro* morphogenesis tracked by plantlet regeneration in higher frequencies by means of nodal segments and leaf discs culture of locally adapted cultivar. For nodal segment culture, basal MS media amended with 2, 4-D/ NAA at the concentration of 2.0 $mgl^{-1}$as alone or in association with 0.5$mgl^{-1}$ TDZ were evidenced meaningly better for callus initiation. However, higher shoot proliferating competence, numbers of shoots per explant with maximum length were recognized on inoculation media reinvigorated with TDZ in the range of 0.2-0.5 $mgl^{-1}$ as sole as well as in association with 0.5$mgl^{-1}$NAA (more than 92% nodal segments initiated shoots, >10.5 shoots/explant and mean shoot length>3.85 cm). Nevertheless, for inoculated leaf disc, maximum callus and morphogenic callus formation along with plantlet regeneration were investigated on culture media supplemented with 2.0 $mgl^{-1}$ auxins: 2,4-D and/or NAA in amalgamation with 0.5$mgl^{-1}$of a cytokinin BA and/or TDZ (more than 76% leaf discs initiated morphogenic calli with >80% regeneration frequencies). Rooting

[a] *Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[b] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
[c] *Department of Medicinal & Aromatic Plants, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[d] *Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[e] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[f] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

Pavan Kumar · R. S. Tomar ·
Jahangeer A. Bhat ·
Manmohan Dobriyal ·
Meenu Rani *Editors*

# Agro-biodiversity and Agri-ecosystem Management

Springer

Pavan Kumar • R. S. Tomar •
Jahangeer A. Bhat • Manmohan Dobriyal •
Meenu Rani
Editors

# Agro-biodiversity and Agri-ecosystem Management

Springer

*Editors*
Pavan Kumar
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

R. S. Tomar
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Jahangeer A. Bhat
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Manmohan Dobriyal
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Meenu Rani
Department of Geography
Kumaun University
Nainital, Uttarakhand, India

ISBN 978-981-19-0927-6 ISBN 978-981-19-0928-3 (eBook)
https://doi.org/10.1007/978-981-19-0928-3



This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Contents

# Genomics Approaches for Restoration and Conservation of Agro-Biodiversity

14

R. S. Tomar, Prabha Singh, Sushma Tiwari, Manoj Kumar Tripathi, Sanjay Singh, K. Bhojaraja Naik, Chandan Kumar Singh, and Shailesh Kumar Singh

**Abstract**

Agro-biodiversity provides foods for living biota along with several things for easy living and survival on the planet. It is in various forms and goods like firewood; approximately two billion population globally utilize firewood as a source of energy for cooking and heating; fiber, like cotton, wool, silk, and flax; drugs, approximately 25% of drugs utilized come from plants; and for construction of household and utilization of timber wood as furniture, sports goods, and many. Nowadays it is an alarming threat because of the reduction in free space, smaller and fragmented habitats, and overexploitation by human for urbanization and fulfillment of their needs. This degradation and destruction have caused imbalance in the nature which has resulted in several calamities and disasters in the recent past. So it is important to protect and conserve the agro-biodiversity to

R. S. Tomar (✉)
College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University, Jhansi, India

P. Singh
Division of Seed Technology, ICAR-IGFRI, Jhansi, U.P., India

S. Tiwari · M. K. Tripathi
Plant Molecular Biology and Biotechnology, RVSKVV, Gwalior, M.P., India

S. Singh
Faculty of Agriculture Sciences, Mandsaur University, Mandsaur, M.P., India

K. B. Naik
ICAR-Indian Institute of Seed Science, Mou, U.P., India

C. K. Singh
ICAR-Indian Agricultural Research Institute, New Delhi, India

S. K. Singh
School of Agriculture, ITM University, Gwalior, M.P., India



P. Kumar et al. (eds.), *Agro-biodiversity and Agri-ecosystem Management*,
https://doi.org/10.1007/978-981-19-0928-3_14

***Chapter 7***
Print ISBN: 978-93-5547-777-4, eBook ISBN: 978-93-5547-778-1

# Massive *In vitro* Propagation from Cultured Nodal Segment of Three *Citrus species*

**Megha Vibhute [a], M. K. Tripathi [a,b*], R. Tiwari [a], Sushma Tiwari [b], Niraj Tripathi [c#], Mohini Sharma [b], Yashi Singh Tomar [b] and Sharad Tiwari [d]**

DOI: 10.9734/bpi/rabs/v6/3508B

## ABSTRACT

Nodal sections excised from *in vitro* grown saplings of three citrus *species viz*., *Citrus aurantiafolia*, *Citrus reticulata* and *Citrus sinensis* were inoculated on diverse modifications of basal MS medium for manifold shootlet production. *In vitro* morphogenesis followed by plant regeneration speckled significantly among species and culture medium fortification. In this investigation, shootlets were developed directly *via* auxiliary bud proliferation along with from callus tissue. Culture medium MS5N.5B/MS5N.Kn (MS + 5.0 $mgl^{-1}$ NAA + 0.5 $mgl^{-1}$BA/Kn) convinced callusing in higher rates. Nutrient medium MS.1Td.5N/MS.5B.5N (MS + 0.1 $mgl^{-1}$ TDZ/0.5 BA + 0.5 $mgl^{-1}$ NAA) boosted plantlet multiplying competence. Whereas, plantlets per explant in higher frequencies (s) of bigger length were recognized on nutrient medium MS.1Td or MS.2Td (MS + 0.1/0.2 $mgl^{-1}$ TDZ). In respect to *in vitro* rooting, root initiating efficacy in higher frequencies was verified on medium MS.5IB (MS + 0.5 $mgl^{-1}$ IBA), while roots in greater numbers were documented on rooting medium MS2IB.5Kn (MS + 2.0 mg $l^{-1}$ IBA + 0.5 mg $l^{-1}$ Kn), whereas nutrient medium MS.5IB.5B (MS + 0.5 mg $l^{-1}$ IBA + 0. 5 mg $l^{-1}$ BAP) improved mean root length. In respect to interspecific *in vitro* response, usually, Acid lime tracked by Mandarin and Sweet orange performed authoritatively for the almost culture stages. The *in vitro* developed shootlets were efficaciously adapted and shifted under field conditions.

*Keywords: Citrus aurantiafolia; citrus reticulata; citrus sinensis; nodal segment culture; direct and indirect organogenesis and plantlet regeneration.*

---

[#] *Directorate of Research Services;*
[a] *Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[b] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior - 474002, India.*
[c] *Jawaharlal Nehru Agricultural University, Jabalpur - 482004, India.*
[d] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur - 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

**Biography of author(s)**

**Mrs. Megha Vibhute**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.

She is working as SMS Horticulture at KVK Burhanpur (M.P.), India. She completed her B.Sc. in Horticulture in 2007 & M.Sc. in Horticulture (Fruit Science) in 2009 from KNK College of Horticulture, Mandsaur, JNKVV, Jabalpur, M.P, India. She did her thesis on Effect of Plant Growth Regulators on In vitro Response of Diverse Explant Cultures of Three Different Citrus species. She has experience of 10 years in the field of Horticulture Extension. She conducted 30 OFTs, 30 FLDs, 50 training programs and 20 Extension Activities. She had membership of 2 societies. She also received young scientist award from Agricultural Technology Development Society, Ghaziabad, U.P. in 2017. She has major Contribution in promotion of technologies in the Burhanpur district: Use of Plastic Mulch & Drip Irrigation in Water Melon (technology spread 95%); Crop Diversification- Introduction & expansion of turmeric Crop in the District area increased from 350 ha to 700 ha; Expansion of spices Crop Ajwain & Varietal Replacement In the District Area Increased up to 298 acre (68 % ) and old traditional var with New Var.Ajmer Ajwain-1; Promotion of banana Based Intercropping. 10% area covered under Intercropping. Use of Skirting bag in Banana to combat the Biotic & Abiotic stresses 10 % Area covered against total Banana Area and Fertigation Technology In Banana Promoted ferti-Irrigation technology in Banana (75% Area). She has 10 research papers published in national and international journals, 30 Abstracts, 15 Popular articles, 60 Articles, 05 folders, 02 booklets, 12 success stories along with 07 radio talks and 04 T.V Talks.

**Prof. M. K. Tripathi**
Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India and Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior - 474002, India.

He is working as Professor and Head of Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 140 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 20 book chapters.

**Dr. Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior - 474002, India.

She is working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards *i.e.*, emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Dr. Niraj Tripathi**
Jawaharlal Nehru Agricultural University, Jabalpur - 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya; Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. He has published one book, six chapters and seventy seven research papers in national and international journals.

**Mohini Sharma**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior - 474002, India.

She is working as Guest Faculty in Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, I ndia. She is a freshy in the field of research, extension and teaching. She received JNU (DBT) scholarship during Masters.

**Yashi Singh Tomar**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior - 474002, India.

She is working as Project Assistant under Institutional Project in Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. She is a freshy in the field of research and has completed her M.Sc (Ag) in Genetics & Plant Breeding form College of Agriculture, RVSKVV, Gwalior and published two research papers and received best thesis award.

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur - 482004, India.

He is Dean of oldest and biggest College of Agriculture Madhya Pradesh at Jabalpur and Director of Biotechnology Centre of prestigious Jawaharlal Nehru Agriculture University, Jabalpur, India. He also held the posts of Director Farms and Professor and Head of Plant Breeding and Genetics Department (2016-2019) at the same university. After completing BSc Govt Science College, Jabalpur in 1976 went for further studies at JNKVV for MSc in Plant Breeding & Genetics. He joined as Assistant Professor (Plant Breeding & Genetics) in 1980 and in 1984 proceeded to Russian State Agrarian University - Agricultural Academy in Moscow for PhD. He was a Visiting Scientist in 2004 at UAH, Alabama, USA. Has also travelled UK, Germany, Japan, Italy, Taiwan, South Africa, Hungary, Ukraine, Kazakhstan, Serbia for various scientific purposes. Presently he is the councilor (Central Zone) of Indian Society of Genetics and Plant Breeding since 2018 and fellow and member of several scientific communities. He Handled 13 national and international level projects as PI funded by ICAR, DBT, DST, DoAC and JICA and developed micropropagation protocols of several medicinal plants and several crops including soybean, transgenic oat lines over-expressing fungal phytase gene and BYMV resistant lines using reverse transcriptase, evaluated molecular marker for various traits in soybean for gene-based cultivar

selection and characterized whitefly and YMV with molecular markers for soybean disease control in MP, isolated several plants growth-promoting rhizobacteria (PGPR) from the rhizosphere displaying various direct plant growth promoting attributes and generated more than 600 sequences for different genes generated from PGPRs have been published in the NCBI domain, performed DNA fingerprinting of major crops, including soybean, minor millets and different medicinal plant species. Filed a patent on newly developed methods for genotype identification based on simple sequence repeats marker data in 2017, which is under review. He also revealed DNA barcode in various medicinal plants with universal markers A patent "DNA barcode for species identification of sedge plants and methods thereof" was granted earlier this year. Another patent on DNA barcoding coupled high resolution melting analysis is under review. As a breeder he developed 2 varieties of rice and collaborator in 2 varieties of soybean (JS 20-94 and JS 20-116) and one variety of chickpea. He has teaching experience of more than 40 years and guided 59 post-graduate and 14 doctoral students in Agriculture Biotechnology and Plant Breeding & Genetics. He is a Supervisor/Mentor of five National Post-doctoral Fellow from DBT, DST and CSIR. He has published more than 110 Scientific Papers (out of which 29 are on soybean) in refereed journals, more than 60 papers presented in conferences, 01 book and 12 Book chapters.

***Chapter 11***
Print ISBN: 978-93-5547-668-5, eBook ISBN: 978-93-5547-669-2

# Assessment of Groundnut Germplasm Lines for Foliar Fungal Diseases and Population Structure Analysis using Gene Based SSR Markers

**Punam Chand Bhawar [a], Sushma Tiwari [a*], M. K. Tripathi [a], R. S. Sikarwar [b], R. S. Tomar [c] and Niraj Tripathi [d]**

DOI: 10.9734/bpi/rdst/v4/2308B

## ABSTRACT

**Introduction:** Peanut (*Arachis hypogaea* L.) is an exceptional cash crop having versatile applications of each plant part. Rust and late leaf spot (LLS) are two main foliar fungal diseases of groundnut and can cause yield damage up to 70%. Employment of fungicide is expensive approach and it is not environment-friendly also, consequently breeding new cultivars with genetic resistance is sustainable, eco-friendly and cost-effective method.
**Aim:** The present investigation aimed to screen groundnut germplasm lines employing allele specific molecular markers against foliar fungal diseases (LLS and rust).
**Study Material:** The present investigation contained 30 uncharacterized germplasm lines along with 4 check varieties of peanut. A set of 4 gene based SSR molecular markers were designated for screening of groundnut germplasm lines against foliar fungal diseases *i.e*., LLS and rust.
**Results:** For polymorphic SSR markers, a total of 14 alleles were identified, with an average of 3.5 alleles per locus. With an average of 0.47, the gene diversity and Polymorphic Information Content (PIC) values ranged between 0.3972-0.5778. In a UPGMA tree based on SSRs, the genetic links between peanut genotypes are shown. Four major demographic groups were formed using principle coordinate analysis (PCA) depending on origin. The population structure of the 34 genotypes was assessed employing STRUCTURE v2.3.3 software based on SSR markers. The optimum K value was determined by employing Structure Harvester, where the highest peak was observed at delta K = 2. The number of sub populations (K) was identified based on maximum likelihood and delta K (dK) values, with two core and pure groups and an admixture group. Present investigation identified four germplasm lines *viz*., AH8054, CS21181, CS708 and Akola White that may be used as foliar disease resistant cultivar for groundnut hybridization and improvement programme.

*Keywords: Groundnut germplasm; SSR markers; population structure; PCoA.*

## 1. INTRODUCTION

Peanut (*Arachis hypogea* L.) is one of the most important oilseed crops grown in the semi-arid tropics. It is an imperative self-pollinated oilseed crop cultivated in more than 100 nations with diverse agro-climatic situations on around on ~27.9 Mha land with worldwide yield of 47 metric tons in 2017 [1-5]. India positions leading with occupying cultivated area of 5.31 Mha (FAOSTAT 2017). Groundnut is one of the most important crops grown during the Kharif season, with Gujarat leading the way, followed by Andhra Pradesh, Tamil Nadu, Rajasthan, and Karnataka. The cultivated peanut (*Arachis hypogaea* L.) is an allotetraploid (2n = 4x = 40) with a genomic size of 2891 Mbp that evolved from a single hybridization and polyploidization event in South America. Peanut sub-genomes contain about

*[a] Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
*[b] Department of Genetics & Plant Breeding, College of Agriculture, RVS Agricultural University, Gwalior, 474002 M. P, India.*
*[c] Rani Laxmibai Central Agricultural University, Jhansi, India.*
*[d] Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: sushma2540@gmail.com;*

**Biography of author(s)**

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is presently working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards i.e., emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**M. K. Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and In charge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. he has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 16 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

\

**Dr. R. S. Sikarwar**
Department of Genetics & Plant Breeding, College of Agriculture, RVS Agricultural University, Gwalior, 474002 M. P, India.

He is working as an Assistant Professor and in charge AICRP on Groundnut, Department of Genetics & Plant Breeding, RVSKVV, College of Agriculture, Gwalior, India. He has 23 years' experience in the field of Research, Extension and Teaching. He is the recipient of many National and International Awards in different scientific occasions. He supervised 03 PhD scholars and 09 M.Sc. (Ag) students. Presently he supervises 05 PhD scholars and 07 M.Sc. (Ag) students and their works are in progress. He has handled four projects funded by Central Government of India. he has presented more than 35 research papers in different National and International conferences. He is an author or co-author of more than 61 research papers published in reputed National and International Journals. He is also the author or editor of 01 Practical Manuals and 02 book chapters. He is the member of 5 scientific societies and Journals.

**Dr. R. S. Tomar**
Rani Laxmibai Central Agricultural University, Jhansi, India.

He is presently working as a faculty in the discipline of Biotechnology in College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi, Uttar Pradesh, India. He has good research experience of conventional and molecular breeding in crops like rice, wheat, soybean and lentil. He has worked on improvement of wheat under both biotic and abiotic stress as well as hybrid wheat development. He has worked as SRF, RA-PDF in ICAR-IARI, New Delhi; ICAR-NIPB, New Delhi and Laval University Quebec City, Canada. He has so far published more than 80 research papers in high impact National and International journals like Science, Molecular Breeding, BMC Genomics, Plos One, IJMS, Frontiers in Science, Plant Breeding, etc., 02 books, 02 practical manuals and 10 book chapters. He is editor and reviewer of highly rated journals like PLOS ONE, Plant Physiology and Molecular Biology Reports, Indian Journal of Genetics & Plant Breeding and IJAS. He has been awarded Fellow of Indian Society of Genetics & Plant Breeding, New Delhi. He has been facilitated with several Awards: Scientist Associate Award, 2016, Jr. Scientist Award, 2016, Young Biotechnologist Award, 2017, Eminent Scientist Award, 2017 and Distinguished Scientist Award, 2017.

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovations on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, six chapters and seventy-seven research papers are published to his credit.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
Current Journal of Applied Science and Technology, 39(2): 75-84, 2020.

**Reviewers' Information**
(1) Elizabeth Amelia Alves Duarte, Faculty Maria Milza, Brazil.
(2) Mohamed A. El-Esawi, Tanta University, Egypt.

***Chapter 7***
Print ISBN: 978-93-5547-521-3, eBook ISBN: 978-93-5547-522-0

# Standardization of *In-vitro* Regeneration Protocol in *Gerbera jamesonii Bolus* Ex Hooker F.

**Deepa Bhatt [a], M. K. Tripathi [a,b*], M. Vidhya Sankar [c], Sushma Tiwari [b], Mohini Sharma [b], Niraj Tripathi [d] and Sharad Tiwari [e]**

DOI: 10.9734/bpi/ctas/v7/2303B

## ABSTRACT

**Introduction:** The gerbera belong to the family Asteraceae is the chief cut flowers and ranks among the top ten cut flowers in the universe. For commercial propgation of this plant species, planting material is required on large-scale which requires the employment of plant tissue culture techniques for massive *in vitro* propagation.
**Study Objectives:** In this investigation**,** an effort was made to compute optimal concentration of plant growth regulators added in culture medium and optimize other physical factors exhibiting higher *in vitro* response by culturing mature embryo *in vitro*.
**Results:** Nutrient media MS3D.5B (MS + 3.0 $mgl^{-1}$ 2, 4 D + 0.5 $mgl^{-1}$BA + 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar powder) evidenced more appropriate for callus initiation. Inoculation media MS2N.5iP/MS3N.5ip (MS + 2.0/3.0mg $l^{-1}$ NAA + 0.5 $mgl^{-1}$2-ip + 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar) displayed higher *in vitro* response *i.e.,* numbers of shoot proliferating explants and numbers of shoot (s) per explant. While, shoot of higher length was recovered on culture medium MSB/MS2B (MS + 2.0/3.0 $mgl^{-1}$BA + 30.0 $gl^{-1}$ sucrose + 7.5 $gl^{-1}$ agar). Enhanced *in vitro* rooting response (root proliferating efficiency, numbers of roots and root of higher length) were documented on rooting medium MS.1IB (MS + 0.1 $mgl^{-1}$IBA + 15.0$gl^{-1}$ sucrose + 7.5 g $l^{-1}$ agar). The regenerants were transferred to pots and hardened in Environmental Growth Cabinet and net House and subsequently shifted to field conditions efficaciously. Phenotypic normal plants were acquired.

*Keywords: Gerbera jamesonii; mature embryo culture; direct and indirect organogenesis; direct and indirect somatic embryogenesis and plantlet regeneration.*

## ABBREVIATIONS

*MS : Murashige and Skoog medium;*
*NAA : α-Naphthalene acetic acid;*
*2, 4-D : 2, 4-dichlorophenoxyacetic acid;*
*2, 4, 5-T : 2, 4, 5 - trichlorophenoxyacetic acid;*
*BA : 6-benzylaminopurine;*
*Kn : Kinetin;*
*TDZ : Thidiazuron;*
*2-ip : N-isopentenyl amino purine;*
*IBA : Indole-3-butyric acid.*

*[a] Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
*[b] Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
*[c] Department of Floriculture and Landscaping, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
*[d] Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
*[e] Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 1***
Print ISBN: 978-93-5547-612-8, eBook ISBN: 978-93-5547-620-3

# Plantlet Regeneration from Cultured Nodal Segments in Sandalwood (*Santalum album* Linn.)

**M. K. Tripathi [a, b*], D. Bele [a], Sushma Tiwari [b], Nishi Mishra [b, e], Niraj Tripathi [c], G. Tiwari [a, d] and Sharad Tiwari [e]**

DOI: 10.9734/bpi/rdst/v2/6011F

## ABSTRACT

**Study Objectives:** An effort has been made to compute the optimal quantity of plant growth regulators to be added in culture medium and other physical factors exhibiting higher *in vitro* morphogenesis with 'elite' lines of sandalwood by culturing nodal segment.
**Results:** Higher percentage of direct somatic embryogenesis, number(s) of somatic embryo per explant and plantlet regeneration *via* direct organogenesis were evidenced on MS medium augmented with a moderate concentration of TDZ (1.0 $mgl^{-1}$) in combination with comparatively a lower concentration of NAA (0.5 $mgl^{-1}$). A comparative higher concentration of BAP (1.0-2.0 $mgl^{-1}$) in amalgamation with a lower concentration of NAA (0.5 $mgl^{-1}$) encouraged frequency of indirect somatic embryogenesis. From culture media fortified with a greater concentration of BA at 4.0 mgl-$^{1}$ in combination with a lower concentration of NAA, the proportion of organ development directly from the surface of cultured explants was recovered (0.5 mgl-$^{1}$). Maximum plantlets regenerated *via* somatic embryogenesis (direct and/or indirect) on regeneration medium fortified with 2.0 $mgl^{-1}$TDZ in combination with 1.0 mg $l^{-1}GA_3$, while plantlets in higher frequencies *via* indirect organogenesis was achieved with regeneration medium modified with relatively lower concentration of TDZ (1.0 mg $l^{-1}$) in amalgamation with 0.5 $mgl^{-1}$ $GA_3$ and 0.5 $mg^{l-1}$ NAA. The plantlets were transferred to pots and hardened in Environmental Growth Cabinet and Net House during initial weaning period and shifted to field magnificently. Morphologically usual plants were obtained.

*Keywords: Santalum album; nodal segment culture; somatic embryogenesis; organogenesis; plantlet regeneration.*

## ABBREVIATIONS

*MS-Murashige and Skoog Medium; BA-6- Benzyl aminopurine; TDZ-Thidiazuron; KN-Kinetin; NAA-Naphthalene acetic acid; 2,4-D-2,4-Dichlorophenoxyacetic acid; 2, 4, 5-T - 2, 4, 5-Trichlorophenoxyacetic acid; IBA-Indole-3- Butyric acid; $GA_3$: Gibberellic acid.*

## 1. INTRODUCTION

Sandalwood is medium-sized hemi parasitic trees and distinguished members are Indian sandalwood (*Santalum album* L.) and Australian sandalwood (*Santalums picatum*). Indian sandalwood belonging to the family santalaceae which is one of the imperative tree species of tropical forests since it crops essential oil in the heartwood which is employed widely in the enrage and perfumery industry [1,2,3].

[a] *Department of Medicinal and Aromatic Plants, KNK-College of Horticulture, Mandsaur – 458001, RVS Agricultural University, Gwalior, M.P., India.*
[b] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV Agricultural University, Gwalior, 474002 M.P., India.*
[c] *Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, India.*
[d] *Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, India.*
[e] *Biotechnology Centre, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 11***
Print ISBN: 978-93-5547-612-8, eBook ISBN: 978-93-5547-620-3

# Production of Synthetic Seed from Encapsulated Nodal Segments of Giloe (*Tinospora cordifolia* Willd.)

**Sonali Singh [a], M. K. Tripathi [a*], Sushma Tiwari [a], Niraj Tripathi [b], G. Tejovathi [c], Ashok Ahuja [a] and Sharad Tiwari [d]**

DOI: 10.9734/bpi/rdst/v2/2400B

## ABSTRACT

*Tinospora cordifolia* (Willd.) Miers is generally acknowledged as giloe belong to the family Menispermaceae employed for medicinal purpose, particularly in Ayurveda for curing different diseases.

Standardization of the concentration of encapsulation matrix and hardening solution affecting the frequency of germination to plant idyllic synthetic seeds of *Tinospora cordifolia* tracked by an efficient plantlet regeneration.

The current investigation was carried out at Plant Tissue Culture & Genetic Transformation Laboratory, Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, M.P., India during 2017 to 2020.

A procedure was recognized for encapsulation of nodal segments of *Tinospora cordifolia* excised from 18-month-old *in vitro* derived plants for short-term conservation and further propagation. Conservation strategies prerequisite to be implemented for constant supply to encounter the ever-increasing demands and sustainable utilization of resources. Diverse concentrations and combinations of gelling matrix *viz*., sodium alginate and complexing agent *i.e*., Calcium chloride were experienced to optimize amalgamation to achieve uniform beads.

The best gelling composition was established using 2.5% sodium alginate and 100 mM calcium chloride. The maximum conversion rate of encapsulated beads was attained on Murashiage and Skoog's medium amended with 2.0 $mgl^{-1}$ BAP in association with 0.2$mgl^{-1}$ NAA. Well, established regenerants were hardened successfully, acclimatized and established first under net house circumstances tracked under field conditions.

In this research, syn seed production procedure in giloe (*Tinospora cordifolia*) has been standardized. Current method warrants feasible tactic for multiplication, conservation and germplasm exchange through artificial, seed development.

*Keywords: Giloe; synthetic seed; micropropagation; encapsulation; germplasm conservation; plantlet regeneration.*

## ABBREVIATIONS

*$CaCl_2.2H_2O$: Calcium chloride; BA: Benzyl adenine; IBA: Indole-3-butyric acid; NAA: α-naphthalene acetic acid; MS: Murashiage and Skoog medium; PGR: Plant growth regulators.*

[a] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002, M.P., India.*
[b] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, M. P., India.*
[c] *VISM Group of Studies, Gwalior, 474002 M.P., India.*
[d] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, M.P., India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 4***
Print ISBN: 978-93-5547-120-8, eBook ISBN: 978-93-5547-121-5

# Morpho-physiological and Molecular Characterization of Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] Germplam Lines for Drought Tolerance

**M. L. Choudhary[1], M. K. Tripathi[1*], Sushma Tiwari[1], R. K. Pandya[2], Neha Gupta[1], Niraj Tripathi[3] and Prerana Parihar[2]**

DOI: 10.9734/bpi/nvst/v5/2541E

## ABSTRACT

**Objectives:** The present investigation was commenced to analyze presence of possible genetic diversity among different pearl millet germplasm lines by means of diverse drought linked morpho-physiological traits along with SSR molecular markers.
**Study Design:** In the present investigation, 96 pearl millet germplasm lines were screened against drought using different morphological and physiological traits along with SSR markers.
**Place and Duration of the Study**: The present study was conducted at College of Agriculture, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, M.P., India during July 2019 to December, 2020.
**Methodology:** The study was conducted to record different morphological and physiological traits related to drought tolerance and susceptibility. Thirty-five microsatellite markers were also used in laboratory to analyze the variability among pearl millet genotypes under study.
**Results:** Pearl millet genotypes were grouped according to their morpho-physiological characteristics. Among 35 SSR markers, twenty-two were successfully amplified across all germplasm lines and seven SSR markers were found to be polymorphic and fifteen markers were monomorphic. All seven polymorphic SSR markers were used consequently for amplification of all the 96 germplasm lines. The range of PIC value was 0.0939 to 0.2980 with an average of 0.2274. The highest PIC value was recorded for the markers Xibmsp26 and Xibmsp29 (0.2980) followed by Xibmsp03 (0.2392), Xibmsp29 (0.2392), Xibmsp06 (0.2289) and Xibmsp07 (0.1948) while the lowest for the marker Xibmsp01 (0.0939). The range of major allele frequency value was 0.7604 to 0.9479 with an average of 0.8363. The range of genetic diversity value was 0.0987 to 0.3644 with an average of 0.2665.
**Conclusions:** According to the morpho-physiological data a total of 22 pearl millet genotypes were found to be grouped distantly from rest of the genotypes. These genotypes may be drought tolerance as they are linked with drought tolerant morpho-physiological traits however, rests of the genotypes were found to be susceptible against drought.

*Keywords: Pearl millet; drought tolerance; genetic diversity; polymorphism; molecular markers.*

## 1. INTRODUCTION

Pearl millet is a $C_4$, annual and diploid species. It belongs to family poaceae. The present legitimately believed name of pearl millet is *Pennisetum glaucum* (L.) R. Br. [1]. It is supposed to have originated from West Africa [2,3] from where it spread into India and other countries. It is cultivated in the arid tropical region and semi-arid areas of Asia and Africa [4]. It is a primary food for most of the countries

*[1]Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.*
*[2]Department of Plant Pathology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.*
*[3]Directorate of Research Services, JN Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com, drmanojtripathi@gmail.com;*

**Biography of author(s)**

**Mr. M. L. Choudhary**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

He completed his B.Sc. (Hons.) Agriculture from Sri Karan Narendra Agriculture University, Jobner in 2018 and M.Sc. (Ag.) in Plant Biotechnology from Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior in 2021. His M.Sc. research was on Molecular, biochemical and morpho-physiological aspect of drought tolerance in pearl millet. He published one research paper and three abstracts.

**Prof. M. K. Tripathi**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior having 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 18 M.Sc. (Ag) students during their Doctoral and Masters degree. He designed innovative course curriculum of Biotechnology for different departments of Masters Degree. He has handled many projects funded by State as well as Central Government of India. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 120 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 3 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 10 scientific journals.

**Dr. Sushma Tiwari**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

She is presently working as Scientist in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has received several awards i.e., Emerging Scientist Award, Distinguished Scientist Award, Scientist of the year award and Young scientist award from different scientific societies. She is teaching courses of Molecular Biology and Biotechnology to Under Graduate, Post Graduate and PhD students since 2016. She has guided more than 10 MSc and 5 PhD students as major advisor (01) and member of advisory board. She is actively associated with several scientific bodies including life term member of Indian Society of Genetics and Plant Breeding (ISGPB), New Delhi; National Environmental Science Academy (NESA), New Delhi; Society for Scientific Development and Agriculture Technology (SSDAT); Indian Society of Genetics, Biotechnology Research & Development (ISGBRD), New Delhi. Recently, she has been elected as member of National Academy of Sciences, India. She has so far published more than 40 research papers in high impact National and International journals including PlosOne, Plants, Plant Breeding, Journal of Biochemistry and Biotechnology and Indian J of Genetics and Plant breeding etc. and participated in more than 25 National and International Conferences, Seminars, Workshops and Trainings. She is a reviewer of several national and international journals with high impact factors.

**Prof. R. K. Pandya**
Department of Plant Pathology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

He is working as Professor and Principal Scientist in the Department of Plant Pathology, College of Agriculture, Gwalior, since July, 2006. Earlier he joined his service as assistant professor in April, 1988 and associate professor from July, 1998 to July, 2006. He supervised eight Ph.D. and more than thirty M.Sc. students as chairman of advisory committee. He published more than fifty research papers in national and international journals. Beside this three books, two practical manuals and five book chapters in his credit. He has more than thirty five years of research experience and thirty years of teaching experience. Presently he is also working as in charge of pearl millet research at Gwalior AICRP on Pearl millet.

**Dr. Neha Gupta**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

She did Ph.D. at School of Studies Biotechnology, Jiwaji University, Gwalior, M.P, India. She has 2 years of teaching experience as associate faculty at biotechnology department, college of agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya Gwalior. She is a recipient of prestigious NASI-Springer Award (Biological Sciences) in 2017. She acquired academic excellence award offered by Jiwaji University, Gwalior in the year 2018 and 2019. She worked on characterization of chickpea proteins/peptidesvis-a-vis ACE inhibition, anticancer activity and anti-diabetic attributes. She has more than five years of research experience on animal cell culture and plant genome analysis employing PCR based markers. She authored 1 book and 5 book chapters. She has published 35 research papers in reputed national and international journals.

**Dr. Niraj Tripathi**
Directorate of Research Services, JN Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, five chapters and seventy five research papers are published to his credit.

**Mrs. Prerana Parihar**
Department of Plant Pathology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

She is a Ph.D. Research scholar (Plant Pathology). She did her B.Sc. (Ag.) in 2016 from IGKV, Raipur, (C.G.) and M.Sc. (Ag.) in 2018 from College of Agriculture, RVSKVV, Gwalior, India. She did her M.Sc. on Study and management of Pearl millet blast incited by *Pyricularia grisea* (Cooke) Sacc. She has published five research papers and 18 Popular articles in international, national journal and magazines of repute. She wrote one book chapter on the subject. Presently she is working on "Characterization of Pearl millet blast pathogen [*Pyricularia grisea* (Cooke) Sacc.] and it's strategic management" for her Ph.D. (Plant Pathology) program at RVSKVV, Gwalior, Madhya Pradesh under the guidance of Prof. R.K. Pandya.

---



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
Current Journal of Applied Science and Technology, 40(5): 46-63, 2021.

**Reviewers' Information**
(1) Moumouni Konate, Institute of Environment and Agriculture Research (INERA), Burkina Faso.
(2) Ummara Waheed, MSN-University of Agriculture, Pakistan.

***Chapter 1***
Print ISBN: 978-93-5547-515-2, eBook ISBN: 978-93-5547-520-6

# Biotechnological Interventions to Combat against Charcoal Rot and *Rhizoctonia* Root Rot Diseases of Soybean [*Glycine max* (L.) Merrill]

**Shikha Upadhyay [a], A. K. Singh [b], M. K. Tripathi [c], Sushma Tiwari [c] and Niraj Tripathi [d*]**

DOI: 10.9734/bpi/ctas/v6/3250E

## ABSTRACT

Soybean is a prime legume in a world's oilseed cultivation set-up. Yield of soybean hampered by several biotic and abiotic stresses including drought. Among different biotic stresses, Charcoal rot and *Rhizoctonia* root rot are the leading diseases for a huge damage in soybean production and still there is no prominent work has been done effectually to address these problems. Biotic stresses can be controlled by using an integrated management approach either by cultural practices including crop rotation, tillage, irrigation, or chemical control like seed treatments could be employed to diminish damage instigated by fungal pathogen in soybeans. The current study was conducted with the objective to characterize soybean genotypes for yield and its accrediting characters along with validation of gene-based SSR molecular markers against charcoal rot and *Rhizoctonia* root rots diseases. On the basis of different traits, genotypes *viz.,* JS335, JS20-69, JS97-52, KDS980 and KDS992 were found to be the most divergent and promising genotypes and may be employed as parents in future hybridization programme to breed tolerance/ resistance against *Rhizoctonia* root rot and charcoal rot by means of conventional and/or molecular breeding approaches.

*Keywords: Molecular breeding; hybridization; fungal diseases; oil seed; SSR markers.*

## 1. INTRODUCTION

Soybean [*Glycine max* (L.) Merr] (2n=40) is a commercially imperative dicot legume in a world's oilseed cultivation scenario, having a prominent position in terms of high productivity, profitability and maintaining soil fertility too [1-5]. On account of its miscellaneous usages and limitless benefits, it is rightly called as "golden bean", "miracle bean" or "wonder crop" of the 20$^{th}$ century [4]. Soybean contributes to our country's economy and foreign earnings by donating 42 percent and 25 percent of national oilseeds and edible oil production, respectively. [6-11]. It encompasses essential amino acids predominantly glycine, tryptophan and lysine, analogous to cow’s milk and animal proteins. After the United States, Brazil, Argentina, and China, India ranked fourth in terms of worldwide soybean producing area (11 million ha) and fifth in terms of production (11 million metric tonnes). Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, and Andhra Pradesh are India's top soybean-producing states, with 96 percent of production subsidized in decreasing order of production.

Yield of soybean hampered by several biotic [12-16] and abiotic stresses including drought [17-21]. Comprehensive gamut biotic stress which decreases both yield and seed quality is Charcoal rot instigated by the soil borne polyphagous fungus *Macrophomina phaseolina* (Tassi) Goid. This

[a] *Department of Genetics & Plant Breeding, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.*
[b] *Office of Director of Instructions, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.*
[c] *Department of Plant Molecular Biology& Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.*
[d] *Directorate of Research Services, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004, India.*
**Corresponding author: E-mail: tripathi.niraj@gmail.com;*

**Biography of author(s)**

**Shikha Upadhyay**
Department of Genetics & Plant Breeding, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.

Shikha Upadhyay received her BSc. (Ag) degree from Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh and M.Sc. (Ag) from Department of Genetics and Plant Breeding from Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh. Currently she is pursuing PhD in Genetics & Plant Breeding at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. She is co-author in many research papers and abstract in journals. Her research interests include Plant Breeding, Tissue culture & Molecular Biology.

**M. K. Tripathi**
Department of Plant Molecular Biology& Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. he has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 6 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Sushma Tiwari**
Department of Plant Molecular Biology& Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior 474002, India.

Dr. Sushma Tiwari, is presently working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining

aspects for biotic and abiotic stresses of crops. She has received several awards *i.e.*, emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, six chapters and seventy seven research papers are published to his credit.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
International Journal of Advanced Biological Research, 10 (2) 2020: 137-144.

***Chapter 11***
Print ISBN: 978-93-5547-180-2, eBook ISBN: 978-93-5547-188-8

# Analysis of Genetic Differences in fatty Acids and Oil Contents among Brassica *juncea* (Linn.) Czern & Coss Genotypes

**Chitralekha Shyam [a], Manoj Kumar Tripathi [a, b*], Niraj Tripathi [c], Sushma Tiwari [b] and R. S. Sikarwar [a]**

DOI: 10.9734/bpi/rdst/v1/6010F

## ABSTRACT

**Study Objectives:** The experimentation was steered to assess erraticism among 188 Indian mustard genotypes owing to assorted biochemical parameters *viz*., palmitic, oleic, linoleic, linolenic and erucic acids accompanied by oil composition.
**Location of Study:** Experiment was carried out at Department of Genetics and Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India
**Results:** Analysis of variance designated the presence of considerable extent of variation among premeditated Indian mustard genotypes which advocate better promises for their enhancement. Genotypic and phenotypic coefficient of variation was investigated to be higher for oleic acid pursued by erucic and palmitic acids. Erucic, oleic, palmitic, linoleic and linolenic acids had determined heritability and genetic advance. Significant negative correlation of erucic acid was recognized with palmitic, oleic, linoleic and linolenic acids. Genotypic and phenotypic path coefficient analysis had the higher positive direct effect of palmitic acid on erucic acid, while highest negative direct effect on erucic acid was demonstrated by linoleic, oleic, linolenic acids and oil content. Genetic deviation employing Euclidean distance cluster congregated the genotypes into eighteen diverse groups. Amongst entirely considered biochemical strictures, erucic acid was investigated to be low in 9, modest in 57 and higher in 122 genotypes. In group investigation of qualitative parameters, extreme inter cluster distance was documented between cluster 18 (Karishma) and cluster 12 (Maya). Consequently, these genotypes may be employed as parentages in Indian mustard breeding arrangement for enhancement of various qualitative parameters.

*Keywords: Indian mustard; biochemical parameters; correlation coefficient; path coefficient; quantitative traits; principle component analysis.*

## 1. INTRODUCTION

*Brassica* genus is uninterruptedly acquiring industrial standing owing to the incidence of oil annoying species for instance *Brassica juncea*, *B. carinata*, *B. rapa* and *B. napus* in it [1]. Explicit nutritional standards are elementary standards to choose the oil for comestible and industrial purposes. Among all the mustard species *B. juncea* has acquired higher adaptableness as oilseed crop in India, China and Pakistan attributable to higher oil contents up to 44% [2-4]. In addition to oil content diverse biochemical traits for instance essential and non-essential fatty acids are also well-thought-out to warrant industrial along with nutritional reputation of mustard oil [5-7]. Among different nutritive strictures of edible oil fatty acids similar to oleic, linolenic, erucic, palmitic and linoleic acids is very significant. Indian mustard (*B. juncea*) genotypes have been testified with higher portions of erucic

[a] *Department of Genetics & Plant Breeding, College of Agriculture, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002 M.P, India.*
[b] *Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002 M.P, India.*
[c] *Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com*

***Chapter 7***
Print ISBN: 978-93-5547-469-8, eBook ISBN: 978-93-5547-470-4

# Characterization of Soybean Genotypes on the Basis of Yield Attributing Traits and SSR Molecular Markers

**Nishi Mishra [a], Manoj Kumar Tripathi [a*], Sushma Tiwari [a], Niraj Tripathi [b#], Neha Gupta [a], Akash Sharma [a], Ravindra Singh Solanki [a] and Sharad Tiwari [c]**

DOI: 10.9734/bpi/ist/v3/2471C

## ABSTRACT

Soybean is well-thought-out to be a main crop as an important foundation of nutrients to humans and animals. The current investigation has been executed to recognize different soybean genotypes on account of diverse morpho-physiological traits and SSR molecular markers. Data for different morpho-physiological traits were documented from experiment conducted under field conditions in RBD design whereas molecular work was conducted in laboratory with 32 microsatellite markers to analyze the existence of possible diversity among different soybean genotypes. Morpho-physiological investigation evidenced the incidence of substantial magnitude of variability. Phylogenetic tree based on morpho-physiological traits grouped the genotypes into major and minor cluster. Major cluster had fifty genotypes while minor cluster had only three genotypes. Among polymorphic 32 microsatellite markers, the highest genetic diversity (0.66) was documented for the marker Satt520 whilst lowest (0.037) for the marker Satt557 with an average of 0.35. The highest PIC value also was 0.59 prearranged by same marker *viz*., Satt520 and lowest 0.036 by marker Satt557. An average major allele frequency was 0.69 while, an average PIC value was 0.32. Microsatellite markers-based data also congregated the genotypes into one major and one minor cluster. Molecular analysis based on microsatellite markers confirms the presence of genetic variability among genotypes under the investigation. Data obtained from the present research may contribute towards improvement of soybean genotypes to advance high yielding varieties by considering assorted genotypes with good agronomical traits in breeding scheme.

*Keywords: Breeding; genetic diversity microsatellites; sustainable agriculture; soybean; variability.*

## 1. STUDY OBJECTIVES

The present study was conducted to characterize different soybean genotypes on the basis of different morpho-physiological traits and SSR molecular markers.

## 2. INTRODUCTION

Soybean [*Glycine max* (L.) Merr.] is among one of the major crops, disbursed as human foods as well as animal feed [1-6]. It is also an ironic foundation of indispensable amino acids in addition to oil. The role of soybean and its components as therapeutic agents, antioxidants, isoflavones *etc*. has been recognized. Multipurpose nature of soybean makes it valuable in the field of industrial formulations, agriculture sector and pharmaceuticals [7-13]. Due to its high protein content, its flour is commonly

[#] *Directorate of Research Services;*
[a] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
[b] *Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[c] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

**Biography of author(s)**

**Mrs. Nishi Mishra**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is a Ph.D. Research scholar (Plant Molecular Biology & Biotechnology) at JNKVV, Jabalpur. She did her B.Sc. (Ag.) in 2017 from RVSKVV, Gwalior, (M.P.) and M.Sc. (Plant Molecular Biology & Biotechnology) in 2019 from RVSKVV, Gwalior. She did her M.Sc. on "Biotechnological Improvement of Soybean (*Glycine max* L. Merrill) against YMV & Drought using Phenotyping, Genotyping and *In Vitro* Selection approaches''. She has received several awards *i.e*., Scientist Associate Award, Young Molecular Biologist Award, Best Thesis Award and also received Smt. Mithlesh Mathur Award for best academic performance in post-graduation by RVSKVV, Gwalior. She has published 14 research papers in National and International journals and participated in more than 20 National and International Conferences, Seminars, Workshops and trainings. She wrote five book chapter & most popular articles on the subject. She acquired several best poster awards in national and international conferences. Presently she is working on "Molecular identification and authentication of different Minor Millets species using DNA barcoding".

**Dr. Manoj Kumar Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is working as Professor and Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 10 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Dr. Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is presently working as a Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-

474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards i.e., emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Dr. Niraj Tripathi**
Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, six chapters and seventy seven research papers are published to his credit.

**Dr. Neha Gupta**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She did Ph.D. at School of Studies Biotechnology, Jiwaji University, Gwalior (M.P.). She has 2 years of teaching experience as Associate Faculty at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India. She is a recipient of prestigious NASI-Springer Award (Biological Sciences) in 2017. She acquired academic excellence award offered by Jiwaji University, Gwalior in the year 2018 and 2019. She worked on characterization of chickpea proteins/peptides vis-a-vis ACE inhibition, anticancer activity and antidiabetic attributes. She has more than five years of research experience on animal cell culture and plant genome analysis employing PCR based markers. She authored 1 book and 5 book chapters. She has published 35 research papers in reputed national and international journals.

**Mr. Akash Sharma**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He was born on 2nd May 1993 at Gwalior, Madhya Pradesh. He is working as Junior Breeder in NOBLE SEEDS PRIVATE LIMITED, Sonipat Haryana, on Cauliflower, Cabbage. He has joined the RVSKVV Gwalior in the year 2014 and successfully completed the degree of B.Sc. (Ag.) in the year 2018 with 7.9 OGPA in 10 point scale. After graduation he joined M.Sc. (Ag) in the Department, Genetics and Plant Breeding at RVSKVV College of Agriculture, Gwalior where he successfully completed the entire course world requirement for master's degree. In Soybean Thesis title was "Molecular breeding approaches for development of tolerant lines against drought in soybean (*Glycine max (L*.) Merrill". He is Passionate for cultivation and agriculture with vast experience in breeding and cultivation. He is Knowledgeable with the latest tools and techniques used in plant breeding. He has Clear understanding of Seed production and breeding methods and experience in DUS characterization in various crops.

**Prof. Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He has been serving as Dean of oldest and biggest College of Agriculture Madhya Pradesh at Jabalpur and Director of Biotechnology Centre of prestigious Jawaharlal Nehru Agriculture University, Jabalpur since 2010. Earlier he also held the posts of Director Farms and Professor & Head of Plant Breeding and Genetics Department during 2016-2019 at the same university. After completing BSc Govt Science College, Jabalpur in 1976, he went for further studies at JNKVV for MSc in Plant Breeding & Genetics. He Joined as Assistant Professor (Plant Breeding & Genetics) in 1980 and in 1984 proceeded to Russian State Agrarian University - Agricultural Academy in Moscow for PhD. He Was a Visiting Scientist in 2004 at UAH, Alabama, USA. Has also travelled UK, Germany, Japan, Italy, Taiwan, South Africa, Hungary, Ukraine, Kazakhstan, Serbia for various scientific purposes. He is Presently Councilor (Central Zone) of Indian Society of Genetics and Plant Breeding and fellow and member of several scientific communities. He Handled 13 national and international level projects as PI funded by ICAR, DBT, DST, DoAC and JICA. He developed micro propagation protocols of several medicinal plants and several crops including soybean. He developed transgenic oat lines over-expressing fungal phytase gene and BYMV resistant lines using reverse transcriptase. He evaluated molecular marker for various traits in soybean for gene-based cultivar selection and characterized whitefly and YMV with molecular markers for soybean disease control in MP. He isolated several plants growth-promoting rhizobacteria (PGPR) from the rhizosphere displaying various direct plant growth promoting attributes and generated more than 600 sequences for different genes generated from PGPRs have been published in the NCBI domain. He performed DNA fingerprinting of major crops, including soybean, minor millets and different medicinal plant species. Filed a patent on newly developed methods for genotype identification based on simple sequence repeats marker data in 2017, which is under review. He revealed DNA barcode in various medicinal plants with universal markers A patent "DNA barcode for species identification of sedge plants and methods thereof" was granted earlier this year. Another patent on DNA barcoding coupled high resolution melting analysis is under review. As a breeder, He developed 2 varieties of rice and collaborator in 2 varieties of soybean (JS 20-94 and JS 20-116) and one variety of chickpea. He has Teaching experience of more than 40 years. He guided 59 post-graduate and 14 doctoral students in Agriculture Biotechnology and Plant Breeding & Genetics. He is a supervisor/Mentor of five National Post-doctoral Fellows from DBT, DST and CSIR. He published more than 110 Scientific Papers in refereed journals, more than 60 papers presented in conferences, 01 book and 12 Book chapters.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
Current Journal of Applied Science and Technology, 40(21): 9-24, 2021.

**Reviewers' Information**
(1) S. Vennila, Annamalai University, India.
(2) Edith Alba Luz Segovia Corrales, Universidad Nacional de Asunción, Paraguay.

***Chapter 4***
Print ISBN: 978-93-5547-469-8, eBook ISBN: 978-93-5547-470-4

# Screening of Soybean Genotypes against Drought on the Basis of Gene-Linked Microsatellite Markers

**Nishi Mishra [a], M. K. Tripathi [a*], Niraj Tripathi [b], Sushma Tiwari [a], Neha Gupta [a] and Akash Sharma [a]**

DOI: 10.9734/bpi/ist/v3/2454C

## ABSTRACT

Soybean is elegant to be a key crop attributable to its significant contribution as vegetable oil and protein in human diet. Nevertheless, inopportunely, its production has been exaggeratedly declined due to the ordinariness of drought related stress. In present investigation, total 12 SSR molecular markers were employed for screening of 53 soybean genotypes to determine the effectiveness of existing markers in genetic diversity analysis as well as their validation on the basis of their connotation with drought tolerant gene. Among applied drought tolerance gene-linked SSR molecular markers, the highest genetic diversity (0.6629) was documented with marker Satt520 while lowest (0.0370) was for the marker Satt557 with an average of 0.3746. The highest PIC value was 0.5887 prearranged by similar markers *viz*., Satt520 and lowest 0.0363 by Satt557 with the mean worth of 0.3063. Dendrogram constructed owing to banding profile of used markers was able to victimize some putative drought tolerant genotypes *i.e*., JS97-52, JS95-60 from rest of the genotypes. The findings of the current investigation may contribute towards improvement of soybean to bread drought tolerant varieties in future.

*Keywords: Climate change; molecular diversity; drought; microsatellites; sustainable agriculture; water stress.*

## 1. STUDY OBJECTIVES

The current chapter was intended to determine the efficacy of existing SSR molecular markers in genetic diversity analysis in addition to their validation based on their implication with drought tolerant gene in soybean genotypes.

## 2. INTRODUCTION

Soybean is the imperative crops owing to its application as a spring of vegetable oil along with proteins throughout the world [1-9]. Production and productivity of soybean has been declined due to different biotic [10-12] and abiotic [13-18] stresses. Among different abiotic factors, drought is prime stress which envisaged to be increased in future [19] as well. It is a serious issue because of its role in reduction of production of important crops including soybean. Accessibility of passable water provisions in growth along with development of plants. But, alteration in weather is a leading reason of drought conditions in many portions of the world. Drought stress may mainly harm to the susceptible crop varieties. So, it is desirable to recognize drought tolerant varieties among the available varietal resources or advance a new variety with tolerant mechanism against drought to develop drought tolerant varieties.

[a] *Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002,India.*
[b] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 3***
Print ISBN: 978-93-5547-157-4, eBook ISBN: 978-93-5547-165-9

# Identification of Low and High Erucic Acid Containing Genotype(S) in Indian Mustard Employing Molecular Markers

**Chitralekha Shyam [a], M. K. Tripathi [b], Sushma Tiwari [b], Niraj Tripathi [c*#] and Ashok Ahuja [a]**

DOI: 10.9734/bpi/rppsr/v5/15384D

## ABSTRACT

In traditional *Brassica* oilseeds, the incidence of erucic acid is well-thought-out as anti-nutritional issue for human ingesting as these reasons toxic possessions on the heart at higher enough dosages. As such there is a pressing necessity to restrain the erucic acid content and develop varieties having low erucic acid through conventional and/or molecular breeding approaches. Genetic enhancement of crops can be augmented when there is a broad genetic variation and information on these genetic possessions is available. The current investigation was carried out with 48 *Brassica* genotype (s) with the intention to recognize genotype (s) with low and high erucic acid content on the basis of molecular markers. For the investigation, a total of 50 SSR molecular markers were chosen for the amplification of genomic DNA. Out of these, only 23 SSR molecular markers were found to be polymorphic. A total of 109 alleles were recognized with an average of 4.47 alleles per locus for polymorphic SSR markers. Genetic diversity ranged between 0.55 for marker Na10-D07 to 0.77 for marker BRMS-098 with a mean worth of 0.68. Polymorphism information content (PIC) value of the markers varied from 0.51 for SSR Na10-D07 to 0.73 for the primer BRMS-098 with an average value of 0.62. The dendrogram was constructed and major three clusters were formed. Most of the genotypes were clustered conferring to the sites they established. Genotypes evidenced with low erucic acid content displayed higher similarity and grouped together. Mustard genotypes recognized with higher genetic variability with convenient traits may be employed for crop improvement programmes in future.

*Keywords: Indian mustard; fatty acid; oil quality; erucic acid, SSR markers.*

## 1. STUDY OBJECTIVES

The present study was conducted with 48 *Brassica* genotype (s) with the aim to distinguish genotype(s) with low and high erucic acid content based on employment of molecular markers.

## 2. INTRODUCTION

India is the world's third-largest producer of mustard seeds. Indian mustard [*Brassica juncea* (Linn.) Czern & Coss] is an ordinary amphidiploid (2n=36) that is the outcome of an interspecific cross between *Brassica campestris* (2n=20) and *Brassica nigra* (2n=16) followed by natural chromosomal doubling [1]. In India, it is mostly grown for its oil seeds. India, as one of the world's largest oilseed producers, contributes around 7% of the worldwide total. Oilseed harvests are also important in the Indian economy. Foremost rapeseed mustard producing countries of the world are Canada, China, France, Germany, Poland, UK, India, Australia, Russia and Ukraine [2-3]. In 2016-17, the total area, production, and productivity of rapeseed mustard cultivation in India were 6.65 million hectares, 7.10

*[#]Directorate of Research Services;*
*[a] Department of Genetics and Plant Breeding, RVS Agricultural University, Gwalior, 474002 M.P. India.*
*[b] Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 M.P., India.*
*[c] Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004, India.*
**Corresponding author: E-mail: tripathi.niraj@gmail.com;*

**Biography of author(s)**

**Chitralekha Shyam**
Department of Genetics and Plant Breeding, RVS Agricultural University, Gwalior, 474002 M.P. India.

She is working as Guest Teacher at Department of Genetics and Plant Breeding, Lt. Dr. Ramchand Singh Dev, College of Agriculture and Research Station, Baikunthpur, Korea, 497335, Indira Gandhi Krishi Vishwavidyalaya, Raipur for 1.5 years. She completed her B. Sc. (Ag.) in 2013 and M. Sc. (Ag.) from Department of Genetics and Plant Breeding in 2015 from Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.). Her M. Sc. Research was on Genetic analysis of yield and its components in Wheat (*Triticum aestivum* L.). She did Ph.D. (Ag.) from Department of Genetics and Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, 474002 (M.P.) in 2020. Her Ph.D. Research was on "Genetic diversity analysis and characterization of low and high erucic acid genotypes by phenotyping, genotyping and in vitro selection in Indian mustard (*Brassica juncea* L.) Czern and Coss". She has published 15 research papers and 14 popular articles in reputed international and national journals, magazines and news papers. She has received Best Young Professional Award and Scientist Associate Award from different scientific societies. She is the member of Genesis Urban and Rural Development Society.

**M. K. Tripathi**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 M.P., India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. he has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 15 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Sushma Tiwari**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 M.P., India.

She is presently working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards i.e., emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Niraj Tripathi**
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, six chapters and seventy seven research papers are published to his credit.

**Ashok Ahuja**
Department of Genetics and Plant Breeding, RVS Agricultural University, Gwalior, 474002 M.P. India.

He a Plant Scientist. His area of Specialization is Medicinal Plant Biotechnology. He did his Post-Doctoral Work with Professor E. Reinhard University of Tubingen, Germany. His research interests include production of bioactive secondary metabolites, micro propagation and conservation biotechnology of Medicinal and Aromatic plants. Currently he is working on application of bioreactor systems as Future Technology for production of plant bioactive, value additions through biotransformation's utilizing plant cell suspension culture system and advanced micro propagation. Dr Ahuja was a Chief Scientist -Group Leader in Plant Tissue Culture, Biodiversity & Applied Botany Division at CSIR-Indian Institute of Integrative Medicine Jammu. Participated as Project Investigator, Co-PI, Task force member, Team member.in a more then 20 CSIR-Network, Department of Biotechnology, DST, National Medicinal Plant Board (Govt.of India) ,industry sponsored and institutional Projects in varying capacities . Managed Plant tissue culture department for more than 30 years and contributed significantly. Created and managed national level facilities- In vitro Culture repository and Regional Hardening Unit at IIIM Jammu. Currently Till recently he was Professor (Retd Faculty Scheme) at Deptt of Plant Molecular Biology & Biotechnology ,RVSKVV Gwalior.With CSIR-IIIM, Jammu experience of more than three decades as researcher in the area of Medicinal & Aromatic Plants Biotechnology translated his work into patents and 125 peer reviewed research publications, Book chapters. Books and Technical Manuals. He is Editorial Board Member/Reviewer to American J Plant Sciences, Journal of Agricultural Biochemistry and Scientia Horticulture,Natural Product Communications, International J of Aurved Research, American J Plant sciences and Member of number of National & International Professional Societies.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
G.J.B.B., 9(2): 56-66, 2020.

ISBN : 978-81-951068-4-4

# सब्जी बीज उत्पादन प्रौद्योगिकी

लेखक
- डॉ. प्रवीण कुमार सिंह गुर्जर
- डॉ. राजेश लेखी

# FUNDAMENTAL OF AGRICULTURAL EXTENSION EDUCATION

# A PRACTICAL MANUAL

Dr. Rohan Sharma
Dr. Abhilasha Sharma
Dr. K. N. Pathak

Department of Agricultural Extension
**R.A.K. College of Agriculture, Sehore (M.P.)**
**RAJMATA VIJAYARAJE SCINDIA KRISHI VISHWA VIDYALAYA, GWALIOR - 474 002 (M.P.)**

# CLIMATE CHANGE: PERSPECTIVES AND IMPACT ON INDIAN AGRICULTURE

**Ekta Joshi[1], Priyadarshni A. Khambalkar[1], Akhilesh Singh[1], Pragati Agarwal[1], Neelam Singh[1], Shashi S. Yadav[1], D.S. Sasode[1], Popiha Bordoloi[2] and S. S. Bhadauria[1]**

*[1]College of Agriculture, RVSKVV, Gwalior (MP), E-mail: joshi.ekta86@gmail.com and [2] KVKRi-Bhoi, ICAR (RC) for NEH Region, Umiam (Barapani), Meghalaya, Corresponding Author: Ekta Joshi*

The Intergovernmental Panel on Climate Change (IPCC) reported that humankind is causing global warming through the emission of greenhouse gases (GHGs), particularly carbon dioxide ($CO_2$) and methane ($CH_4$) (Stocker *et al.*, 2013). The GHGs play a vital role on the climate system by absorbing the long wave infrared radiation and causes warming the earth's atmosphere. Thus, radiation emitted from the surface through the atmospheric window is higher compared to radiation from the stratosphere (Schmithusen *et al*., 2015). $CO_2$ levels have been consistently increasing since preindustrial time and its daily mean value reached 400 ppm in May 2013 at the reference site of Mauna Loa, Hawaii (Monastersky, 2013). Most regions in the world are warming because of increasing concentrations of atmospheric $CO_2$ (Sid Perkins, 2015). This increase is caused by human activities, which is subsequently contributing to increase the earth's surface temperature (Huang *et al.,* 2015). Arid and semi-arid areas comprise about 30% of the Earth's land surface. Climate change and climate variability will likely have a significant impact on these regions. The variability of environmental factors may result in significant effects on regional climate and global climate (Wang *et al.,* 2010), especially the radiative forcing, via the biogeochemical pathways affecting the terrestrial carbon cycle. Global climate change has serious impacts on humans and ecosystems.

This climate change altered the atmospheric concentration which leads to warming of the global temperature by 0.7° C till the recent past. It has been estimated that the Climate Change will lead to increase in temperature between 1.8 and 4° C in the years to come. This increasing temperature has caused global warming and created consequent environmental changes (Singh *et al*., 2011) which lead to decreased precipitation and increased temperature. This climate change will have a significant impact in developing countries like India because of their low adaptation capacity. The agriculture sector is primarily vulnerable and may create risk to the rural population (IPCC, 2007). As it has been estimated by the World Bank that, if climate change continues unhindered, then average temperatures in India is likely to reach as high as 29.1° C by the end of the century (up from 25.1 °C currently). Increase in temperature of the earth may lead to decrease in the length of growing season and yield of most crops (Saseendran *et al.*, 2008; Lal *et al.*, 2020; Sharma *et al.*, 2020; Sagar *et al.*, 2019; Parth *et al.*, 2019; Sagar *et al.*, 2019; Rao, 2019; Sharma and Rao, 2019; Dharbale *et al.*, 2019; Nyath *et al.*, 2018; Singh *et al.*, 2018). The anticipated negative impact of global warming on the climate of India is large; influence livestock population, agriculture and related allied sectors and ecosystem. A wide range of studies have substantiated that agroforestry systems have unique opportunity to augment the carbon stocks in the terrestrial biosphere (IPCC, 2000; Albrecht and Kandji, 2003). It has been estimated that 63 million ha of land areas are suitable for agroforestry and making this system a quantitatively important carbon stock (Kandji *et al.*, 2012).

This article reviews the understanding of consequence of climate change on Indian agriculture, various environmental parameters, livestock's population and health parameter etc. to highlight some important aspects in particular. As the agriculture and animal production system which is vulnerable to climate change is itself a large contributor to potential global warming through emission of $CO_2$, methane and nitrous oxide. The paper also presents a comprehensive review of the effect of climate change and GHG emissions in Indian scenario.

**Is Climate Change Really Happening?:** What are the indicators? Climate Change is the long-term average of the weather in a given place. While the weather can change in minutes or hours, a change in climate is something that develops over longer periods of decades to centuries. Climate is defined not only by average temperature and precipitation but also by the type, frequency, duration, and intensity of weather events such as heat waves, cold spells, storms, floods, and droughts (Source: https://www.epa.gov/climate-indicators). Global Climate Change indicators The Earth's climate is

# AQUAPONICS: AN INNOVATIVE SUSTAINABLE FOOD PRODUCTION FARMING SYSTEM

**Ekta Joshi[1], Pragati Agarwal[1], D.S. Sasode[1], Priyadarshini Khambalkar[1], Popiha Bordoloi[3], Dinesh Ginger[2]and Neeshu Joshi[4]**

*[1]College of Agriculture, RVSKVV, Gwalior (MP), E-mail: joshi.ekta86@gmail.com, [2]ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Vasad, Anand (Gujarat), [3]KVK Ri-Bhoi, ICAR (RC) for NEH Region, Umiam (Barapani), Meghalaya and [4]Agriculture Research Sub-Station, Sumerpur, Pali, Agriculture University, Jodhpur (Rajasthan), Corresponding Author: Ekta Joshi*

By 2050, the world population is estimated to increase to 9 billion. The expansive numbers of people are expecting to rely on agricultural sector including farming, fisheries, woodcrafts, and livestock. Natural calamities and crisis affect millions of people who depend on the primary sector. Indian farmers are exposed to many challenges resulting from low agricultural growth, sustainability concerns, and land degradation, as a large area of farmland has become infertile due to the overuse of fertilizers and pesticides. Conventional farming methods because of large usage of fertilizers for growing crops degraded the quality of the soil and local water sources. It is high time to overcome these challenges through innovative farming methods. For reducing poverty and attaining food security, expansion of agriculture sector is the most efficacious means. The technological and scientific advancement in the field of agriculture has opened a new era for the design and development of modern devices for plant health monitoring.

In order to meet human demand for aquatic products, total global aquatic production increased by 27.5% in 2010–2018, during which aquaculture and capture output increased by 29.8% and 10.4%, respectively (FAO, 2018). Aquaponics farming is a solution to overcome some of these challenges to an extent if the farmers are able to maintain the system with proper care and technical support. Aquaponics is an integrated system combination of aquaculture together with growing vegetables and crops without the use of fertilizers. Water circulates between the components of the system (fish tank, biofilter, hydroponic system), during which the feces of the fish become fertilizers for the plants (Nichols and Savidov, 2012).

Aquaponic systems have the potential to avoid some of the major resource inefficiencies present in conventional agriculture; however, achieving the resource efficiency as mentioned above, has been largely unquantified in scientific publications. Based on several past reviews, successful aquaponic operations must consider the impacts of system design (Palm *et al*., 2018), system water pH control (Tyson *et al*., 2011), aeration and filtration technologies (Danaher *et al*., 2013), acceptable nutrient ranges (Delaide *et al*., 2016), pairing of plant and fish species, microbial populations, nitrogen levels, quantity and type of feed (Endut *et al*., 2010), pest management and effective marketing. These factors are the main concern of those managing the system.

Thus aquaponics has emerged as a low-risk, high-profit farming method that requires only little maintenance and expenditure once it's set up and it also happens to be purely organic, chemical free, sustainable, no tilling the soil, no compost, no manure spreading, no tractor and no breaking back and sore joints, no cracked skin or needless exhaustion, no working to the bone for no reward, no trouble feeding the family. This is a globally accepted technology and adapted to a greater extent. Aquaponics has already made waves in the USA as well as other parts of the developed world.

**Definition and Concept of Aquaponics:** The term "aquaponics" is derived from the "aqua" in aquaculture and "ponics" in hydroponics (Marklin *et al*., 2013). Aquaponics is defined as the combination of hydroponics and recirculating aquaculture system which also plays a major role in minimizing the negative environmental impacts resulted from intensive fish farming and crop production. While aquaculture constitutes the breeding, rearing, and harvesting of fishes and other aquatic organisms in a controlled environment, hydroponics is a method of growing plants without soil by using mineral nutrient solutions in a water solvent. Aquaponics is an integrated sustainable method of farming by bringing aquaculture and hydroponics together in a single re-circulating system(Fig. 1).This process is the same closed-loop symbiotic combination as occurrs in nature, such as in a river or lake basin, where plants and fish live together in which fish wasteserves as nutrients for the plants, which in turn clean the water for the fish. In this type of integration, nutrients excreted by the fish through microbial activity (Zou *et al*., 2016) and the nitrifying bacteria in the biofilter

***Chapter 4***
Print ISBN: 978-93-5547-120-8, eBook ISBN: 978-93-5547-121-5

# Morpho-physiological and Molecular Characterization of Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] Germplam Lines for Drought Tolerance

**M. L. Choudhary[1], M. K. Tripathi[1*], Sushma Tiwari[1], R. K. Pandya[2], Neha Gupta[1], Niraj Tripathi[3] and Prerana Parihar[2]**

DOI: 10.9734/bpi/nvst/v5/2541E

## ABSTRACT

**Objectives:** The present investigation was commenced to analyze presence of possible genetic diversity among different pearl millet germplasm lines by means of diverse drought linked morpho-physiological traits along with SSR molecular markers.
**Study Design:** In the present investigation, 96 pearl millet germplasm lines were screened against drought using different morphological and physiological traits along with SSR markers.
**Place and Duration of the Study**: The present study was conducted at College of Agriculture, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, M.P., India during July 2019 to December, 2020.
**Methodology:** The study was conducted to record different morphological and physiological traits related to drought tolerance and susceptibility. Thirty-five microsatellite markers were also used in laboratory to analyze the variability among pearl millet genotypes under study.
**Results:** Pearl millet genotypes were grouped according to their morpho-physiological characteristics. Among 35 SSR markers, twenty-two were successfully amplified across all germplasm lines and seven SSR markers were found to be polymorphic and fifteen markers were monomorphic. All seven polymorphic SSR markers were used consequently for amplification of all the 96 germplasm lines. The range of PIC value was 0.0939 to 0.2980 with an average of 0.2274. The highest PIC value was recorded for the markers Xibmsp26 and Xibmsp29 (0.2980) followed by Xibmsp03 (0.2392), Xibmsp29 (0.2392), Xibmsp06 (0.2289) and Xibmsp07 (0.1948) while the lowest for the marker Xibmsp01 (0.0939). The range of major allele frequency value was 0.7604 to 0.9479 with an average of 0.8363. The range of genetic diversity value was 0.0987 to 0.3644 with an average of 0.2665.
**Conclusions:** According to the morpho-physiological data a total of 22 pearl millet genotypes were found to be grouped distantly from rest of the genotypes. These genotypes may be drought tolerance as they are linked with drought tolerant morpho-physiological traits however, rests of the genotypes were found to be susceptible against drought.

*Keywords: Pearl millet; drought tolerance; genetic diversity; polymorphism; molecular markers.*

## 1. INTRODUCTION

Pearl millet is a $C_4$, annual and diploid species. It belongs to family poaceae. The present legitimately believed name of pearl millet is *Pennisetum glaucum* (L.) R. Br. [1]. It is supposed to have originated from West Africa [2,3] from where it spread into India and other countries. It is cultivated in the arid tropical region and semi-arid areas of Asia and Africa [4]. It is a primary food for most of the countries

*[1]Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.*
*[2]Department of Plant Pathology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.*
*[3]Directorate of Research Services, JN Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com, drmanojtripathi@gmail.com;*

**Biography of author(s)**

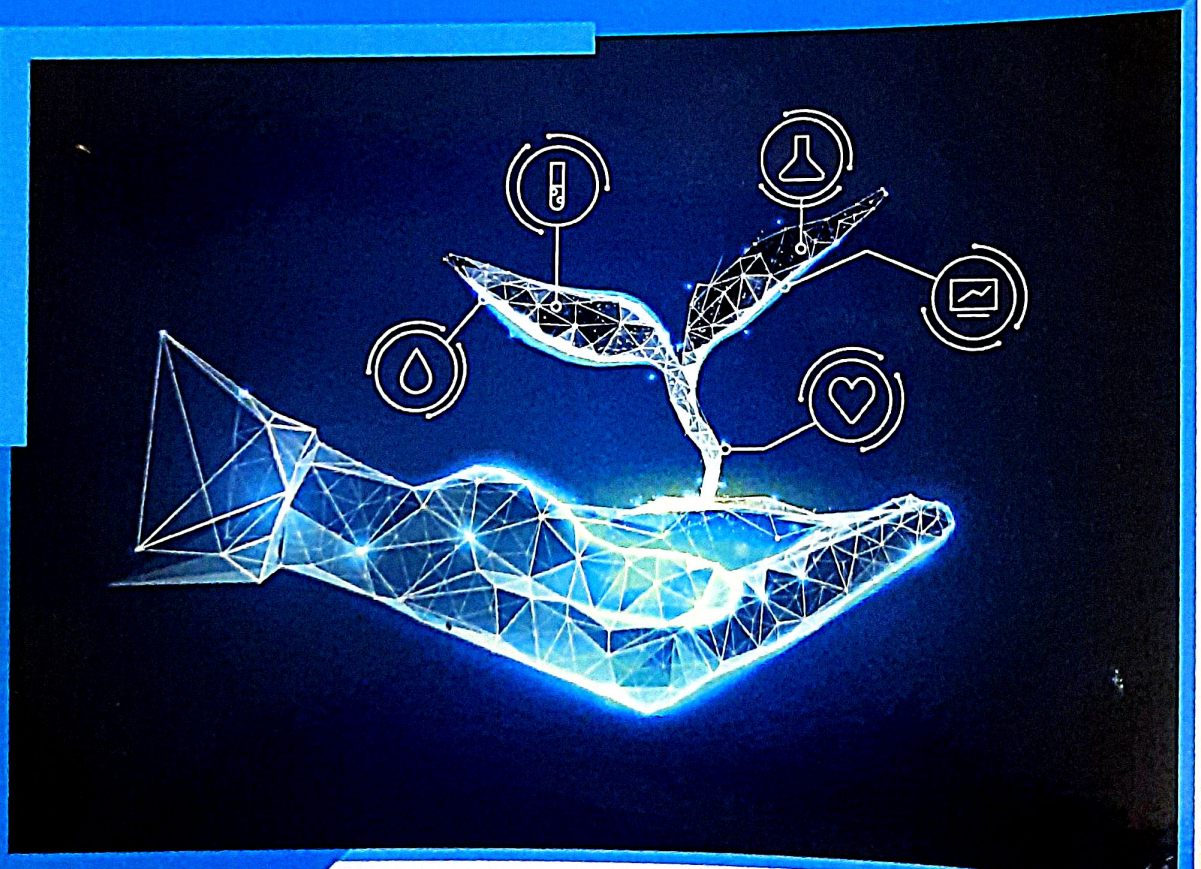
**Mr. M. L. Choudhary**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

He completed his B.Sc. (Hons.) Agriculture from Sri Karan Narendra Agriculture University, Jobner in 2018 and M.Sc. (Ag.) in Plant Biotechnology from Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior in 2021. His M.Sc. research was on Molecular, biochemical and morpho-physiological aspect of drought tolerance in pearl millet. He published one research paper and three abstracts.

**Prof. M. K. Tripathi**
Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVS Agricultural University, Gwalior, 474002 (M.P.), India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior having 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 18 M.Sc. (Ag) students during their Doctoral and Masters degree. He designed innovative course curriculum of Biotechnology for different departments of Masters Degree. He has handled many projects funded by State as well as Central Government of India. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 120 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 3 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 10 scientific journals.

# Molecular Biology and PLANT BIOTECHNOLOGY at a Glance



Phundan Singh
Sushma Tiwari
Pratibha Bisen

DAYA

ASTRAL

***Chapter 8***
Print ISBN: 978-93-5547-186-4, eBook ISBN: 978-93-5547-187-1

# Role of Biochemical and Antioxidant Enzymes Activities in Drought Tolerance in Soybean: A Recent Study

**N. Mishra[1], M. K. Tripathi[1*], N. Tripathi[2], S. Tiwari[1], N. Gupta[1], A. Sharma[1] and M. K. Shrivastav[3]**

DOI: 10.9734/bpi/ctas/v3/2117C

## ABSTRACT

Soybean genotypes were divided into two groups based on biochemical profiling, anti-oxidant enzyme activities and protein profiling. Drought tolerance features were found in three genotypes *viz*., JS97-52, RVS-14, and JS95-60, based on different biochemical and antioxidant enzyme activities analysis among 53 diverse genotypes. The results obtained could aid in the improvement of soybean genotypes through the production of drought-tolerant genotypes using both conventional and molecular breeding approaches. These findings also provided a foundation for additional research employing advanced biotechnological technologies to investigate the drought tolerance mechanism in soybean crops.

*Keywords: Antioxidant enzymes; Biochemical parameters; Drought; Protein profiling; Sustainable agriculture*

## 1. INTRODUCTION

Changes in the environment are to blame for the emergence of new issues. Climate change is one of them, and it has a significant impact on agriculture. In most parts of the world, there is a high need for water for crop irrigation in order to meet grain production targets. More than 40% of people from 54 nations will face a major problem in the coming days as a result of the drought [1]. A crop species or genotype that is tolerant of low rainfall intensity, unpredictable distribution, and high temperatures would be critical for ensuring a long-term food supply for the world's ever-growing population. It is believed that by carefully crafting biotechnological ways to build a cultivar for such a suboptimal environment, food security in inhospitable regions will be maintained.

Soybean is also acknowledged as a ‘miracle crop’ due to over 40% protein and 20% oil [2-8]. It needs an adequate water supply for the duration of its growth and development course to accomplish better yields [9]. The plants of soybean have been found to be affected by drought at every stage of life [10-15]. Significant reductions in the levels of chlorophyll a, b, and total chlorophyll have been observed due to drought in soybean crop [16]. Plants develop various mechanisms to fight different stresses [17] and these mechanisms may be due to alteration in biochemical pathways. Numerous biochemical parameters have been exploited to recognize tolerant genotype (s) to drought [18-20]. Knowledge of the biochemical mechanisms for drought tolerance in vegetable-type soybeans is very limited. Plants have evolved a number of biochemical and physiological mechanisms to improve their tolerance to abiotic stress. These may include the employment of various antioxidative mechanisms that are enzymatic or non-enzymatic in nature [21-24].

*[1]Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Agricultural University, Gwalior 474002, India.*
*[2]Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
*[3]Department of Plant Breeding & Genetics, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

***Chapter 4***
Print ISBN: 978-93-5547-075-1, eBook ISBN: 978-93-5547-083-6

# Plant Tissue Culture Techniques for Conservation of Biodiversity of Some Plants Appropriate for Propgation in Degraded and Temperate Areas

**Manoj Kumar Tripathi [a*], Sushma Tiwari [a], Niraj Tripathi [b], Gyanendra Tiwari [c], Deepa Bhatt [a], Megha Vibhute [d], Neha Gupta [a], Nishi Mishra [a], Prerana Parihar [a], Purnima Singh [a], Akash Sharma [a], Ashok Ahuja [a] and Sharad Tiwari [e]**

DOI: 10.9734/bpi/ctas/v4/2119C

## ABSTRACT

Plant Biotechnology is being employed as a device for conservation of natural habitats and their sustainable utilization for ecological balance, technologies for cultivation of plants in diverse cropping systems and on the problematic soil, improvement of state-of-art technologies for extraction, characterization and utilization of necessary bioactive components, generation of scientific and clinical information to support the health entitlements of botanical medicines, elicitation and improving the production of known and novel metabolites using metabolic engineering technology, DNA barcoding : identification and characterization of plant material, design and discovery of newer molecules for human and plant health, development of post-harvest management including establishment of effective partnerships between different stakeholders. Plant tissue culture can be used to rapidly multiply virus-free planting material in plants suitable for degraded lands and temperate areas by developing micropropagation protocols. Micropropogation is a time and space efficient technique that produces more viral disease-free and elite propagules. Germplasm storage and conservation is possible through the use of *in vitro* gene bank technology, in which vegetatively propagated plants can be conserved in cryogene banks, and recalcitrant seeds, embryos, and pollens can be stored in liquid nitrogen for long periods of time. This chapter discusses micropropagation protocols developed in our lab for various plants suitable for cultivation in undulated lands and temperate regions, as well as detection and production of natural compounds found in plants and ex situ conservation methods. Biotechnology and biodiversity of high value plants can be harnessed together as developmental challenge as well as an economic opportunity in future.

*Keywords: Biodiversity; degraded land; plant cell; tissue & organ; culture; medicinal plants; metabolic engineering; bioactive compounds.*

## 1. INTRODUCTION

Plant Biotechnology is being used as a tool for conservation of natural habitats and their sustainable utilization for ecological balance, technologies for cultivation of plants in different cropping systems and on the problematic soil, development of state-of-art technologies for extraction, characterization and utilization of essential bioactive components, generating scientific and clinical data to support the health claims of botanical drugs, elicitation and enhancing the production of known and novel metabolites using metabolic engineering technology, DNA bar coding: identification and characterization of plant material, design and discovery of newer molecules for human and plant

[a] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
[b] *Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[c] *Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[d] *Krishi Vigyan Kendra, Burhanpur, India.*
[e] *Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

**Biography of author(s)**

**Manoj Kumar Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. he has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 6 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is presently working as Scientist, in the discipline of Genetics & Plant Breeding, and Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards i.e., emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of

one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovation on molecular marker technology for identification and authentication of crop varieties and cultivars. He has published One book, six chapters and seventy-seven research papers to his credit.

**Gyanendra Tiwari**
Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is working as a Professor, Department of Plant Physiology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India. he has 23 years' experience in the field of Research, Teaching and Extension of Medicinal and Aromatic Plants and Physiology of Plants. He is working as In Charge, Prestigious Herbal Garden cum Plant Conservatory of JNKVV, Jabalpur where more than 1100 species of medicinal and aromatic plants are conserved. He is member of MP State Medicinal Plant Board. He is also in charge of Revolving Fund on Medicinal Plants. He also received JNKVV University merit scholarship during his graduation and post-graduation. He is the recipient of Awards in different scientific occasions. He supervised 3 PhD scholars and 20 M.Sc. (Ag) students during their Doctoral and Master's degree as Major Advisor. As member of advisory committee he guided 3 PhD and 20 M.Sc. (Ag) students. He designed innovative course curriculum of M Sc. (Horticulture) Medicinal and Aromatic Plants at College of Horticulture, Mandsaur under RVSKVV, Gwalior. He has handled 4 projects funded by State Government of MP. He has presented many research papers in different National and International conferences. He is an author or co-author of more than 60 research papers published in reputed National and International Journals. He is also the edited of 2 books and authored 10 book chapters. He is the member of 2scientific societies and serving as reviewer of more than 4 scientific journals.

**Deepa Bhatt**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She did her B.Sc. in agriculture in 2012 from R.V.S.K.V.V., Gwalior, (M.P.) and M.Sc. in Floriculture and landscape architecture. in 2014 from K.N.K. college of Horticulture, Mandsaur. She did her Ph.D. in 2020 from R.V.S.K.V.V., Gwalior. She has published four research papers in international & national journal. Presently she is working on Project entitled "Commercial propagation for quality plants by tissue culture technology & marketing for revenue generation" at Department of Plant Molecular Biology & Biotechnology, College of Agriculture, RVSKVV, Gwalior (M.P.).

**Megha Vibhute**
Krishi Vigyan Kendra, Burhanpur, India.

She did her B.Sc. Horticulture in 2007 & M.Sc. Horticulture (Fruit Science) in 2009 from KNK College of Horticulture, Mandsaur, JNKVV, Jabalpur, M.P. She did her thesis on Effect of Plant Growth Regulators on In vitro Response of Diverse Explant Cultures of Three Different Citrus species. She has experience of 10 years in the field of Horticulture Extension. Presently she is working as SMS Horticulture at KVK Burhanpur (M.P.) since 2013. She conducted 30 OFTs, 30 FLDs, 50 training programs and 20 Extension Activities. She has having 10 research papers, 30 Abstracts, 15 Popular articles, 60 Articles, 05 folders, 02 booklets, 12 success stories along with 07 radio talks and 04 T.V Talks. She had membership of 2 societies. She also received young scientist award from Agricultural Technology Development Society, Ghaziabad, U.P. in 2017. She has Major Contribution in promotion of technologies in the Burhanpur district: 1. Use of Plastic Mulch & Drip Irrigation in Water Melon (technology spread 95%); 2.Crop Diversification- Introduction & expansion of turmeric Crop in the District area increased from 350 ha to 700 ha; 3.Expansion of spices Crop Ajwain & Varietal Replacement In the District Area Increased up to 298 acre (68 % ) and old traditional var with New Var.Ajmer Ajwain-1; 4.Promotion of banana Based Intercropping. 10% area covered under Intercropping. Use of Skirting bag in Banana to combat the Biotic & Abiotic stresses 10 % Area covered against total Banana Area; 5.Fertigation Technology In Banana Promoted ferti-Irrigation technology in Banana (75% Area).

**Neha Gupta**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She did Ph.D. at School of Studies Biotechnology, Jiwaji University, Gwalior (M.P.), India. She has 2 years of teaching experience as associate faculty at biotechnology department, college of agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya Gwalior, India. She is a recipient of prestigious NASI-Springer Award (Biological Sciences) in 2017. She acquired academic excellence award offered by Jiwaji University, Gwalior in the year 2018 and 2019. She worked on characterization of chickpea proteins/peptides vis-a-vis ACE inhibition, anticancer activity and antidiabetic attributes. She has more than five years of research experience on animal cell culture and plant genome analysis employing PCR based markers. She authored 1 book and 5 book chapters. She has published 35 research papers in reputed national and international journals.

**Nishi Mishra**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is a Ph.D. Research scholar (Plant Molecular Biology & Biotechnology) at JNKVV, Jabalpur, India. She did her B.Sc. (Ag.) in 2017 from RVSKVV, Gwalior, (M.P.) and M.Sc. (Plant Molecular Biology & Biotechnology) in 2019 from RVSKVV, Gwalior.

She did her M.Sc. on "Biotechnological Improvement of Soybean (Glycine max L. Merrill) against YMV & Drought using Phenotyping, Genotyping and In Vitro Selection approaches''. She has received several awards i.e., Scientist Associate Award, Young Molecular Biologist Award, thesis award and also received Smt. Mithlesh Mathur award for best academic performance in post-graduation by RVSKVV. She has published 14 research papers in National and International journals and participated in more than 20 National and International Conferences, Seminars, Workshops and trainings. She wrote one book chapter & most popular articles on the subject. She acquired several best poster awards in national and international conferences. Presently she is working on "Molecular identification and authentication of different Minor Millets species using DNA barcoding".

**Prerana Parihar**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is a Ph.D. Research scholar (Plant Pathology) , did her B.Sc. (Ag.) in 2016 from IGKV, Raipur, (C.G.) and M.Sc. (Ag.) in 2018 from college of agriculture, RVSKVV, Gwalior. She did her M.Sc. on Study and management of Pearl millet blast incited by Pyricularia grisea (Cooke) Sacc. She has published five research papers and 18 popular articles in international, national journal and magazines of repute. She wrote one book chapter on the subject. Presently she is working on "Characterization of Pearl millet blast pathogen [Pyricularia grisea (Cooke) Sacc.] and it's strategic management" for her Ph.D. (Plant Pathology) program at RVSKVV, Gwalior, Madhya Pradesh under the guidance of Prof. R.K. Pandya.

**Purnima Singh**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is a Ph.D. Research Scholar (Plant Pathology), did her B.Sc. (Ag.) in 2016 from BAU, Sabour, Bhagalpur (Bihar) and M.Sc. (Ag.) in 2018 from College of Agriculture, JNKVV, Jabalpur, M.P. She did her M.Sc. on Studies on Morphological and Molecular Variability in Trichoderma isolates with special reference to Chickpea wilt. She has published five research papers and 20 Popular articles in International, National journal and Magazines of repute. She wrote two book chapters on the subject. Presently she is working on "Studies on Variability and Management of Collar rot of Lentil incited by Sclerotium rolfsii (Sacc.)" for her Ph.D. (Plant Pathology) program at RVSKVV, Gwalior, Madhya Pradesh under the guidance of Prof. Reeti Singh.

**Akash Sharma**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He was born on 2nd May 1993 at Gwalior, Madhya Pradesh, India. He is working as a Junior Breeder in NOBLE SEEDS PRIVATE LIMITED, Sonipat Haryana, on Cauliflower, Cabbage. He has joined the RVSKVV Gwalior in the year 2014 and

successfully completed the degree of B.Sc. (Ag.) in the year 2018 with 7.9 OGPA in 10 point scale. After graduation he joined M.Sc. (Ag) in the Department, Genetics and Plant Breeding at RVSKVV College of Agriculture, Gwalior where he successfully completed the entire course world requirement for master's degree. In Soybean Thesis title was "Molecular breeding approaches for development of tolerant lines against drought in soybean (Glycine max (L.) Merrill". He is Passionate for cultivation and agriculture with vast experience in breeding and cultivation. He is Knowledgeable with the latest tools and techniques used in plant breeding. He has Clear understanding of Seed production and breeding methods and experience in DUS characterization in various crops.

**Ashok Ahuja**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is a Plant Scientist. His area of Specialization is Medicinal Plant Biotechnology. He did his Post-Doctoral Work with Professor E. Reinhard University of Tubingen, Germany. His research interests include production of bioactive secondary metabolites, micro propagation and conservation biotechnology of Medicinal and Aromatic plants. Currently he is working on application of bioreactor systems as Future Technology for production of plant bioactive, value additions through biotransformation's utilizing plant cell suspension culture system and advanced micro propagation He was a Chief Scientist - Group Leader in Plant Tissue Culture, Biodiversity & Applied Botany Division at CSIR-Indian Institute of Integrative Medicine Jammu. Participated as Project Investigator, Co-PI, Task force member, Team member.in a more then 20 CSIR-Network, Department of Biotechnology, DST, National Medicinal Plant Board (Govt.of India) ,industry sponsored and institutional Projects in varying capacities . Managed Plant tissue culture department for more than 30 years and contributed significantly. Created and managed national level facilities- In vitro Culture repository and Regional Hardening Unit at IIIM Jammu. He was a Professor (Retd Faculty Scheme) at Deptt of Plant Molecular Biology & Biotechnology, RVSKVV Gwalior. With CSIR-IIIM, Jammu. He has experience of more than three decades as a researcher in the area of Medicinal & Aromatic Plants Biotechnology, and translated his work into patents and 125 peer reviewed research publications, Book chapters. Books and Technical Manuals. He is Editorial Board Member, and Reviewer to American J Plant Sciences, Journal of Agricultural Biochemistry and Scientia Horticulture, Natural Product Communications, International J of Ayurveda Research, American J Plant sciences and Member of number of National & International Professional Societies.

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is Dean of oldest and biggest College of Agriculture Madhya Pradesh at Jabalpur and Director of Biotechnology Centre of prestigious Jawaharlal Nehru Agriculture University, Jabalpur since 2010. Earlier he also held the posts of Director Farms and Professor & Head of Plant Breeding and Genetics Department during 2016-2019 at the same university. After completing BSc, Govt Science College, Jabalpur in 1976, he went for further studies at JNKVV for MSc in Plant Breeding & Genetics. He Joined as Assistant Professor (Plant Breeding & Genetics) in 1980 and in 1984 proceeded to Russian State Agrarian University - Agricultural Academy in Moscow for PhD. He Was a Visiting Scientist in 2004 at UAH, Alabama, USA. He has also travelled UK, Germany, Japan, Italy, Taiwan, South Africa, Hungary, Ukraine, Kazakhstan, Serbia for various scientific purposes. Presently, he is a Councilor (Central Zone) of Indian Society of Genetics and Plant Breeding since 2018 and fellow and member of several scientific communities. He Handled 13 national and international level projects as PI funded by ICAR, DBT, DST, DoAC and JICA. He developed micropropagation protocols of several medicinal plants and several crops including soybean. He Developed transgenic oat lines over-expressing fungal phytase gene and BYMV resistant lines using reverse transcriptase. He Evaluated molecular marker for various traits in soybean for gene-based cultivar selection and characterized whitefly and YMV with molecular markers for soybean disease control in MP. He isolated several plants growth-promoting rhizobacteria (PGPR) from the rhizosphere displaying various direct plant growth promoting attributes and generated more than 600 sequences for different genes generated from PGPRs have been published in the NCBI domain. He performed DNA fingerprinting of major crops, including soybean, minor millets and different medicinal plant species. Filed a patent on newly

developed methods for genotype identification based on simple sequence repeats marker data in 2017, which is under review. He Revealed DNA barcode in various medicinal plants with universal markers A patent "DNA barcode for species identification of sedge plants and methods thereof" was granted earlier this year. Another patent on DNA barcoding coupled high resolution melting analysis is under review. As a breeder, he developed 2 varieties of rice and collaborator in 2 varieties of soybean (JS 20-94 and JS 20-116) and one variety of chickpea. He has Teaching experience of more than 40 years. He Guided 59 post-graduate and 14 doctoral students in Agriculture Biotechnology and Plant Breeding & Genetics. He is a Supervisor/Mentor of five National Post-doctoral Fellow from DBT, DST and CSIR. He published more than 110 Scientific Papers (out of which 29 are on soybean) in refereed journals, more than 60 papers presented in conferences, 01 book and 12 Book chapters.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
Progressive Research – An International Journal, 11 (4): 443-457, 2016.

***Chapter 12***
Print ISBN: 978-93-5547-035-5, eBook ISBN: 978-93-5547-095-9

# *In vitro* Production of Secondary Metabolites Reserpine and Ajmalicine in *Rauvolfia Serpentina* (L.) Benth.

**Gyanendra Tiwari[1], M. K. Tripathi[2*], Sushma Tiwari[2], Niraj Tripathi[3], Devi Singh Uikey[4] and R. P. Patel[5]**

DOI: 10.9734/bpi/caprd/v4/2136C

## ABSTRACT

*Rauvolfia serpentina* is an erect evergreen, woody perennial shrub and usually recognized as Sarpgandha Main institutes of sarpgandha roots are reserpine, rescinnamine, deserpidine and yohimbine and the root part of the plant is employed in several Ayurvedic polyherbal formations *viz.,* sarpgandha vati. When efficient and reproducible plant regeneration systems are available, in vitro culture is an important experimental tool in medicinal and aromatic crops. Experiments were carried out to quantify secondary metabolite production in *Rauvolfia serpentina* from filtrate of callus and cell suspension cultures. Reserpine and ajmalicine were found infiltrate of both one-month-old callus and cell suspension cultures. The culture medium MSD.5IB (MS+1.0 $mgl^{-1}$ 2,4-D + 0.5 $mgl^{-1}$ IBA) recovers the most reserpine content in both callus and cell suspension cultures after one month. The amount of reserpine in a liquid medium decreased dramatically as the concentration of 2,4-D in the medium increased. When the concentration of 2,4-D was increased, the concentration of Ajmalicine in both callus and cell suspension cultures decreased linearly. These products may be further produced in commercial scale in bioreactor by using raw biomolecules for commercial purposes.

*Keywords: Rauvolfia serpentina; callus and cell suspension cultures; reserpine and ajmalicine.*

## ABBREVIATIONS

*MS : Murashige and Skoog medium*
*Wh : White's medium*
*$B_5$ : Gamborg's medium*
*BA : 6-benzylaminopurine*
*TDZ : Thidiazuron*
*Kn : Kinetin*
*NAA : α-Naphthalene acetic acid*
*2,4-D : 2, 4-dichlorophenoxyacetic acid*
*IBA : Indole-3-butyric acid*

## 1. INTRODUCTION

*Rauvolfia serpentina* is an erect evergreen, woody perennial shrub and usually recognized as Sarpgandha, Snake root plant, Chota Chand, Chandrika *etc.* It is belonging to family Apocynaceae. It

[1]*Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[2]*Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Krishi Vishwavidyalaya, Gwalior, MP, India.*
[3]*Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
[4]*Department of Medicinal and Aromatic Plants, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
[5]*Department of Plant Pathology, KNK-College of Horticulture, Mandsaur - 458001, RVS Agricultural University, Gwalior, MP, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

**Biography of author(s)**

**Prof. Gyanendra Tiwari**
Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is working as Professor (Plant Physiology), Department of Plant Physiology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur having 23 years' experience in the field of Research, Teaching and Extension of Medicinal and Aromatic Plants and Physiology of Plants. He is working as In Charge, Prestigious Herbal Garden cum Plant Conservatory of JNKVV, Jabalpur where more than 1100 species of medicinal and aromatic plants are conserved. He is member of MP State Medicinal Plant Board. He is also incharge of Revolving Fund on Medicinal Plants. He also received JNKVV University merit scholarship during his graduation and post-graduation. He is the recipient of Awards in different scientific occasions. He supervised 3 PhD scholars and 20 M.Sc. (Ag) students during their Doctoral and Master's degree as Major Advisor. As member of advisory committee, he guided 3 PhD and 20 M.Sc. (Ag) students. He designed innovative course curriculum of M Sc. (Horticulture) Medicinal and Aromatic Plants at College of Horticulture, Mandsaur under RVSKVV, Gwalior. He has handled 4 projects funded by State Government of MP. He has presented many research papers in different National and International conferences. He is an author or co-author of more than 60 research papers published in reputed National and International Journals. He is also the edited of 2 books and authored 10 book chapters. He is the member of 2scientific societies and serving as reviewer of more than 4 scientific journals.

**Dr. M. K. Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Krishi Vishwavidyalaya, Gwalior, MP, India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior having 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. Dr. Tripathi has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. Dr. Tripathi is an author or co-author of more than 120 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 6 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Dr. Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Krishi Vishwavidyalaya, Gwalior, MP, India.

She is presently working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-

474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards *i.e.*, emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Dr. Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. Submission of 148 sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. Plant breeders value for one of his innovations on molecular marker technology for identification and authentication of crop varieties and cultivars. One book, six chapters and seventy-seven research papers are published to his credit.



**DISCLAIMER**
This chapter is an extended version of the article published by the same author(s) in the following journal.
International Journal of Indigenous Medicinal Plants, 47(2), 2014.

***Chapter 7***
Print ISBN: 978-93-5547-359-2, eBook ISBN: 978-93-5547-361-5

# Plant Genomic DNA Isolation: An Important Technology for Marker Assisted Selection

**Sushma Tiwari [a*], M. K. Tripathi [a], R. S. Tomar [b] and Ashok Ahuja [a]**

DOI: 10.9734/bpi/rppsr/v4/15255D

## ABSTRACT

Plant biotechnology is necessary to maximize the probability of success in crop improvement programs. One area of biotechnology is DNA marker technology, derived from research in molecular genetics and genomics, offers great promise for plant breeding. Marker assisted selection in plant breeding, increase efficiency and precision. Mapping and marker assisted selection of targeted trait require high quality of DNA from a large number of plants in short time. However, many protocols have been developed and reported for extraction of plant DNA with the primary aim of development of a relatively quick, inexpensive and consistent to extract high quality DNA. The general principle of all these DNA extraction protocols remains the same involving disruption of the cell wall, cell membrane and nuclear membrane to release the highly intact DNA into solution ensuring removal of the contaminating biomolecules such as the proteins, polysaccharides, lipids, phenols and other secondary metabolites by enzymatic or chemical methods. High quality DNA is prime requirement for marker assisted selection applications in crop improvement as well as sequencing-based applications. Current article compiled Plant Genomic DNA isolation and quantification protocols for different crops.

*Keywords: Agarose gel electrophoresis; MAS; plant genomic DNA isolation; purification; spectrophotometer; quantification.*

## 1. INTRODUCTION

Plant Genomic DNA isolation is one of the prime requirements for marker assisted selection for precise breeding programmes [1,2]. The plant DNA isolation and purification procedures can be grouped into three categories, viz., (1) Cetyl Trimethyl Ammonium Bromide (CTAB) method [3,4], (2) Rapid DNA extraction method [5], and (3) DNA isolation by commercial kits such as DNeasy Mini and Maxi kits from QIAGEN, NucleoSpin Plant kits from Clontech, PureLink® Genomic Plant DNA Purification Kit from Life Technologies, PowerPlant® DNA Isolation Kit from MO BIO Laboratories, MasterPure™ Plant Leaf DNA Purification Kit from Epicentre, etc. These procedures usually consist of three steps: (1) rupture and lysis of cells to obtain cell extract (tissue maceration), using DNA extraction buffer (2) purification of DNA, and (3) quantification of DNA. Generally, for plant tissues, fresh leaves of 15 to 20 days are preferred (fresh, freeze-dried, or frozen in liquid nitrogen) and usually ruptured by mechanical force in pestle and motor or tissue lyzer. The main objective of various DNA isolation methods is development of relatively quick, inexpensive and consistent protocol to extract high quality DNA with better yield. Leaf samples contain large quantities of polyphenols, tannins and polysaccharides, so purification of DNA is equally important to get high quality DNA. The basic principle of DNA isolation is disruption of the cell wall, cell membrane and nuclear membrane to release the highly intact DNA into solution followed by precipitation of DNA and removal of the contaminating biomolecules such as the proteins, polysaccharides, lipids, phenols and other secondary metabolites by enzymatic or chemical methods. In present review, we have described two modified methods for plant genomic DNA isolation from leaf tissue.

[a] *Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India.*
[b] *Rani Laxmibai Central Agricultural University, Jhansi, India.*
**Corresponding author: E-mail: sushma2540@gmail.com;*

**Biography of author(s)**

**Dr. Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India.

She is working as a Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India. She has worked as Senior Research Fellow and Research Associate at Indian Agriculture Research Institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has been elected as member of National Academy of Sciences, India. She has published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings. She has received several awards *i.e.*, Emerging Scientist Award, Distinguished Scientist Award, Scientist of the Year Award and Young Scientist Award from different scientific societies.

**Dr. M. K. Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India.

He is working as Professor & Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and Incharge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Ag) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 6 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Dr. R. S. Tomar**
Rani Laxmibai Central Agricultural University, Jhansi, India.

He is presently working as a faculty in the discipline of Biotechnology in College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi, Uttar Pradesh, India. He has good research experience of conventional and

molecular breeding in crops like rice, wheat, soybean and lentil. He has worked on improvement of wheat under both biotic and abiotic stress as well as hybrid wheat development. He has worked as SRF, RA-PDF in ICAR-IARI, New Delhi; ICAR-NIPB, New Delhi and Laval University Quebec City, Canada. He has so far published more than 80 research papers in high impact National and International journals like Science, Molecular Breeding, BMC Genomics, Plos One, IJMS, Frontiers in Science, Plant Breeding, etc., 02 books, 02 practical manuals and 10 book chapters. He is editor and reviewer of highly rated journals like PLOS ONE, Plant Physiology and Molecular Biology Reports, Indian Journal of Genetics & Plant Breeding and IJAS. He has been awarded Fellow of Indian Society of Genetics & Plant Breeding, New Delhi. He has been facilitated with several Awards: Scientist Associate Award, 2016, Jr. Scientist Award, 2016, Young Biotechnologist Award, 2017, Eminent Scientist Award, 2017 and Distinguished Scientist Award, 2017.

**Dr. Ashok Ahuja**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior, Madhya Pradesh, India.

He is a Plant Scientist. His area of Specialization is Medicinal Plant Biotechnology. He did his Post-Doctoral Work with Professor E. Reinhard University of Tubingen, Germany. His research interests include production of bioactive secondary metabolites, micro propagation and conservation biotechnology of Medicinal and Aromatic plants. Currently he is working on application of bioreactor systems as Future Technology for production of plant bioactive, value additions through biotransformation's utilizing plant cell suspension culture system and advanced micro propagation. He was a Chief Scientist - Group Leader in Plant Tissue Culture, Biodiversity & Applied Botany Division at CSIR-Indian Institute of Integrative Medicine Jammu. He Participated as Project Investigator, Co-PI, Task force member, Team member.in a more then 20 CSIR-Network, Department of Biotechnology, DST, National Medicinal Plant Board (Govt. of India) ,industry sponsored and institutional Projects in varying capacities. He Managed Plant tissue culture department for more than 30 years and contributed significantly. He Created and managed national level facilities- *In vitro* Culture repository and Regional Hardening Unit at IIIM Jammu. He was a Professor (Retd Faculty Scheme) at departments of Plant Molecular Biology & Biotechnology, RVSKVV Gwalior. With CSIR-IIIM, Jammu experience of more than three decades as a researcher in the area of Medicinal & Aromatic Plants Biotechnology translated his work into patents and 125 peer reviewed research publications, Book chapters. He has Books and Technical Manuals. He is Editorial Board Member/Reviewer to American J Plant Sciences, Journal of Agricultural Biochemistry and Scientia Horticulture, Natural Product Communications, International Journal of Ayurveda Research, American Journal Plant sciences and Member of number of National & International Professional Societies.

***Chapter 9***
Print ISBN: 978-93-5547-285-4, eBook ISBN: 978-93-5547-293-9

# Recent Advancements on Callus and Cell Suspension Cultures: An Effectual Reserve for the Production of Pharmaceutically Significant Metabolites

**Ashok Ahuja [a], Manoj Kumar Tripathi [a*], Sushma Tiwari [a], Niraj Tripathi [b], Gyanendra Tiwari [c], Nishi Mishra [a], Shashank Bhargav [a] and Sharad Tiwari [d]**

DOI: 10.9734/bpi/caprd/v6/2260C

## ABSTRACT

Secondary metabolites of pharmaceutically importance or phytopharmaceuticals comprise alkaloids, glycosides, flavonoids, volatile oils, tannins, resins *etc*. At present, most of these secondary metabolites are extracted from wild or cultivated plants since their chemical synthesis is either tremendously tough or economically impracticable. Production through callus and cell suspension cultures is a gorgeous substitute, nevertheless till yet this has had only restricted marketable accomplishment owing to less-existence of empathetic of how these metabolites are synthesized. The current book chapter has summarized some of the current progresses and investigations conducted by authors for the production of some of the useful bioactive secondary metabolites *viz.,* withanolides, bacosides, glychyrhizin, reserpine, ajmalicine, amarogentin, plumbagin and terpenoids from callus and cell suspension cultures of corresponding plant species. The similar have been deliberated vastly.

*Keywords: Secondary metabolites; callus culture; cell suspension culture; medicinal plants; metabolic engineering; bioactive; withanolides; bacosides; glychyrhizin; terpenoids; reserpine, plumbagin; indole alkaloids; secoirridoids; xanthones.*

## 1. STUDY OBJECTIVES

The present chapter was aimed to describe possible role of different plant growth regulators their concentrations, nature of explants and other culture conditions on establishment of callus and cell suspension cultures appropriate for production of secondary metabolites of pharmaceutical importance of imperative medicinal plants.

## 2. INTRODUCTION

Plants are ironic spring of bioactive compounds or phyto-pharmaceuticals employed in pharmaceutical industry. Some of the plant produced natural products including drugs for instance morphine, codeine, cocaine, quinine *etc*; anti-cancer catharanthus alkaloids, belladonna alkaloids, colchicines, phytostigminine, pilocarpine, reserpine and steroids like diosgenin, digoxin and digitoxin. Several of these pharmaceuticals are still in practice today and regularly no useful synthetic substitutes have been found that possess the same efficacy and pharmacological specificity [1-5]. Presently one four$^{th}$ of all prearranged pharmaceuticals in industrialized nations cover amalgams that are unswervingly or tortuously, *via* semi-synthesis, derived from plants. Besides, 11% of the 252

*[a] Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.*
*[b] Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
*[c] Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
*[d] Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.*
**Corresponding author: E-mail: drmanojtripathi64@gmail.com;*

**Biography of author(s)**

**Ashok Ahuja**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is a Plant Scientist. He is a Professor of Plant Molecular Biology & Biotechnology, RVSKVV Gwalior, India. He has done his Post-Doctoral Work with Professor E. Reinhard University of Tubingen, Germany. His research interests include production of Medicinal Plant Biotechnology, bioactive secondary metabolites, micro propagation and conservation biotechnology of Medicinal and Aromatic plants. He is working on application of bioreactor systems as Future Technology for production of plant bioactive, value additions through biotransformation's utilizing plant cell suspension culture system and advanced micro propagation. He was a Chief Scientist -Group Leader in Plant Tissue Culture, Biodiversity & Applied Botany Division at CSIR-Indian Institute of Integrative Medicine Jammu. He Participated as Project Investigator, Co-PI, Task force member, Team member.in a more then 20 CSIR-Network, Department of Biotechnology, DST, National Medicinal Plant Board (Govt.of India), industry sponsored and institutional Projects in varying capacities . He Managed Plant tissue culture department for more than 30 years and contributed significantly. He Created and managed national level facilities- In vitro Culture repository and Regional Hardening Unit at IIIM Jammu, India. He has over 30 years of experience as researcher in the area of Medicinal & Aromatic Plants Biotechnology with CSIR-IIIM, Jammu. He translated his work into patents and 125 peer reviewed research publications, Book chapters, and Technical Manuals. He is Editorial Board Member/Reviewer to American J Plant Sciences, Journal of Agricultural Biochemistry and Scientia Horticulture, Natural Product Communications, International J of Ayurveda Research, American J Plant sciences and Member of number of National & International Professional Societies.

**Manoj Kumar Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is working as Professor and Head, Department of Plant Molecular Biology & Biotechnology and Genetics & Plant Breeding and In charge, Biotechnology Centre, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India. He has 24 years' experience in the field of Research, Extension and Teaching. He received "Grameen Pratibhavan Khoj" Scholarship and M.P. Education Board merit scholarship during his schooling. He also received ICAR merit-cum-means scholarship (GoI) during his graduation. He is the recipient of many National and International Awards in different scientific occasions. He supervised 5 PhD scholars and 28 M.Sc. (Agriculture) students during their Doctoral and Master's degree. He designed innovative course curriculum of Biotechnology for different departments of Master's Degree. He has handled many projects funded by State as well as Central Government of India. He has presented more than hundred research papers in different National and International conferences. He has also organized various trainings as well as seminars and conferences. He is an author or co-author of more than 130 research papers published in reputed National and International Journals. He is also the author or editor of 8 Laboratory Manuals and 6 book chapters. He is the member of 5 scientific societies and serving as reviewer of more than 15 scientific journals.

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is working as Scientist, in the discipline of Genetics & Plant Breeding/Biotechnology at Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayeraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002, Madhya Pradesh, India. She has worked as senior research fellow and research associate at Indian Agriculture Research institute, New Delhi, India and worked on functional genomics, gene pyramiding and allele mining aspects for biotic and abiotic stresses of crops. She has received several awards i.e., emerging scientist award, distinguished scientist award, scientist of the year award and young scientist award from different scientific societies. She has been elected as member of National Academy of Sciences, India. She has so far published more than 50 research papers, 03 books, 3 practical manuals and 06 book chapters in high impact National and International journals and participated in more than 30 National and International Conferences, Seminars, Workshops and Trainings.

**Niraj Tripathi**
Directorate of Research Services, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Research Associate at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India is acknowledged for his innovations and sharing of his acquired skills. Among the ten patent applications filed in the Indian Patent Office, He is credited with the grant of one. The product and processes developed by this promising bio-technologist are helpful for science as well as society. He is a life member of the Indian Science Congress Association (ISCA), Society for Advancement of Natural Resins and Gums (SANRAG), Environment and Social Development Association (ESDA) and Mahakaushal Vigyan Parishad. He 148 Submission sequences in the National Centre for Bio-technology Information (NCBI) reflects his dedicated work in molecular and genetic diversity field. He has Plant breeders value for one of his innovations on molecular marker technology for identification and authentication of crop varieties and cultivars. He has one book, six chapters and seventy seven research papers are published to his credit.

**Gyanendra Tiwari**
Department of Plant Physiology, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Professor of Plant Physiology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India. He is having 23 years' experience in the field of Research, Teaching and Extension of Medicinal and Aromatic Plants and Physiology of Plants. He is working as In Charge, Prestigious Herbal Garden cum Plant Conservatory of JNKVV, Jabalpur, India where more than 1100 species of medicinal and aromatic plants are conserved. He is member of MP State Medicinal Plant Board. He

is also in charge of Revolving Fund on Medicinal Plants. He also received JNKVV University merit scholarship during his graduation and post-graduation. He is the recipient of Awards in different scientific occasions. He supervised 3 PhD scholars and 20 M.Sc. (Agriculture) students during their Doctoral and Master's degree as Major Advisor. As member of advisory committee he guided 3 PhD and 20 M.Sc. (Agriculture) students. He designed innovative course curriculum of M Sc. (Horticulture) Medicinal and Aromatic Plants at College of Horticulture, Mandsaur under RVSKVV, Gwalior, India. He has handled 4 projects funded by State Government of MP. He has presented many research papers in different National and International conferences. He is an author or co-author of more than 60 research papers published in reputed National and International Journals. He is also the edited of 2 books and authored 10 book chapters. He is the member of 2 scientific societies and serving as reviewer of more than 4 scientific journals.

**Nishi Mishra**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

She is a Ph.D. Research scholar in Plant Molecular Biology & Biotechnology at JNKVV, Jabalpur, India. She has done her B.Sc. in Agriculture, 2017 and M.Sc. in Plant Molecular Biology & Biotechnology, 2019 from RVSKVV, Gwalior, India. She is working on "Molecular identification and authentication of different Minor Millets species using DNA barcoding". She did her M.Sc. on "Biotechnological Improvement of Soybean (Glycine max L. Merrill) against YMV & Drought using Phenotyping, Genotyping and In Vitro Selection approaches''. She has received several awards i.e., Scientist Associate Award, Young Molecular Biologist Award, thesis award and also received Smt. Mithlesh Mathur award for best academic performance in post-graduation by RVSKVV. She has published 14 research papers in National and International journals and participated in more than 20 National and International Conferences, Seminars, Workshops and trainings. She wrote one book chapter & most popular articles on the subject. She acquired several best poster awards in national and international conferences.

**Shashank Bhargav**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, Rajmata Vijayraje Scindia Agricultural University, Gwalior 474002, India.

He is a Post Graduate Research scholar of Plant Molecular Biology & Biotechnology. He has done his B.Sc. Agriculture in 2018 from School of Agriculture, ITM University, Gwalior, India. He is working on "In vitro morphogenesis studies and quantification of secondary metabolites in black turmeric (Curcuma caesia Roxb)" for his M.Sc. (PMB&B) programme at RVSKVV, Gwalior, Madhya Pradesh, India under the guidance of Dr. Manoj Kumar Tripathi, Professor and Head, Department of Plant Molecular Biology & Biotechnology, RVSKVV, Gwalior, 474002, India.

**Sharad Tiwari**
Biotechnology Centre, Jawaharlal Nehru Agricultural University, Jabalpur 482004, India.

He is a Dean of oldest and biggest College of Agriculture Madhya Pradesh at Jabalpur and Director of Biotechnology Centre of prestigious Jawaharlal Nehru Agriculture University, Jabalpur, India since 2010. He is a Councilor (Central Zone) of Indian Society of Genetics and Plant Breeding since 2018 and fellow and member of several scientific communities. He is Director Farms and Professor and Head of Plant Breeding and Genetics Department during 2016-2019 at Jawaharlal Nehru Agriculture University, Jabalpur, India. He has done BSc from Govt Science College, Jabalpur, 1976 and MSc in Plant Breeding & Genetics from JNKVV, India. He Joined as Assistance Professor in Plant Breeding & Genetics, 1980 and proceeded to Russian State Agrarian University - Agricultural Academy in Moscow for PhD in 1984. He Was a Visiting Scientist in 2004 at UAH, Alabama, USA. Has also travelled UK, Germany, Japan, Italy, Taiwan, South Africa, Hungary, Ukraine, Kazakhstan, Serbia for various scientific purposes. He handled 13 national and international level projects as PI funded by ICAR, DBT, DST, DoAC and JICA. He developed micropropagation protocols of several medicinal plants and several crops including soybean and transgenic oat lines over-expressing fungal phytase gene and BYMV resistant lines using reverse transcriptase. He evaluated molecular marker for various traits in soybean for gene-based cultivar selection and characterized whitefly and YMV with molecular markers for soybean disease control in MP, India. He isolated several plants growth-promoting rhizobacteria (PGPR) from the rhizosphere displaying various direct plant growth promoting attributes and generated more than 600 sequences for different genes generated from PGPRs have been published in the NCBI domain. He performed DNA fingerprinting of major crops, including soybean, minor millets and different medicinal plant species. Filed a patent on newly developed methods for genotype identification based on simple sequence repeats marker data in 2017, which is under review. He revealed DNA barcode in various medicinal plants with universal markers A patent "DNA barcode for species identification of sedge plants and methods thereof" was granted earlier this year, another patent on DNA barcoding coupled high resolution melting analysis is under review. He served as a breeder developed 2 varieties of rice and collaborator in 2 varieties of soybean (JS 20-94 and JS 20-116) and one variety of chickpea. He has over 40 years of teaching experience. He guided 59 post-graduate and 14 doctoral students in Agriculture Biotechnology and Plant Breeding & Genetics. He is Supervisor of five National Post-doctoral Fellow from DBT, DST, and CSIR. He Published more than 110 Scientific Papers in refereed journals, more than 60 papers presented in conferences, 01 book and 12 Book chapters.

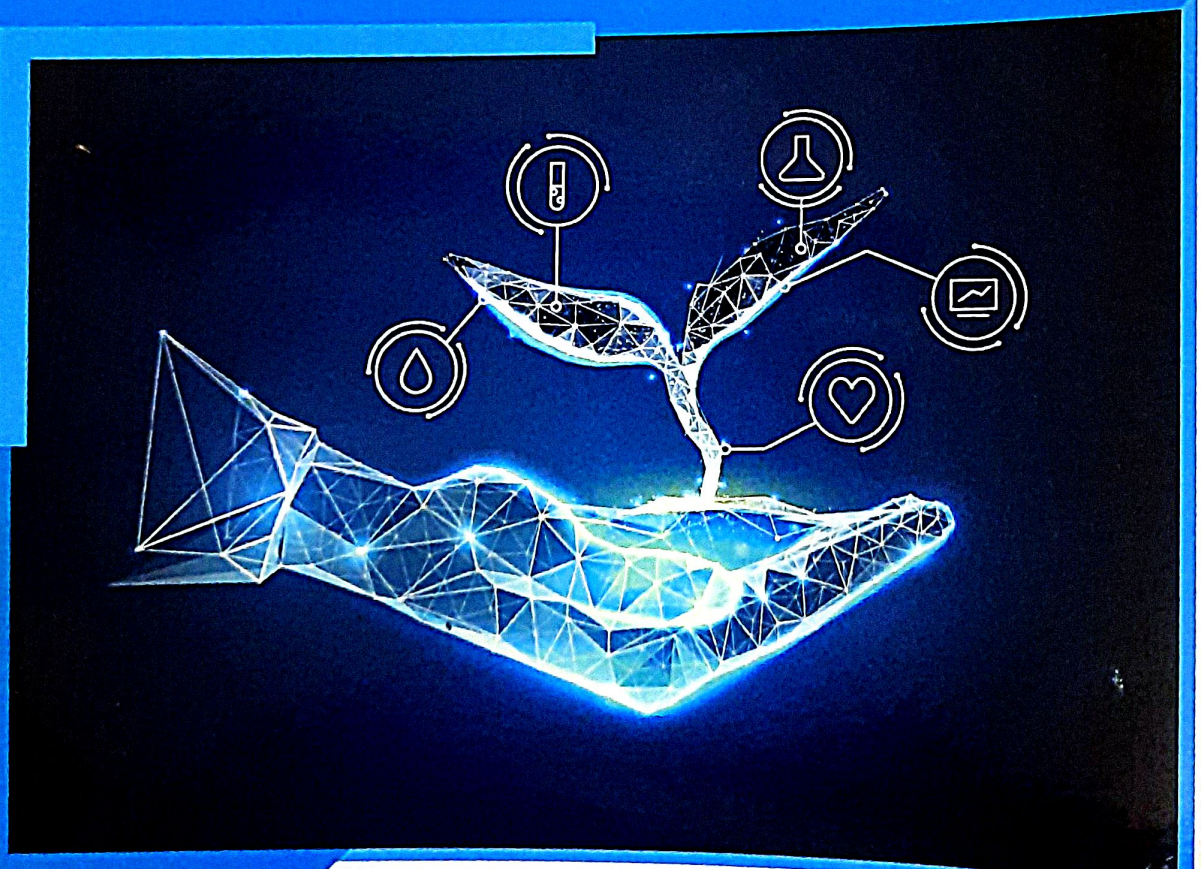
# OBJECTIVE MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY

Phundan Singh
Sushma Tiwari
Sharda Choudhary

DAYA

ASTRAL

# Molecular Biology and PLANT BIOTECHNOLOGY at a Glance



Phundan Singh
Sushma Tiwari
Pratibha Bisen

DAYA

ASTRAL

# Research Trends in Horticulture Sciences

Volume - 14

**Chief Editor**

**Manoj Kumar Ahirwar**

Scientist Horticulture JNKVV, KVK, Damoh, Madhya Pradesh, India

**AkiNik Publications**

**New Delhi**

**Published By:** AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No. – 9711224068, 9911215212
Email – akinikbooks@gmail.com

**Chief Editor:** Manoj Kumar Ahirwar



**Publication Year:** 2020

**Pages:** 130

**ISBN:** 978-93-90420-14-8

**Book DOI:** https://doi.org/10.22271/ed.book.916

**Price:** ₹ 753/-

# Contents

# Chapter - 6
# Dragon Fruit: A Super Food in India


**Authors**

**Khushboo Tandon**
Department of Horticulture, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

**P.K.S. Gurjar**
Department of Horticulture, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

**R. Lekhi**
Department of Horticulture, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

# Chapter - 6

## Dragon Fruit: A Super Food in India

Khushboo Tandon, P.K.S. Gurjar and R. Lekhi

**Abstract**

Dragon fruit (*Hylocereus undatus*) Family *Cactaceae*, Most Hylocereus species principally is originated in Mexico and Central and South America. It is a recently introduced super fruit in India, is considered to be a promising, remunerative fruit crop. It is a climbing vine cactus species which has received worldwide recognition first as ornamental plant and then as a fruit crop. Fruit has very attractive colour and mellow mouth melting pulp with black colour edible seed embedded in the pulp along with tremendous nutritive property which attracts the growers from different part of India to cultivate this fruit crop. It also contains phytonutrients, antioxidants, vitamin C, Protein, Carbohydrate, Vitamin B, Carotene and polyunsaturated fatty acids. Dragon fruit can be processed into a wide range of industrial products such as juice, sherbet, jam, syrup, ice cream, jelly, preserve, candy, pastries and Wine making. The tropical weather conditions are better for the dragon fruit cultivation. The dragon fruit plant gets the flowering in May to June month and fruits from Aug to Dec month.

**Keywords:** dragon fruit, nutritional properties, medicinal properties, fruit types etc.

### Introduction

Dragon fruit (*Hylocereus undatus*) Family *Cactaceae*, Most Hylocereus species principally is originated in Mexico and Central and South America. It is a recently introduced super fruit in India, is considered to be a promising, remunerative fruit crop. It is a climbing vine cactus species which has received worldwide recognition first as ornamental plant and then as a fruit crop. Fruit has very attractive colour and mellow mouth melting pulp with black colour edible seed embedded in the pulp along with tremendous nutritive property which attracts the growers from different part of India to cultivate this fruit crop. The flower is so beautiful that it is nicknamed as 'Noble Women' or 'Queen of the Night'. The biggest advantage of this crop

**श्री देवेंद्र विश्वकर्मा :–** मैंने बी.एस.सी. (एग्री) एवं एम.एस.सी. (उद्यान विभाग – सब्जी विज्ञान), जे.एन.के.व्ही.व्ही., जबलपुर (म.प्र.) से उत्तीर्ण की हैं। तथा वर्तमान समय में पी.एच.डी. (शोधार्थी), राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय, ग्वालियर (म.प्र.) में अध्ययनरत हूँ।

**डॉ. व्ही.के. सिंह :–** सह प्राध्यापक, उद्यान विभाग (फल विज्ञान), कृषि महाविद्यालय, टीकमगढ़, जे.एन.के.व्ही.व्ही., जबलपुर (म.प्र.)।

**डॉ. सुधीर सिंह :–** सहायक प्राध्यापक, कृषि अर्थशास्त्र, कृषि महाविद्यालय, आर.व्ही. एस.के.व्ही.व्ही., ग्वालियर (म.प्र.)।

**श्री भरत लाल :–** मैंने बी.एस.सी. (एग्री) एवं एम.एस.सी. (कीटशास्त्र), जे.एन.के.व्ही.व्ही. , जबलपुर (म.प्र.) से उत्तीर्ण की हैं। तथा वर्तमान समय में पी.एच.डी. (शोधार्थी), राजमाता विजयाराजे सिंधिया कृषि विश्वविद्यालय, ग्वालियर (म.प्र.) में अध्ययनरत हूँ।

SSDN

SSDN Publishers & Distributors

5A, Sahni Mansion, Ansari Road, Daryaganj, New Delhi-110002
Ph.: 011-47520102, 9871115366, E-mail: ssdn.katia@gmail.com
ssdnbooks@gmail.com, info@ssdnbooks.com

Website: www.ssdnbooks.com

₹ 995.00

ISBN : 978-93-8805-024-4

आधुनिक फलोत्पादन

विश्वकर्मा • सिंह • लाल

SSDN

श्री देवेंद्र विश्वकर्मा
डॉ. व्ही. के. सिंह
डॉ. सुधीर सिंह
श्री भरत लाल

# आधुनिक फलोत्पादन

## प्रबंधन एवं तकनीकी

Pavan Kumar · R. S. Tomar ·
Jahangeer A. Bhat ·
Manmohan Dobriyal ·
Meenu Rani *Editors*

# Agro-biodiversity and Agri-ecosystem Management

Springer

Pavan Kumar • R. S. Tomar •
Jahangeer A. Bhat • Manmohan Dobriyal •
Meenu Rani
Editors

# Agro-biodiversity and Agri-ecosystem Management

Springer

*Editors*
Pavan Kumar
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

R. S. Tomar
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Jahangeer A. Bhat
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Manmohan Dobriyal
College of Horticulture and Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi, India

Meenu Rani
Department of Geography
Kumaun University
Nainital, Uttarakhand, India

ISBN 978-981-19-0927-6 ISBN 978-981-19-0928-3 (eBook)
https://doi.org/10.1007/978-981-19-0928-3



This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Contents

**Part V Technological Intervention for Agricultural Development**

# Genomics Approaches for Restoration and Conservation of Agro-Biodiversity

14

R. S. Tomar, Prabha Singh, Sushma Tiwari, Manoj Kumar Tripathi, Sanjay Singh, K. Bhojaraja Naik, Chandan Kumar Singh, and Shailesh Kumar Singh

**Abstract**

Agro-biodiversity provides foods for living biota along with several things for easy living and survival on the planet. It is in various forms and goods like firewood; approximately two billion population globally utilize firewood as a source of energy for cooking and heating; fiber, like cotton, wool, silk, and flax; drugs, approximately 25% of drugs utilized come from plants; and for construction of household and utilization of timber wood as furniture, sports goods, and many. Nowadays it is an alarming threat because of the reduction in free space, smaller and fragmented habitats, and overexploitation by human for urbanization and fulfillment of their needs. This degradation and destruction have caused imbalance in the nature which has resulted in several calamities and disasters in the recent past. So it is important to protect and conserve the agro-biodiversity to

R. S. Tomar (✉)
College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University, Jhansi, India

P. Singh
Division of Seed Technology, ICAR-IGFRI, Jhansi, U.P., India

S. Tiwari · M. K. Tripathi
Plant Molecular Biology and Biotechnology, RVSKVV, Gwalior, M.P., India

S. Singh
Faculty of Agriculture Sciences, Mandsaur University, Mandsaur, M.P., India

K. B. Naik
ICAR-Indian Institute of Seed Science, Mou, U.P., India

C. K. Singh
ICAR-Indian Agricultural Research Institute, New Delhi, India

S. K. Singh
School of Agriculture, ITM University, Gwalior, M.P., India



P. Kumar et al. (eds.), *Agro-biodiversity and Agri-ecosystem Management*,
https://doi.org/10.1007/978-981-19-0928-3_14

# सामुदायिक बीज बैंक


डॉ. यासीन
डॉ.चंदन कुमार

डॉ. आई.एस.तोमर
डॉ.जगदीश मौर्य

**हस्तपुस्तिका**

**कृषि विज्ञान केन्द्र, झाबुआ**

राजमाता विजयाराजे सिंधिया कृषि विश्व विद्यालय, ग्वालियर

Pin- 457661 (M.P.) Phone & Fax - 07392-244367,

Email-kvkjhabua@rediffmail.com Website - www.kvkjhabua.org

app- KVK Jhabua (Kheti badi)

RVSKVV PUB. NO. 132

# MANUAL
## ON
# DETECTION AND DIAGNOSIS OF DISEASES OF HORTICULTURAL CROPS

By
Drs. (Mrs.) Moly Saxena
and D.R. Saxena
PLANT PATHOLOGY SECTION
R.A.K. COLLEGE OF AGRICULTURE
R.V.S.K.V.V.
SEHORE- 466001 (M.P.)

RVSKVV. Pub. No. 132/2021

# PRACTICAL MANUAL ON DETECTION AND DIAGNOSIS OF DISEASES OF HORTICULTURAL CROPS

By

Dr. (Mrs.) Moly Saxena

Dr. D.R. Saxena

**PLANT PATHOLOGY SECTION**

***RVSKVV-R.A.K. COLLEGE OF AGRICULTURE***

**SEHORE- 466 001 (M.P.)**

(125)

# K.N.K. SERIES ON AGRICULTURE
# (Volume-I)

## MCQs
## *for*
## JRF/SRF/NET/OTHER COMPETITIVE EXAMINATIONS


Compiled by

**Dr. Anuj Kumar**

Assistant Professor & Head
Floriculture & Landscape Architecture
KNK College of Horticulture, Mandsaur (M.P.)

**Dr. Jyoti Kanwar**

Assistant Professor
Fruit Science
KNK College of Horticulture, Mandsaur (M.P.)



RAJMATA VIJAYARAJE SCINDIA KRISHI VISHWAVIDYALAYA
GWALIOR (M.P.)

# K.N.K. SERIES ON HORTICULTURE
# (Volume-I)

## MCQs
## *for*
## JRF/SRF/NET/OTHER COMPETITIVE EXAMINATIONS


Compiled by

**Dr. Anuj Kumar**

Assistant Professor & Head
Floriculture & Landscape Architecture
KNK College of Horticulture, Mandsaur (M.P.)

**Dr. Jyoti Kanwar**

Assistant Professor
Fruit Science
KNK College of Horticulture, Mandsaur (M.P.)

# TEXTBOOK OF SOIL AND WATER CONSERVATION

(As Per 5th Dean's Committee Syllabus)

RAJIV DUBEY
VINAY KUMAR GAUTAM
DEEPAK SHARMA
LAXMI L. SOMANI
R.C. DADHEECH

ATPA

Mrs. Geeta Somani
Agrotech Publishing Academy
1-GA-24 GAYATRI NAGAR, HIRAN MAGRI, SECTOR-5
Udaipur - 313002 (INDIA)
Mob – 9414169635

# DISCLAIMER

Information contained in this book has been published by Agrotech Publishing Academy, has been obtained by its authors believed to be reliable, and are correct to the best of their knowledge. However, the publisher and its authors shall in no event be liable for any errors, omissions or damage arising out of use of this information and specially disclaim any implied warranties or merchantability or fitness for any particular use. The information in this book does not warrant or assume any legal liability or responsibility for the accuracy, completeness or usefulness of the courseware contents.

Disputes if any are subjected to Udaipur Jurisdiction only.

First Edition 2020


ISBN: 978-81-8321-535-0

*Typeset by:*
Vikas Yadav
Udaipur - 313002

# K.N.K. SERIES ON HORTICULTURE
# (Volume-I)

## MCQs
## *for*
## JRF/SRF/NET/OTHER COMPETITIVE EXAMINATIONS


Compiled by

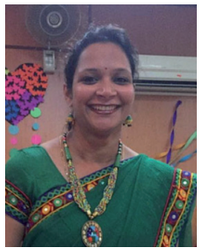
**Dr. Anuj Kumar**

Assistant Professor & Head
Floriculture & Landscape Architecture
KNK College of Horticulture, Mandsaur (M.P.)

**Dr. Jyoti Kanwar**

Assistant Professor
Fruit Science
KNK College of Horticulture, Mandsaur (M.P.)

In South East Asia maize-wheat cropping system is important as it remains to be staple part of diet but production is limited by low fertilizer efficiency, inadequacy of current fertilizer recommendations, and the ignorance of nutrients. Currently recorded average maize and wheat yields compared with the yield potential for a given variety and climate indicate significant opportunities to further increase their productivity through site-specific, integrated nutrient and crop management based on crop requirements, soil test values and yield targets. This nutrient omissions study was conducted at research farm, IARI, New Delhi, India suggests that the recommended dose for the maize-wheat cropping system is sub-optimal and establishes STCR based nutrient application as more scientific management of nutrients in the cropping system. Omission of P, K and Zn in the cropping system highlighted the significance of P and K application to both the crops but the effect of K omission is more pronounced as compared to P omission in the system. While Zn may be conveniently omitted from the system due to high DTPA extractable Zn status in soil.



I am a groundnut scientist working under *Government of India* since 2016. Growing up at Rajasthan and studying at IARI, New Delhi inspired in me a desire to be a scientist devoted to the nature and nation. I was awarded with gold medal during my master's and received a prestigious International award from IPNI, USA for my doctoral research work.

978-620-0-44022-8

Nutrients Omission Studies in Cereals



Ekta Joshi
Abhay Kumar Vyas
Deep Singh Sasode

# Nutrient Omissions Studies in Maize-Wheat Cropping System of India

LAP LAMBERT Academic Publishing

Joshi, Vyas, Sasode

**Ekta Joshi**
**Abhay Kumar Vyas**
**Deep Singh Sasode**

# Nutrient Omissions Studies in Maize-Wheat Cropping System of India



**LAP LAMBERT Academic Publishing**

**Imprint**


Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
**ISBN: 978-620-0-44022-8**

Due to constant decrement in soil fertility status, the production and productivity of groundnut in India is decreasing. Although, the chemical fertilizers are known to increase production but our complete reliance on chemicals has led to poor soil health and pollution problems which in turn affects crop yield. There is an urgent need to explore an alternative strategy for sustainable production of crops. Liquid biofertlilizers, one of the best modern tools for agriculture, when integrated with chemical fertilizers boost up the crop yield as well as improve soil fertility status. They aid in meeting the nutrient demands of crop by enhancing their availability and absorption by the plants. Taking into account these facts, this book represents the results obtained from the M.Sc. thesis study about Integrated Nutrient Management in kharif groundnut. It also emphasizes on studying the effect of integration of chemicals and liquid biofertilizers on soil health and various quality parameters of groundnut crop concerning economics of INM practices in groundnut cropping.

Neelam Singh pursuing Ph.D. in Agronomy at RVSKVV. The author holds M.Sc. on INM in groundnut & has articles and book chapters about the theme published in several journals. She graduated the B.Sc. in Agriculture at MGCGVV in 2016. She is recipient of INSPIRE fellowship by DST, New Delhi & a gold medalist in both her B.Sc. & M.Sc. degree program.

978-3-659-52632-9

Nutrient Management in kharif groundnut



Neelam Singh
Ekta Joshi

# Nutrient Management in *kharif* groundnut

## Integrating chemical fertilizers with biofertilizers: An approach towards sustained crop productivity and soil health

LAP LAMBERT Academic Publishing

Singh, Joshi

**Imprint**


Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
**ISBN: 978-3-659-52632-9**

## CONTENTS

# Recent Trends in Molecular Biology and Biotechnology

**Volume - 1**

**Chief Editor**

**Dr. Yogendra Singh**
Assistant Professor
(Senior Scale) (Biotechnology), Jawaharlal Nehru Krishi Vishwa Vidyalaya,
Jabalpur, Madhya Pradesh, India

**Integrated Publications**
**New Delhi**

**Published By:** Integrated Publications

Integrated Publications
H. No. - 3 Pocket - H34, Sector - 3,
Rohini, Delhi-110085, India

**Chief Editor:** Dr. Yogendra Singh



**Publication Year:** 2020

**Pages:** 173

**ISBN:**

**Price:** ₹ 788/-

# Contents

# Chapter - 8
# Bioinformatics and Its Applications in Crop Improvement

**Authors**

**Radha Gupta**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

**Sushma Tiwari**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

**M.K. Tripathi**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

**Sajjan Kumar Pooniya**
Department of Plant Molecular Biology and Biotechnology, College of Agriculture, RVSKVV, Gwalior, Madhya Pradesh, India

# Chapter - 8

## Bioinformatics and Its Applications in Crop Improvement

**Radha Gupta, Sushma Tiwari, M.K. Tripathi and Sajjan Kumar Pooniya**

**Abstract**

Bioinformatics is a rapidly developing branch of science and is highly interdisciplinary, using concepts and techniques from informatics, mathematics, statistics, biology, chemistry, biochemistry, physics, and linguistics. Bioinformatics application is in information technology to manage biological data that helps in plant genomes study. Biological research that earlier used to start in laboratories, fields and plant clinics is now starts at the computational level using computers (In-silico) for analysis of the data, experiment planning and hypothesis development. Bioinformatics database and tools have various application in biological research enables storage, retrieval, analysis, annotation and visualization of results to promotes and better understanding of biological system. This will help in crop improvement and plant disease diagnosis to improve the quality of Plant.

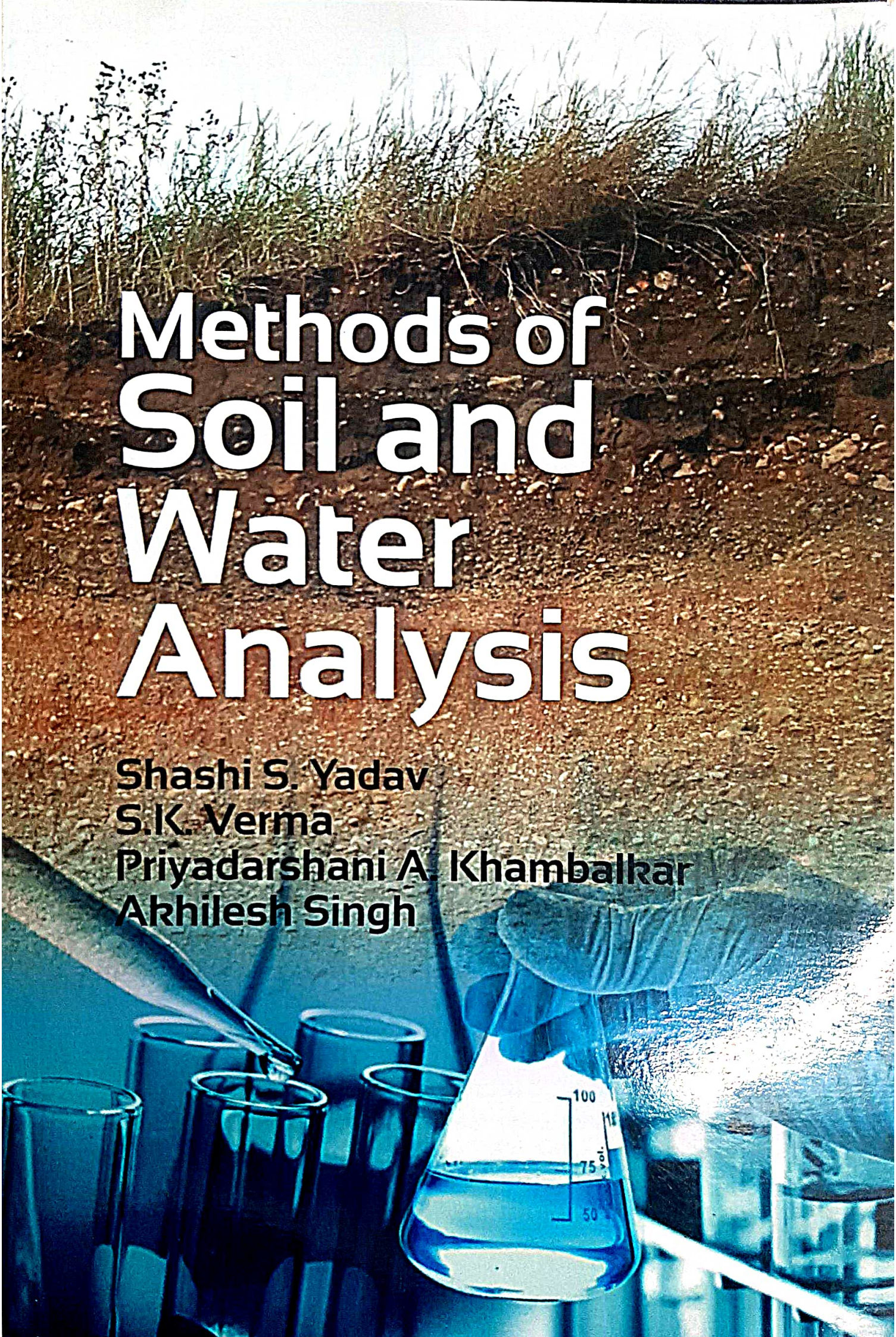
**Keywords:** bioinformatics, genomics, agriculture, crop improvement and biotic stress

### Introduction

Bioinformatics is defined as the study of information content and its flow in biological systems. It is an interdisciplinary branch of the science composed of biology, mathematics and computer science. According to the National Centre for Biotechnology Information (NCBI), “bioinformatics is the research development or application of computational tools and approaches for expanding the use of biological, medical, plant data base for acquire, store, organize, archive, analyze or visualize such data”. Although bioinformatics is a new field of science but it is making progress in every field of biotechnology. Bioinformatics common activities includes, mapping, aligning different DNA, protein sequences, creating and viewing 3-D models of protein structures (Nilges and Linge, 2009). The purpose of bioinformatics is to understand the genetic and molecular basis of all biological processes in plants that are relevant to the specie. Bioinformatics

# Methods of Soil and Water Analysis

Shashi S. Yadav
S.K. Verma
Priyadarshani A. Khambalkar
Akhilesh Singh



*Published by :*

**SATISH SERIAL PUBLISHING HOUSE**

403, Express Tower, Commercial Complex, Azadpur, Delhi-110033 (INDIA)
Phone : 011-27672852 Fax : 91-11-27672046
E-mail : info@satishserial.com, hkjain1975@yahoo.com



ISBN 978-93-88020-71-8



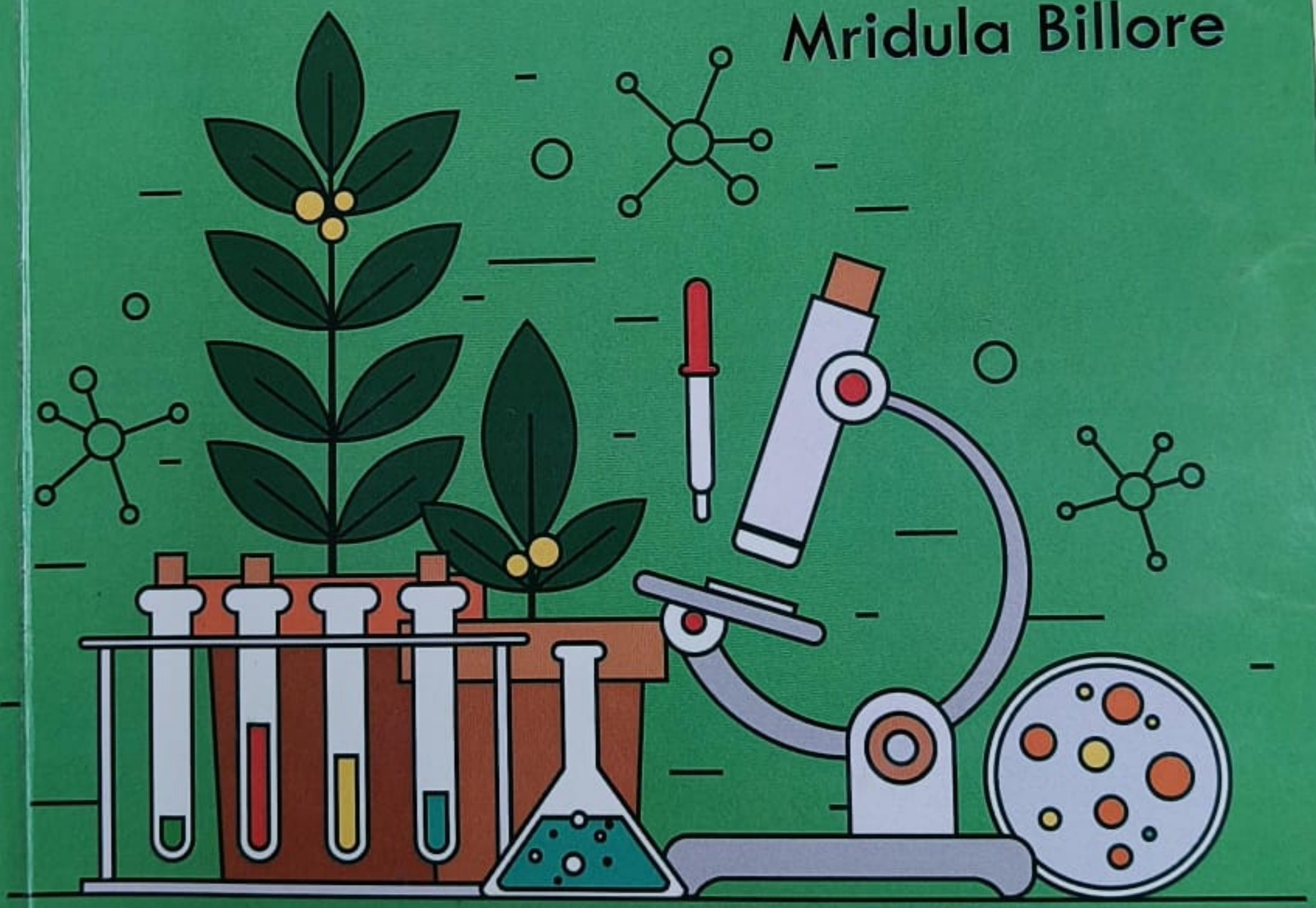
Composed, Designed & Printed in India

# *Contents*

As per ICAR 5th Deans' Committee Recommendation

# FUNDAMENTALS OF MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY

Phundan Singh
Sushma Tiwari
Mridula Billore



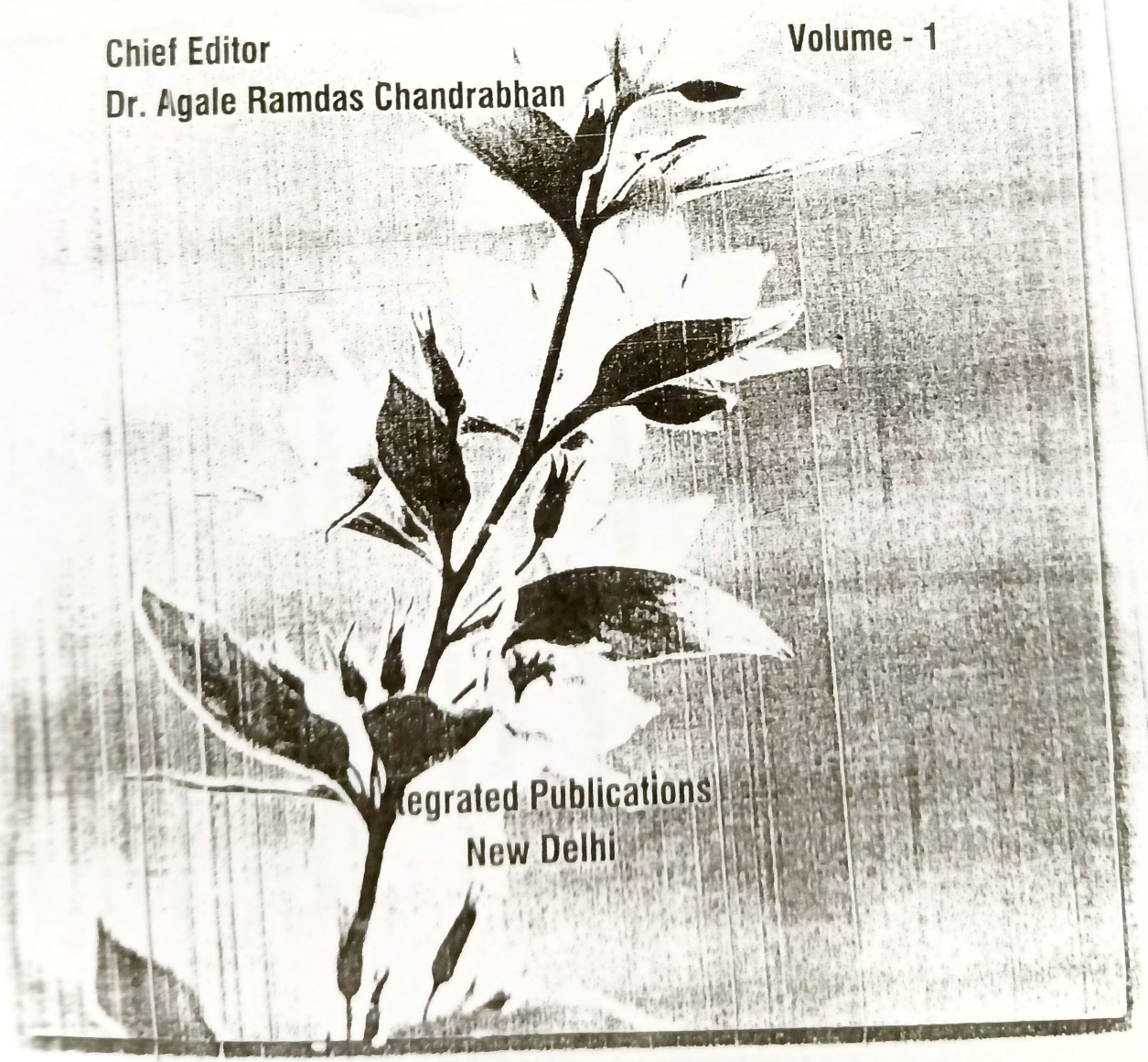
DAYA

ASTRAL

# RESEARCH TRENDS AND INNOVATIONS IN PLANT PATHOLOGY

Chief Editor
Dr. Agale Ramdas Chandrabhan

Volume - 1



tegrated Publications
New Delhi

**Published By:** Integrated Publications

Integrated Publications
H. No. - 3 Pocket - H34, Sector - 3,
Rohini, Delhi-110035, India

**Chief Editor:** Dr. Agale Ramdas Chandrabhan



**Publication Year:** 2020

**Pages:** 125

**ISBN:** 978-81-947809-1-5

**Book DOI:** https://doi.org/10.22271/int.book.21

**Price:** ₹ 742/-

## Contents

# Chapter - 4

## Foliar Diseases of Cluster Bean: A Consortium Approach for Disease Management to Improve Productivity

Dr. Rajni Singh Sasode and Dr. Pramod Kumar Fatehpuria

**Abstract**

Arid legume in India comprises four annual legumes *viz.*, Cluster bean or guar, Moth bean, Cowpea and Horse gram. These crops could not considered as major crops due to their low acreage at the national level. These crops are drought hardy can grow in soils with poor fertility and have deep mat type root system which is of great adaptive significance. Therefore these legumes are specifically important for sustaining production under arid and semi-arid ecosystem. However, these crops are important at the regional level especially, in the traditional farming system. These minor pulses may not substantially influence the productivity figures of pulses as a whole at the country level, the same may; however spectacularly contribute through specific climate zones and ecological niches. The pulses are known for their unique and specific adaptation towards fragile ecosystem where they encounter with degree of adversities composed of moisture scarcity, extremes of temperature and poor agronomic inputs with less care. Besides having versatile uses with low cultivation cost, these crops from important component of complex cropping systems, varying from one climatic zone to other. Suited to nutritionally poor and texturally degraded soils, pulses are recognized as essential segment of traditionally and indigenous and technologies with assured production in such area. The poor productivity of Cluster bean is of major concern. Several biotic and abiotic reasons can be assigned for stagnation in poor productivity of these legumes. Since, arid legumes are grown basically without plant protection and agronomic inputs. In recent year concerted efforts at various levels have led to the development of amenable technological advancements which are quite useful in raising the productivity of crops. In context of diseases the fungal foliar diseases among these legumes play an important role in reducing production and productivity of the crops. Fungal leaf spots are caused by a large number of

# लोक जैवविविधता पंजी

## (People's Biodiversity Register- PBR)

## जैवविविधता प्रबंधन समिति – पंचखैरिया

## जनपद पंचायत – थांदला

## जिला – झाबुआ

# Under GEF Project

***"Mainstreaming Agricultural Biodiversity Conservation and Utilization in Agricultural Sector to Ensure Ecosystem Services and Reduce Vulnerability"***

## –तकनीकी सहयोग–

**Principle Investigator**
**Dr. M.Yasim**
**Principal Scientist, R.A.K.College of Agriculture Sehore**

**Collaborating institutions and staff:**
**Dr. I S Tomar Head and Project Coordinator**
**KVK RVSKVV Jhabua M P**

**Data Collection**
**Mr. Nansingh Bariya**

## –संस्था–

**R.A.K.College of Agriculture Sehore, 466001(M.P.)**
**&**
**Krishi Vigyan Kendra Jhabua,457661 (M.P.)**

## INDEX अनुक्रमणिका

# लोक जैवविविधता पंजी

## (People's Biodiversity Register- PBR)

जैवविविधता प्रबंधन समिति – सजेली मालजीसाथ

जनपद पंचायत – मेघनगर

जिला – झाबुआ

# Under GEF Project

***"Mainstreaming Agricultural Biodiversity Conservation and Utilization in Agricultural Sector to Ensure Ecosystem Services and Reduce Vulnerability"***

## –तकनीकी सहयोग–

**Principle Investigator**
**Dr. M.Yasim**
**Principal Scientist, R.A.K.College of Agriculture Sehore**

**Collaborating institutions and staff:**
**Dr. I S Tomar Head and Project Coordinator**
**KVK RVSKVV Jhabua M P**

**Data Collection**
**Mr. Nansingh Bariya**

## –संस्था–

**R.A.K.College of Agriculture Sehore, 466001(M.P.)**
**&**
**Krishi Vigyan Kendra Jhabua,457661 (M.P.)**

## INDEX अनुक्रमणिका

# लोक जैवविविधता पंजी

## (People's Biodiversity Register- PBR)

जैवविविधता प्रबंधन समिति – काकनवानी

जनपद पंचायत – थांदला

जिला – झाबुआ

# Under GEF Project

***"Mainstreaming Agricultural Biodiversity Conservation and Utilization in Agricultural Sector to Ensure Ecosystem Services and Reduce Vulnerability"***

## INDEX अनुक्रमणिका

# 1. सामान्य जानकारी

| कमांक | विवरण | जानकारी |
|---|---|---|
| **1.** | Name of the Local Body स्थानीय निकाय का नाम | Kakanwani |
| **2.** | Taluk तहसील | Thandla |
| **3.** | District जिला | Jhabua |
| **4.** | State राज्य | Madhya Pradesh |
| **5.** | Geographical Area of the Local Body<br>स्थानीय निकाय की भौगोलिक स्थिति | 680.89 Hectares |
| **6.** | Population under the Local Body<br>स्थानीय निकाय की कुल जनसंख्या | Total : 4913<br>Male : 2467<br>Female : 2446 |
| **7.** | Families/House-holds परिवार एवं आवास | 909 |
| **8.** | GPS Coordinates | भौगोलिक रूप से यह क्षेत्र 23.0542494885 N अक्षांश तथा 74.4348150236 E देशान्तर पर स्थित है। |
| **9.** | Climate (Rainfall, Temperature and other weather patterns)<br>जलवायु (वर्षा, तापमान और अन्य मौसम के पैटर्न) | क्षेत्र की जलवायु भुष्क है। औसत वर्षा 800 mm औसत तापमान गर्मी के मौसम में यहाँ का तापमान अधिकतम 44 °C होता है एवं सर्दी के मौसम में न्यून्तम 18.9 °C रहता है। |
| **10.** | Land Use (Nine-fold classification available with village records) (in Hectares) भूमि उपयोगिता (ग्राम के अभिलेख में उपलब्ध नौ वर्गीकरण) | FA - 0 , NAUA - 71.55 , BLA - 14.76 , PGLA - 9.81 , MTCA - 93.94 , CWLA - 10.62 , FLOCFA - 2.95 , CFA - 477.26 , NSA - 4 . |
| **11.** | Date, Month and Year of PBR Completion<br>लोक जैवविविधता पंजी निर्माण पूर्ण होने की तिथि | Year - 2020 |
| **12.** | Management Regime of Forest area : Reserve Forests (RF) / Joint Forest Management (JFM) / Protected Areas (PA) / Community Owned and Managed Forests (COM)<br>वन क्षेत्र में प्रबंधन व्यवस्था (आरक्षित वन/संयुक्त वन प्रबंधन/संरक्षित क्षेत्र/सामुदायिक एवं प्रबंधीय वन) | . |

**FA**- Forest Area, **NAUA**- Area under Non-Agricultural Uses, **BLA**- Barren & Un-cultivable Land Area, **PGLA-** Permanent Pastures and Other Grazing Land Area**, MTCA**- Land Under Miscellaneous Tree Crops etc. Area, **CWLA**- Culturable Waste Land Area, **FLOCFA-** Fallows Land other than Current Fallows Area, **CFA**- Current Fallows Area , **NSA**- Net Area Sown

Surendra Kumar Ghoshi
K. C. Meena
Ajay Haldar

# Garlic (*Allium sativum* L.) Germplasms: A Breeding Research Studies

## Breeding of garlic

LAP LAMBERT Academic Publishing

# OBJECTIVE QUESTIONS ON FRUIT CROPS

Useful for :- ICAR-JRF, SRF,ARS,NET, SAUs Entrance Exams, UPSC- Civil Services - Prelims. & Main, B.Sc. (Agri), B.SC.(Horti), M.Sc & Ph.D. Entrance Examination and Interviews of All Agricultural Services.

Arjun Kashyap, Rajesh Lekhi
Niharika Rathore, Ajay Dangi
Brajraj Singh Kasana



SR.SCIENTIFIC

# CONTENTS

CHAPTER

1. Kagzi li
(a) Indi
(c) Sri L
2. Which
(a) Citr
(c) Citr
3. Which
(a) Vi
(c) Sa
4. Whic
(a) Vi
(c) S
5. See
(a) V
(c) S
6. Can
(a)
(c)
7. Tris
(a)
(c)
8. Mi
(a
(c
9. Pl
(a
(c
10. J
(
(
Fill in t
1.
2.
3.
4.

## About The Authors

**Dr. Arjun Kashyap** is born at Morena on 14-07-1989 and completed his school education at Ujjain MP. After completion of higher secondary he did his B.Sc. (Ag), M.Sc. (Horti.) and Ph.D in fruit science from RVSKVV Gwalior. He is very good student and qualified ICAR NET two times in 2015 and 2016 in fruit science. have two book chapters in reputed books and have also many popular articles and technical folder published by various magazines and from department of horticulture College of agriculture Gwalior. Dr. Kashyap has 14 research papers in different reputed NAAS rated journal in his short academic career. Dr. Kashyap was also awarded 5 times from different societies for best poster presentation during various national seminars.

**Dr. Rajesh Lekhi** is born in the year 1958 at Ludhiana district Punjab). He received his under graduate degree in agriculture from JNKVV, Jabalpur in the year 1981. He has done his M.Sc. (Ag) Horticulture from JNKVV, Jabalpur in the year 1983. He was awarded Ph.D. (Horti.) degree from agriculture university Agra (UP). The author has so far 30 years of experience in the field of teaching, research and extension. Besides several important assignments, Dr. Lekhi presently works as professor & head Horticulture at College of Agriculture Gwalior.

**Dr. Brajraj singh Kasana** is born at Gwalior on 03/09/1978. He had completed his graduation in Agriculture and post graduation in agronomy from JNKVV, Jabalpur (MP). He did his Ph.D. in Agronomy from RVSKVV Gwalior and also qualified the ASRB ICAR-NET with Agronomy. He is currently working as scientist in RVSKVV, Gwalior. He had awarded as child scientist award (1993) from science centre MP. He had a long experience in working asextension agronomist under Krishi Vigyan Kendra. He have 4 ICAR award for his work in KVK-Datia (2010 to 2017), Young Scientist Award (2015) from SSDAT- Meerut (UP) and Excellence in communication award (2016) from AASTHA Foundation with 10 best poster presentation award during various national seminars on different aspects of agriculture research and extension. He has two books namely "Ganna utapadan ki Vyavsayik Technique" and "Key to success in Agronomy – Terminology". Dr Kasana had published 22 papers in various popular and reputed NAAS rated journals. Several technical bulletins, Folder and popular article were also in his account.


**S. R. Scientific Publication**
8, Gandhi Nagar, Near Pallwal Park,
Agra - 282003 (U.P) INDIA
Phone No :- 09927426509, 0562-4042663
E-mail :- srscientificpublication@gmail.com
Web:- www.srscientificpublication.com

Price : ₹ 395.00
ISBN.No: 978-9383774-326



About The Authors

# POSTHARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES

(As per Vth Dean's Committee's Recommendations)

M.K. Kureel
D.S. Mandloi
K.V. Singh
Rajesh Lekhi

BIOTECH

# Contents

The practical manual on Postharvest Management and Value Addition of Fruits and Vegetables has been designed strictly according to Vth Deans' Committees' Recommendations. The book contains information on important postharvest technologies such as maturity indices, suitable harvesting timing, pre-harvest and post-harvest handling of crops, fast cooling, preparation of facilities, packing, packaging, transportation and storage. This training manual includes 13 chapters and covers the complete syllabus of UG and by and large a greater portion of the PhD Course.

This practical manual will contribute to the enrichment of the technical library from one side and to be considered as a tool for students, farmers, handlers, sellers and exporters to implement new methods in the production of high quality crops, methods and timing for harvesting, handling, storage, necessary handling both before and after harvesting and finally to prepare the crops for local marketing and for export.

The information in the manual is applicable worldwide. Machines and equipments required in Postharvest Technology of Horticultural Crops is illustrated with color photos, graphs and illustrations. Information related to permitted and banned colours, Additives in unspecified food products, thermally processed fruits and vegetables, microbial requirements of food products etc. have been appended.

This book has been prepared in most simple, original and appropriate manner which covers all the topics of postharvest technology. We hope that the book would be interesting and useful to students of agriculture and allied disciplines especially to horticulture graduates.

xvi+165p., figs., tbls., ind., 25 cm

Scan me

ISBN: 978-81-7622-399-7

9 788176 223997

₹ 1600

BIOTECH BOOKS
4762-63/23, Ansari Road,
Daryaganj, New Delhi-110002
Ph.: 011-43003222
E-mail : biotechbooks@yahoo.co.in
Website : www.biotechbooks.in

BIOTECH

# Nutrient Omission Plot Technique and its role in determining the nutrients rate and limiting nutrient in SSNM

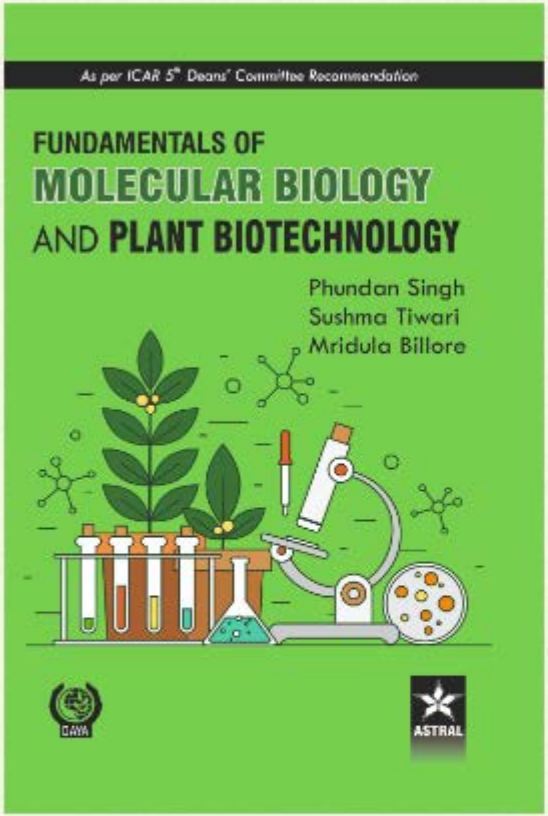
Ekta Joshi[1*], Kailash Prajapat[2], Dinesh Jinger[3], Deep Singh Sasode[1]and Neelam Singh[1]

[1]*College of Agriculture, RVSKVV, Gwalior-474 002 (MP), India*
[2]*ICAR-Central Soil Salinity Research Institute, Karnal-132 001 (Haryana), India*
[3]*ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Vasad, Anand-388 306 (Gujarat), India*

## Introduction

The role of fertilizers in attaining the green revolution during 1960's in India cannot be overlooked which made the country a surplus producer of food grains. But over dependency on high analysis fertilizers and their continuous indiscriminate use,led in consistence decrease in factor productivity and nutrient use efficiency of major nutrients, which is now become a matter of serious concern to increase the agricultural productivity in the country. In many parts of India, land useintensification with inadequate and suboptimal nutrientinputs has led to accelerated nutrient removal resulting in nutrient deficiencies to plants and poor crop yield levels. These nutritional disorders are commonly manifested with visual symptoms and resulted in decrease in the growth and production of any crop. These problems are increasingly addressed by the application of fertilizers containing primarily N, P and K, though still used at inadequate rates with very large variations to all crops.

On another hand, due to seasonal and temporal variation in climate and indigenous soil nutrient supplies, the crop response to fertilizer application is also not always easy to predict. The spatial variability for soil nutrient supplying exists across the farmer's field so it is necessary to estimate that variability for efficient nutrient uptake and to increase crop productivity. Both climate and soil indigenous nutrient supplying capacity leads to large differences in optimal rates for fertilizer recommendations for different sites, season and years. The blanket recommendations of fertilizer with fixed rates and timings for large crop growing areas may lead farmers to over-fertilize in one and under-fertilize in other area. Now the fertilizers recommendation approach in the country needs a paradigm shift towards rationalized approach to supply the nutrient demand of a crop or rather a cropping system while maintaining the soil fertility. An alternative to blanket guidance for nitrogen (N), phosphorus (P), and potassium (K) fertilizers, SiteSpecific Nutrient Management (SSNM) aims to optimize the supply of soil nutrients over time and space to match the requirements of crops through five key principles (Balasubramanian *et al*., 1999; Dobermann *et al*., 2002). The field experiments are designed in such a way that with adoption of suitable crop




# Fundamentals of Molecular Biology and Plant Biotechnology by Billore, Mridula, Phundan Singh & Sushma Tiwari


ISBN: 9789389719376

Binding: Hard Bound

Biblio: xiv+221p

Weight: 370 gms

Pages: 221

Imprint: Daya Publishing House

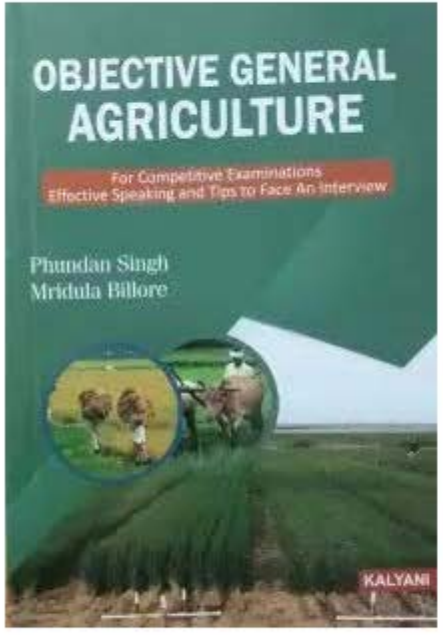
Year: 2020


**Price : Rs 1495.00**

Buy From Astral

## About the Book

This book covers the courses offered in Molecular Biology and Plant Biotechnology at under graduate level in all General and Agricultural Universities of India in one compact volume of 22 chapters. Hope, this volume would be useful to the students, teachers and researchers engaged in the teaching and research of Molecular Biology and Plant Biotechnology.




# Objective General Agriculture Paperback – January 1, 2017

by Billore Mridula Phundan Singh (Author)

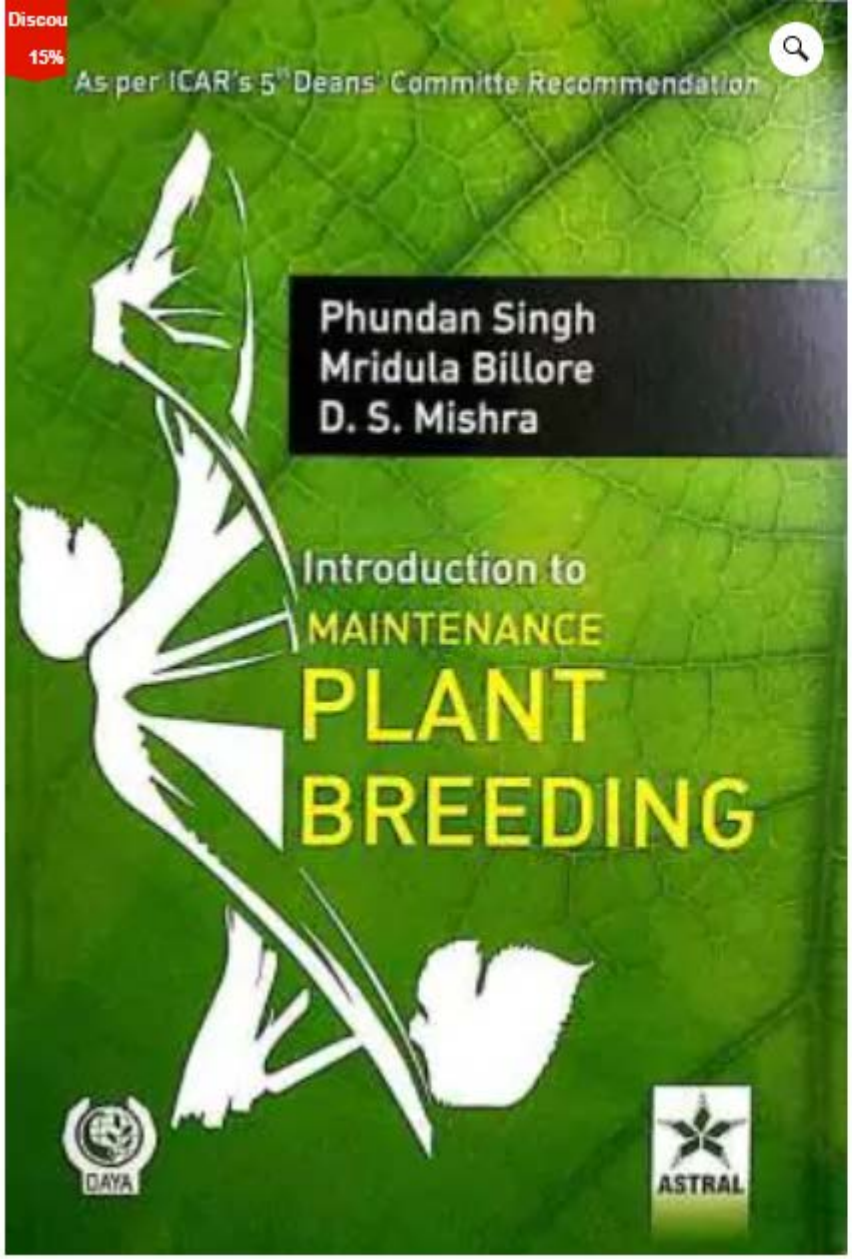
See all formats and e

Report an issue with this product or seller

| Publisher | Publication date | Dimensions | ISBN-10 | ISBN-13 |
|---|---|---|---|---|
| KALYANI | January 1, 2017 | 7.99 x 10 x 1.85 inches | 932727783X | 978-9327277838 |

**The Amazon Book Review**

Book recommendations, author interviews, editors' picks, and more. Read it now.




# Introduction To Maintenance Plant Breeding

~~₹295.00~~ **₹250.00**

Introduction To Maintenance Plant Breeding

Author : Phundan Singh, Mridula Billore, D.S. Mishra
Language : English
Publisher : Daya Publishing House
Edition : 1st Edition,2019
Media : Paper Back
ISBN : 9789388982450

In stock

**Add to cart** **Buy Now**

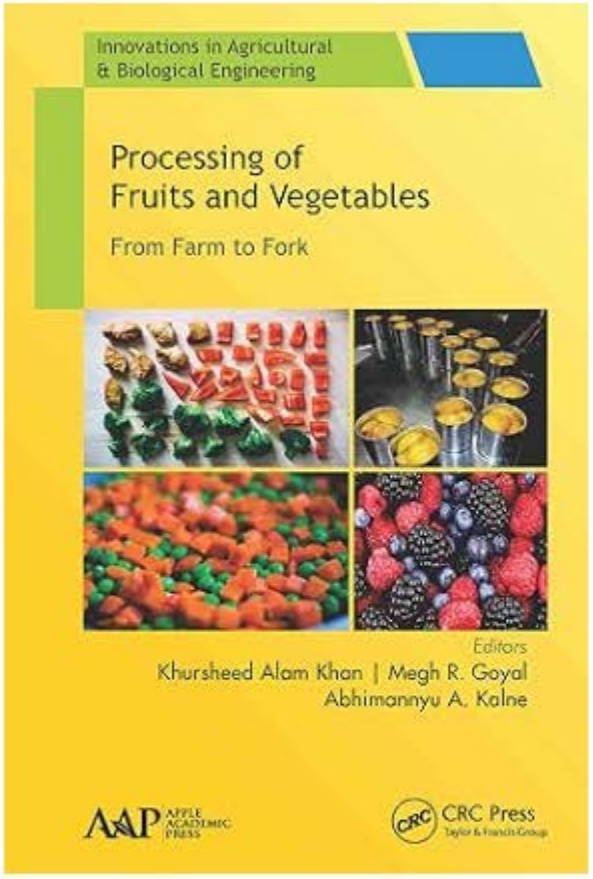
**Live Chat**

**Pincode Delivery Location**

India

Delhi

‹ Back to results




Roll over image to zoom in

Read sample

# Processing of Fruits and Vegetables: From Farm to Fork (Innovations in Agricultural & Biological Engineering) 1st Edition, Kindle Edition

by Khursheed Alam Khan (Editor), Megh R. Goyal (Editor), Abhimannyu A Kalne (Editor) | Format: Kindle Edition

Part of: Innovations in Agricultural & Biological Engineering (40 books) See all formats and editions

This volume looks at new and established processing technologies for fruits and vegetables, taking into consideration the physical and biochemical properties of fruits and vegetables and their products, the challenges of the processing industry, the effect of processing on nutritional content, economic utilization of bio-wastes and byproducts, and much more.

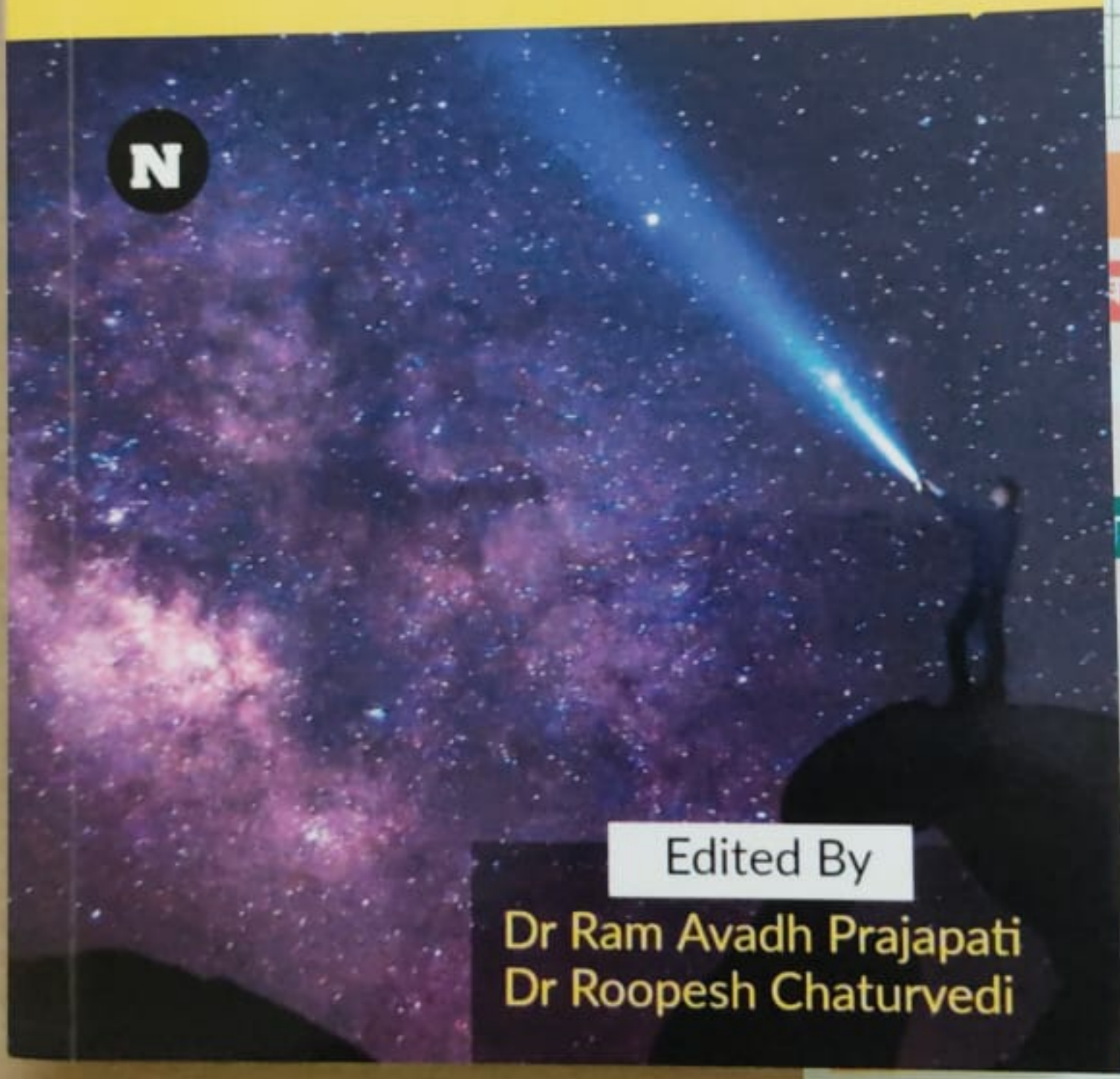
Divided into several sections, the volume covers:

- processing and antioxidant/enzyme profiles of fruits and vegetables (role of antioxidants and enzymes in processing, use of solar energy in processing, and techniques used in making processed products from fruits and vegetables)
- novel processing technologies in fruits and vegetables (ultraviolet light, pulsed light technology, hurdle technology, physical and biochemical properties)
- the challenges and solutions in waste reduction, negative effects of processing, and effects of processing on vitamins of fruits and vegetables

| ISBN-13 | Edition | Sticky notes | Publisher | Publication date |
|---|---|---|---|---|
| 978-1774634035 | 1st | Not Enabled | Apple Academic Press | May 13, 2019 |

# Recent Trends in Fiction Writing

## Themes, Contexts & Techniques



Edited By
Dr Ram Avadh Prajapati
Dr Roopesh Chaturvedi

Dr Ram Avadh Prajapati is working as an Assistant Professor of English in Bareilly College, Bareilly, Uttar Pradesh, India

Dr. Roopesh Chaturvedi is working as Head of the Department of English, RVSKVV College of Horticulture Mandsaur (MP), India

Price Rs 895.00
ISBN 978-1-64951-463-9

9 781649 514639

XpressPublishing
An imprint of Notion Press

NOTION PRESS

India. Singapore. Malaysia.

Published by Notion Press 2020


ISBN 978-1-64951-463-9

Title- ***Recent Trends in Fiction Writing***
Editors- *Dr Ram Avadh Prajapati & Dr Roopesh Chaturvedi*

# An Oath To Fire

Dr. Roopesh Chaturvedi
& Dr.O.P Singh

An Oath to Fire follows the story of Krishna, a young man working as a lawyer in one of the largest telecommunication companies of India. Everything seems to be perfect, from a loving wife to exponential success in his job. However, it is his job that lands against his roots, his village. Following with the lawsuit, he finds out dark secrets related to his father's death that leads him down a path of self-realisation and morality. He decides to quit his job and fight from the village's side, remembering the oath he took to avenge his father over his burning pyre. He tries to follow his father's methods of truth and honestly, yet it only lands him further down the slide. Eventually, he realises to get the right thing done he must do it his own way, leading him to formulate a plan to settle the decade long battle once and for all. But the largest corporation of India isn't giving up that easily to a small village union…

Xpress Publishing
An imprint of Notion Press

Price ₹155
ISBN 978-1-64760-487-5
90000
9 781647 604875

## Recent Trends in **Vegetable Science**

### Unleashing the Future Direction

**Jaydeepkumar Ganvit** obtained his bachelor's degree in B.Sc. (Hons.) Horticulture and his master's degree in M.Sc. (Hort.) with a specialization in Vegetable Science from ASPEE College of Horticulture, Navsari Agricultural University, Navsari (GJ) in 2019 and 2021, respectively. He is currently pursuing his Ph.D. at Navsari Agricultural University. He successfully cleared the ICAR (ASRB) NET in vegetable science in 2023. His scholarly contributions include the publication of 9 research papers, 4 book chapters and 2 popular articles in both national and international journals.

**Mr. Harsh S. Hathi** is a gold medalist from College of Horticulture-Jagudan, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (GJ) where he did his post graduation in Horticulture (Vegetable Science) in 2022. He received his under graduate's degree in B.Sc. (Hons.) Horticulture from Junagadh Agricultural University, Junagadh (GJ). He is recognised with "Young Horticulturist Award" in 2021, "Young Author Award" in 2022 and "Best Thesis Award (M.Sc.) (Vegetable Science)" in 2022. He has published 6 research papers, 9 review papers and 16 articles. He is a regular reviewer in an International E-Magazine. Currently, he is pursuing Ph.D. in Navsari Agricultural University, Navsari (GJ).

**Dinesh Kumar Kuldeep** was born in Mandal, a small village surrounded by forest in district Balaghat state of Madhya Pradesh. His parents are farming background. He received his under graduate's degree in B.Sc Agriculture from Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur. He completed his post-graduation degree in M.Sc. Horticulture from Banaras Hindu University, Varanasi. He has qualified the ICAR NET in Horticulture (Fruit Science) and he has worked as a post of SRF at Indian Institute of Vegetable Research, Varanasi. Mr. Kuldeep has contributed 11 research papers in NAAS rated scientific journal, 6 book chapters, 5 popular articles, 5 abstract and one edited book covering various aspects of horticulture and agriculture science. He has also a member of the Agricultural Technology Development Society and Research and Environment and Life Science. At present he is pursuing his PhD in Horticulture (Fruit Science) at Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur.

**Miss. Reema Lautre** completed her B.Sc. (Hort.) from IGKV, Raipur, (C.G.) and her M.Sc. (Ag.) Horti. in Vegetable Science from R.V.S.K.V.V., Gwalior, and awarded with a university gold medal. She is currently pursuing Ph.D. in vegetable science at IGKV, Raipur (C.G.). She is also awarded with the 'Inspire Fellowship 2021 given by DST, New Delhi, for her doctoral research work. She qualified two times ASRB/ICAR-NET in 2021 and 2023. She is bestowed with the "Best Master's Thesis Award 2021 for her work. She has contributed to many publications in journals of national and international repute, including research articles, popular articles and book chapters.


-EPH-
Elite Publishing House
Publishers and Distributor
A-16/28, Sector - 18, Rohini, New Delhi - 110089
Tele-info: 9289051518, 9289051519
Email:ephelitepublishers@gmail.com, ephpublishers@yahoo.com



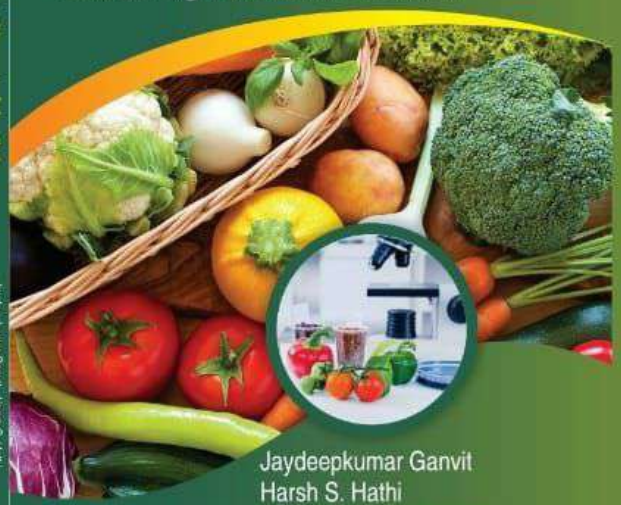
ISBN 978-93-5989-[illegible]-[illegible]
9 789351 899267


Recent Trends in **Vegetable Science**

Jaydeepkumar Ganvit • Harsh S. Hathi
Dinesh Kumar Kuldeep • Reema Lautre

## Recent Trends in **Vegetable Science**

### Unleashing the Future Direction




Jaydeepkumar Ganvit
Harsh S. Hathi
Dinesh Kumar Kuldeep
Reema Lautre


-EPH-

# Contents

# Chapter - 12

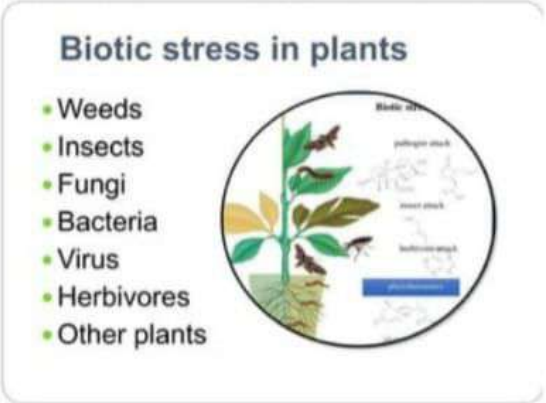
# Biotic Stress Management in Vegetable Crop Production

**Pragya Singh[1] and Nikhil Parihar[2]**

[1]Department of Horticulture (Vegetable Science), Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.)
[2]Ph.D. Research Scholar, Department of Horticulture (Fruit Science), Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.)
*corresponding author e-mail: spragya455@gmail.com

## Introduction

Biotic stress is an adverse condition in which plant cannot sustain its normal growth due to the interaction with deleterious microorganisms (fungi, bacteria, viruses, viroids, phytoplasma, and nematodes), pest and weed or any living factor Balodi *et al.*, (2017). According to Wang *et al.* (2013), the biotic stresses are responsible for approximately, 28.2%, 37.4%, 31.2%, 40.3%, 26.3%, and 28.8% yield losses in wheat, rice, maize, potatoes, soybeans, and cotton crops, respectively. After infection with microorganisms, reactive oxygen species (ROS) increases and plants use the defense systems to scavenge these free radicals Atkinson and Urwin, (2012).




Sources: ALASKA (2008)

# Opportunities in Agriculture & Animal Husbandry for Sustainable Entrepreneurship & Livelihood Security

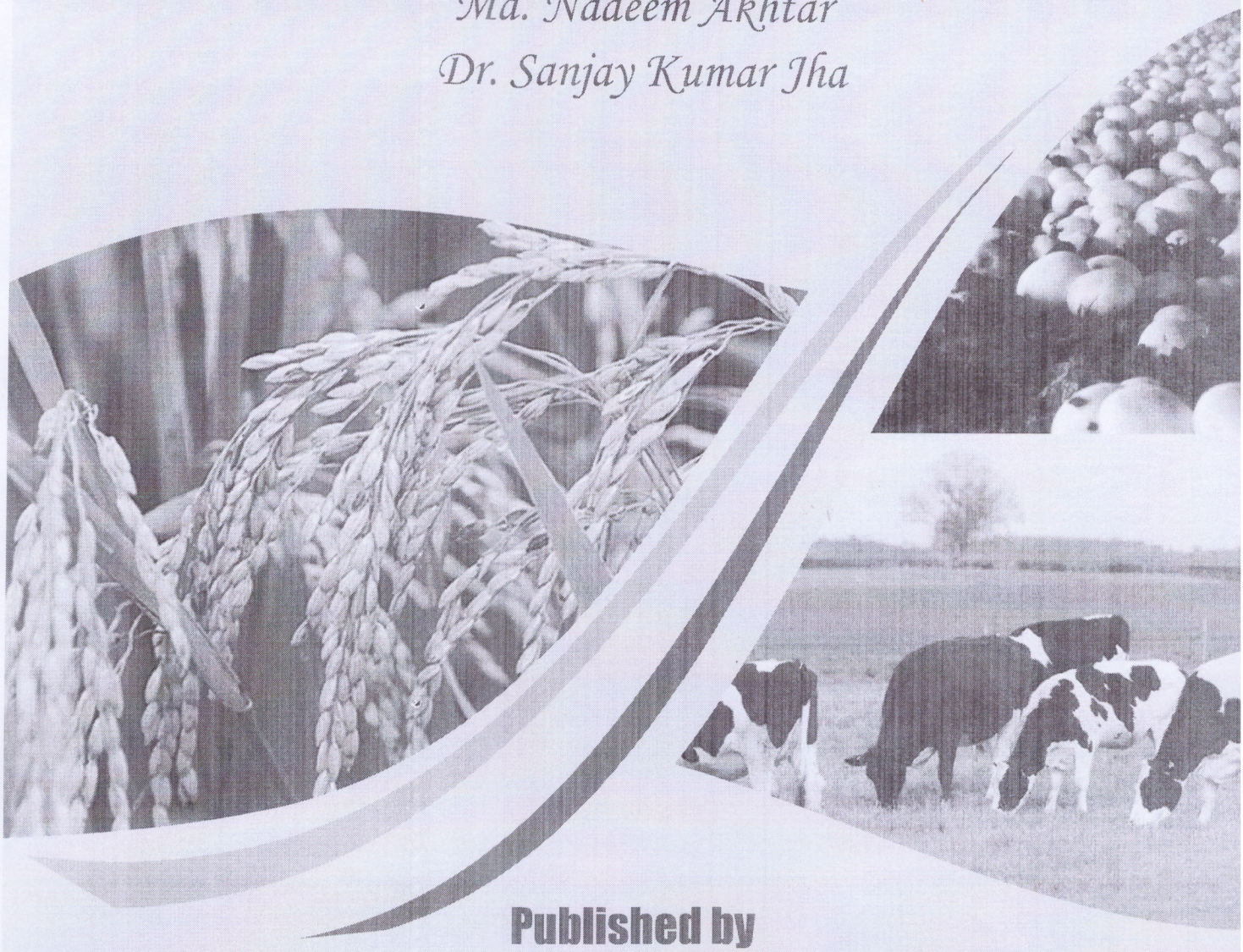
*Editors*

*Dr. Chhatarpal Singh*

*Dr. Sudhir Singh Bhadauria*

*Md. Nadeem Akhtar*

*Dr. Sanjay Kumar Jha*



**Published by**

**JPS Scientific Publications, India**

# Opportunities in Agriculture & Animal Husbandry for Sustainable Entrepreneurship & Livelihood Security

*Editors*

*Dr. Chhatarpal Singh*

*Dr. Sudhir Singh Bhadauria*

*Md. Nadeem Akhtar*

*Dr. Sanjay Kumar Jha*

***Published by***



Periya Olaipadi, Tiruvannamalai (District) Tamil Nadu, India.
E-mail: jpsscientificpublications@gmail.com
www.jpsscientificpublications.com

**Disclaimer**

The authors are solely responsible for the contents of the papers compiled in this volume. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN : 978-93-91342-42-5**

# Contents

# Entrepreneur Skills Development Through Commercial Production And Value Addition Of Grapes

**Dr. Nitin Soni*[1], Mr. D.K. Patidar[1], Er. K.A. Khan[1], and Dr. K.C. Meena[1]**

*Corresponding Author
[1]College of Horticulture, Mandaur of RVSKVV, Gwalior

## ABSTRACT

Establishing strong collaboration with national and international institutes in multidisciplinary approach or network or consortia mode would help in developing technologies and resolve the issues in a holistic manner. Human Resource Development enhancing quality of human resource is a pre-requisite for implementing and upgrading research programmes, developing technologies, evolving institutional arrangements to face challenges and harness opportunities.

Imparting education on all the aspects of Viticulture and Enology through full time graduate degree, PG Diploma, Certificate courses may help in developing specialists at all the levels so that grape cultivation and processing will be done in systematic manner with trained man power.

## INTRODUCTION

Grape is one of the sweet, juicy and healthiest fruit available on the earth. Penalty minerals and vitamins are available in the grape required for human body growth. Grape is called as 'King of fruit' in 'Ayurveda' being a digestive property.

Grape cultivation is originated in Central Asia Region (from Black Sea and Caucasian Sea), after that, it spread to Europe and eastward to Iran and Afghanistan. In India Grape was introduced in 1300 AD by trespassers from Iran and Afghanistan.

India is among the first ten countries in the world in the production of grape. The leading producers of grape are Italy, France, Spain, USA, Turkey, China and Argentina. This crop occupies fifth position amongst fruit crops in India with a production of 2920.0 thousand tonnes from an area of 38.91 thousand ha. in 2018-19. (Horticultural Statistics at A Glance 2018)

The area under grape is 1.2 % of the total area of fruit crops in the country. Production is 2.8% of total fruits produced in the country. About 80% of the production comes from Maharashtra followed by Karnataka and Tamil Nadu. In

SPRINGER NATURE Reference

LIVING EDITION

# Handbook of Nutraceuticals

Springer

# Potential Food Nutraceutical Ingredients

Anshu Sharma, Jyoti Rani, Pavneet Kaur, Shailendra K. Dwivedi, and Munisha Sharma

## Contents



**Abstract**

Nutraceuticals are products with food extracts or bioactive ingredients of foods which have shown great health benefits to their consumers in the last few years. The functional ingredients present in food have a great potential to act as nutraceuticals when taken in proper amount as they are capable enough to prevent and even cure diseases. The organic functional ingredients generally obtained from plants and animals have exhibited great potential in the prevention or cure of many chronic diseases as dietary supplements to replace pharmaceutical drugs

A. Sharma · J. Rani · P. Kaur
Department of Food Science and Technology, Dr. YS Parmar University of Horticulture and Forestry, Solan, HP, India

S. K. Dwivedi (✉)
Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, College of Horticulture, Mandsaur, Madhya Pradesh, India

M. Sharma
Medical Research Scholar, Sri Shankara Cancer Hospital and Research Centre, Bengaluru, Karnataka, India



R. Rajakumari, S. Thomas (eds.), *Handbook of Nutraceuticals*,
https://doi.org/10.1007/978-3-030-69677-1_2-1

# Nutrient Requirements in Health and Disease

Shailendra K. Dwivedi, Kanika Issar, and Vivek Tiwari

## Contents



S. K. Dwivedi (✉)
KNK College of Horticulture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Mandsaur, India

K. Issar
DIBNS, Dehradun, India

V. Tiwari
Defence Institute of High Altitude Research (DIHAR), DRDO, Base Lab, Chandigarh, India



R. Rajakumari, S. Thomas (eds.), *Handbook of Nutraceuticals*,
https://doi.org/10.1007/978-3-030-69677-1_3-1

*Editors* DEV RAJ | Z. P. PATEL

# INNOVATIONS IN FOOD PROCESSING INDUSTRY

# Innovations in Food Processing Industry


Edited by

**Dev Raj**
Professor & Head (PHT)
Department of Post Harvest Technology
ASPEE College of Horticulture
Navsari Agricultural University
Navsari-396450, Gujarat (India)

**Z.P. Patel**
Hon'ble Vice Chancellor
Navsari Agricultural University
Navsari-396450, Gujarat (India)



NIPA. GENX ELECTRONIC RESOURCES & SOLUTIONS P. LTD.
New Delhi-110 034

## ABOUT THE AUTHORS

**Dr. Dhan Singh Mandloi** is working as Technical Officer (Horticulture) at RVSKV-KNK College of Horticulture, Mandsour (M.P.) since 2003. He obedient his B.Sc. (Ag.) R.A.K. College of Agriculture, Sehore, J.N.K.V.V, Jabalpur (M.P.)in the year 2000 and M. Sc. (Horti.) in Horticulture from College of Horticulture, Mandsour (RVSKVV), Gwaloir (M.P.). He has passed NET in Horticulture (Fruit Science) from Agricultural Scientist Recruitment Board, New Delhi. He has experienced more than 19 years in Agriculture/Horticulture working with tribal farmers, extension personnel and different line departments. He has served as Field Extension Officer in Mandsour for 14 years and serving as Technical Officer (Horticulture) in R.V.S.K.V.V. Krishi Vigyan Kendra, Dhar (M.P.) since last Six years. Dr. Dhan Singh Mandloi is awarded with Best KVK Award (National 2020) from ICAR, New Delhi. He has been awarded with Scientist of the Year 2020 from Society of Tropical Agriculture, New Delhi, Best KVK Extension Scientist Award 2020 from ATDS, Utter Pradesh. He has published 04 books, 15 research papers, 04 book chapters and 21 popular articles, 5 extension bulletins in national and international journals.

**Dr. Manoj Kumar Kureel** graduated in agriculture from J.N.K.V.V, Jabalpur and post-graduate degree in horticulture in specialization in fruit science was awarded to him by the same university. He qualified the National Eligibility Test (NET) in 2004. Started his professional career as Senior Horticulture Development Officer in 2003 and was promoted to Assistant Director, Horticulture in 2007 but being obsessed with teaching profession he quit the lucrative post and joined as Assistant Professor (Horticulture) at college of Agriculture, Khandwa, RVSKVV,Gwalior in the year 2017 and is serving there since then. He has two books to his credit. He has published about 21 research papers in international and national journals and has written various popular articles in different magazine. Apart from education he is also serving as associate NCC Officer of the college. He was awarded with National Awarded of NCC (Director General's Baton of Honour) in 2014 at Officers Training Academy, Kamptee (MH).

**Dr. Singh** joined as Subject Matter Specialist (Horticulture) in Krishi Vigyan Kendra, Ujjain on 12 March, 2007. At present Dr. Singh is posted at KVK, Lahr (Bhind) M.P., he has also performed duties as Technical Officer to Hon'ble Vice Chancellor during Sept. 2008 to March 2021. He has a long experience in the field of horticulture. Dr. Singh is continuously associated with extension activities through KVK, Ujjain KVK, Gwalior and Directorate of Extension Services. Other than mandatory work of KVKs, he has also developed Crop Cafeteria of horticulture crops at KVK, Ujjain and a Technological Park at KVK, Gwalior as a showcase of all the appropriate technologies for technological empowerment of the farmers, farm women, extension personnel, distinguished visitors as well as KVK staff. A panorama of various horticultural crops has been planted as "Crop Varieties Cafeteria". In Agro-Technology Park Scion Bank and High Density Orcharding is also a feature which attracts many visitors. In this park, fruit plants (Aonla 4 var., Guava 5 var., Lime 3 var., Pomegranate 3 var.) were planted. Through KVK Gwalior Dr. Singh popularized kharif onion production technology among the farmer's which is adopted in large scale of the Gird area. He has honoured with First Prize in Best Poster presentation Award during Global Ravine Conference 2016, RVSKVV, Gwalior, Society of Human Resource and Innovation, Agra conferred prestigious Scientist of the year Award in National Conference (AGRAT-2017) at Agra and Gwalior Gaurav Samman 2017 by Gwalior Vikas Samiti, Gwalior. He has to his credit more than 50 publications in the form of research papers, scientific article, books and book chapters, technical bulletins, manuals, popular articles, university annual reports, RVSKVV newsletters and other important reports of the university. Dr. Singh also participated in 02 International Conferences, 10 National Seminars/ Conference/ Symposia, 10 Workshops, 30 Trainings and 04 Summer/Winter school. Dr. Singh has guided 12 M.Sc. students and 05 Ph.D. students as major advisor and also Member of advisory committees of M.Sc. Students and Ph.D. Students.

**Dr. Santosh Kumar Maida** S/o Shri Nanuram Maida was born on January 01, 1986 at Ratlam, Madhya Pradesh. He passed his B. Sc. (Horticulture) degree and M.Sc. (Horticulture) in Vegetable Science degree from K.N.K. College of Horticulture Mandsaur under (R.V.S.K.V.V) Gwalior Madhya Pradesh. Doctor of Philosophy (Ph.D.) Horticulture, Mahatma Gandhi Chitakoot Gramodaya Vishwa vidyalaya, Chitrakoot, Satna (M.P.) and completed the degree in the year 2022 and he is presently posted as at Assistant Professor(Horticulture) at Govt. Agriculture College Borvat Banswara, Rajasthan.


₹ 795/-

ISBN 978-81-964111-3-8

9 788196 411138

ELPHINSTONE
Publication & Distributors
New Delhi-110062


Production Technology of Ornamental Plants

Dr. Dhan Singh Mandloi
Dr. Manoj Kumar Kureel

Dr. Karan Vir Singh
Dr. Santosh Kumar Maida

# Production Technology of Ornamental Plants


**Dr. Dhan Singh Mandloi**
**Dr. Manoj Kumar Kureel**
**Dr. Karan Vir Singh**
**Dr. Santosh Kumar Maida**



ELPHINSTONE
Publication & Distributors
New Delhi-110062

## लेखक परिचय

**डॉ. धन सिंह मंडलोई** वर्ष 2003 से राजमाता विजयाराजे सिंधिया कृषि विष्वविधालय, ग्वालियर–के,एन,के उधानिकी महाविद्यालय, मंदसौर (म.प्र.) में प्रक्षेत्र विस्तार अधिकारी के पद पर उन्होंने 14 वर्षों तक कार्य किया हैं। इन्होने इसके पष्चात र्वतमान में वर्ष 2016 से राजमाता विजयाराजे सिंधिया कृषि विष्वविधालय, ग्वालियर में तकनीकी अधिकारी (उधानिकी) के रूप में कृषि विज्ञान केंद्र, धार (म.प्र.) पिछले छः वर्षों से है। इन्होने अपनी बी.एससी. (कृषि) आर.ए.के. कृषि महाविद्यालय, सीहोर वर्ष 2000 में जे.एन.के.वी.वी., जबलपुर (म.प्र.) तथा एम.एससी. (उधानिकी) फल विज्ञान से उधानिकी महाविधालय, मंदसौर (राजमाता विजयाराजे सिंधिया कृषि विष्वविधालय), ग्वालियर (म.प्र) से की है। उन्होंने कृषि वैज्ञानिक भर्ती बोर्ड, नई दिल्ली से उधानिकी (फल विज्ञान) में नेट पास किया है। उन्होंने आदिवासी किसानों, विस्तार कर्मियों और विभिन्न लाइन विभागों के साथ कृषि/बागवानी में काम करने का 19 से अधिक वर्षों का अनुभव किया है। डॉ. धन सिंह मंडलोई को आई. सी.ए.आर, नई दिल्ली से सर्वश्रेष्ठ कृषि विज्ञान केन्द्र पुरस्कार (राष्ट्रीय 2020) से सम्मानित किया गया। उन्हें सोसाइटी ऑफ ट्रॉपिकल एग्रीकल्चर, नई दिल्ली से साइंटिस्ट ऑफ द ईयर 2020, एटीडीएस, उत्तर प्रदेश से बेस्ट कृषि विज्ञान केन्द्र एक्सटेंशन साइंटिस्ट अवार्ड 2020 से सम्मानित किया गया है। एवं उन्होंने राष्ट्रीय और अंतर्राष्ट्रीय पत्रिकाओं में 04 पुस्तकें, 15 शोध पत्र, 04 पुस्तक अध्याय और 21 लोकप्रिय लेख, 5 विस्तार बुलेटिन प्रकाशित किए हैं।

**डॉ. मनोज कुमार कुरील** ने जे.एन.के.वी.वी, जबलपुर से कृषि में स्नातक और फल विज्ञान में विशेषज्ञता में उधानिकी में स्नातकोत्तर उपाधि उसी विश्वविद्यालय द्वारा उन्हें प्रदान की गई। उन्होंने 2004 में राष्ट्रीय पात्रता परीक्षा (नेट) उत्तीर्ण की। वर्ष 2003 में वरिष्ठ उधानिकी विकास अधिकारी के रूप में अपना पेशेवर करियर शुरू किया और 2007 में सहायक निदेशक, उधानिकी के रूप में पदोन्नत हुए, लेकिन शिक्षण पेशे से ग्रस्त होने के कारण उन्होंने आकर्षक पद छोड़ दिया और कृषि महाविद्यालय, खंडवा, राजमाता विजयाराजे सिंधिया कृषि विष्वविधालय, ग्वालियर में सहायक प्रोफेसर (उधानिकी) के रूप में शामिल हो गए। वर्ष 2017 में और तब से वहां सेवा दे रहे हैं। इनकी दो पुस्तकें, हैं। और उन्होंने अंतरराष्ट्रीय और राष्ट्रीय पत्रिकाओं में लगभग 21 शोध पत्र प्रकाशित किए हैं और विभिन्न पत्रिकाओं में विभिन्न लोकप्रिय लेख लिखे हैं। शिक्षा के अलावा वह महाविधालय के सहयोगी एनसीसी अधिकारी के रूप में भी कार्यरत हैं। उन्हें 2014 में अधिकारी प्रशिक्षण अकादमी, कैम्पटी (महाराष्ट्रा) में एनसीसी (महानिदेशक के बैटन ऑफ ऑनर) के राष्ट्रीय पुरस्कार से सम्मानित किया गया था।

**डॉ. प्रवीण बर्डे** का जन्म 20 मार्च 1981 को ग्राम गढ़वा पोस्ट बिसनूर तहसील मुलताई जिला बैतूल मध्य प्रदेश में हुआ था। उन्होंने बी.एस.सी. (बागवानी) और एम.एससी। उद्यानिकी फल विज्ञान के.एन.के. उद्यानिकी महाविद्यालय मंदसौर (जे.एन.के.वी.वी., जबलपुर) मध्य प्रदेश और पीएच.डी. उद्यानिकी (फल विज्ञान) डॉ. बी.आर. अम्बेडकर सामाजिक विज्ञान विश्वविद्यालय महू (म.प्र.) वे वर्तमान में राजमाता विजयाराजे सिंधिया कृषि विष्वविधालय, ग्वालियर में फल अनुसंधान स्टेशन, इटखेड़ी, भोपाल (म.प्र.) में उद्यानिकी सहायक के पद पर हूँ। उन्होंने उद्यानिकी अनुसंधान और शैक्षणिक क्षेत्र में व्यापक अनुभव है। प्रासंगिक अनुशासन में उनके उत्कृष्ट योगदान के लिए उन्हें जनपरिषद सोसाइटी से युवा वैज्ञानिक पुरस्कार मिला। 7 शोध पत्र प्रकाशित, 10 लेख, 9 पर्चे, कई राष्ट्रीय और अंतर्राष्ट्रीय सम्मेलन में भाग लिया और प्रशिक्षण कार्यक्रम में दिए गए कई व्याख्यानों ने प्रशिक्षण समन्वयक के रूप में प्रशिक्षण आयोजित किया।

**डॉ. संतोष कुमार मैढा** पुत्र श्री नानूराम मैढा का जन्म 01 जनवरी 1986 को रतलाम, मध्य प्रदेश में हुआ था। उन्होंने बी.एससी. (उधानिकी) की डिग्री और एम.एससी। (उधानिकी) के.एन.के. से वनस्पति विज्ञान की डिग्री उद्यानिकी महाविद्यालय मंदसौर (राजमाता विजयाराजे सिंधिया कृषि विश्वविधालय) ग्वालियर मध्य प्रदेश। डॉक्टर ऑफ फिलॉसफी (पीएचडी) उधानिकी, महात्मा गांधी चित्रकूट ग्रामोदय विश्व विद्यालय, चित्रकूट, सतना (म.प्र.) और वर्ष 2022 में डिग्री पूरी की और वह वर्तमान में सरकार में सहायक प्रोफेसर (उधानिकी) के पद पर कृषि महाविद्यालय बोरवट बांसवाड़ा, राजस्थान हैं।

**डॉ. प्रवीण कुमार गुर्जर** वैज्ञानिक उधानिकी पद पर राजमाता विजयाराजे सिंधिया कृषि विश्वविधालय, ग्वालियर कृषि विज्ञान केंद्र, लहार (म.प्र.) में वर्ष 2007 से हूँ। इन्हीनें जे.एन.के.वी.वी, जबलपुर से कृषि में स्नातक और फल विज्ञान में विशेषज्ञता में उधानिकी में स्नातकोत्तर उपाधि उसी विश्वविद्यालय द्वारा उन्हें प्रदान की गई। इन्हीनें स्नातक स्नातकोत्तर उपाधि एवं पीएचडी विधार्थीयो को पढाया तथा लगभग 20 विधार्थीयो गाईड किया गया। इनकी तीन प्रयोगिक पुस्तकें, 7 विस्तार बुलेटिन हैं। और उन्होंने अंतरराष्ट्रीय और राष्ट्रीय पत्रिकाओं में लगभग 40 शोध पत्र प्रकाशित किए हैं और विभिन्न पत्रिकाओं में विभिन्न लोकप्रिय लेख 45 लिखे हैं।

₹ 795/-

ELPHINSTONE
Publication & Distributors
New Delhi-110062

नर्सरी प्रबंधनः एक परिचय एवं इसकी उपयोगिता

डॉ. धन सिंह मंडलोई • डॉ. मनोज कुमार कुरील
डॉ. प्रवीण बर्डे • डॉ. संतोष कुमार मैढा
डॉ. प्रवीण कुमार गुर्जर

# नर्सरी प्रबंधनः

## एक परिचय एवं इसकी उपयोगिता

डॉ. धन सिंह मंडलोई • डॉ. मनोज कुमार कुरील
डॉ. प्रवीण बर्डे • डॉ. संतोष कुमार मैढा
डॉ. प्रवीण कुमार गुर्जर

ELPHINSTONE
Publication & Distributors
New Delhi-110062

The practical manual on Postharvest Management and Value Addition of Fruits and Vegetables has been designed strictly according to Vth Deans' Committees' Recommendations. The book contains information on important postharvest technologies such as maturity indices, suitable harvesting timing, pre-harvest and post-harvest handling of crops, fast cooling, preparation of facilities, packing, packaging, transportation and storage. This training manual includes 13 chapters and covers the complete syllabus of UG and by and large a greater portion of the PhD Course.

This practical manual will contribute to the enrichment of the technical library from one side and to be considered as a tool for students, farmers, handlers, sellers and exporters to implement new methods in the production of high quality crops, methods and timing for harvesting, handling, storage, necessary handling both before and after harvesting and finally to prepare the crops for local marketing and for export.

The information in the manual is applicable worldwide. Machines and equipments required in Postharvest Technology of Horticultural Crops is illustrated with color photos, graphs and illustrations. Information related to permitted and banned colours, Additives in unspecified food products, thermally processed fruits and vegetables, microbial requirements of food products etc. have been appended.

This book has been prepared in most simple, original and appropriate manner which covers all the topics of postharvest technology. We hope that the book would be interesting and useful to students of agriculture and allied disciplines especially to horticulture graduates.

xvi+165p., figs., tbls., ind., 25 cm

Scan me

ISBN: 978-81-7622-399-7

9 788176 223997

₹ 0000

BIOTECH BOOKS
4762-63/23, Ansari Road,
Daryaganj, New Delhi-110002
Ph.: 011-43003222
E-mail : biotechbooks@yahoo.co.in
Website : www.biotechbooks.in

BIOTECH

POSTHARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES

Kureel • Mandloi Singh • Lekhi

BIOTECH

# POSTHARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES

## (As per Vth Dean's Committee's Recommendations)

M.K. Kureel
D.S. Mandloi
K.V. Singh
Rajesh Lekhi

BIOTECH