



# Resource Conservation Technology in Pulses

**P.K. Ghosh  
Narendra Kumar  
M.S. Venkatesh  
K.K. Hazra  
N. Nadarajan**

 **SCIENTIFIC  
PUBLISHERS (INDIA)**



# Resource Conservation Technology in Pulses

*Editors*

**P.K. Ghosh**  
**Narendra Kumar**  
**M.S. Venkatesh**  
**K.K. Hazra**  
**N. Nadarajan**

 **SCIENTIFIC**  
**PUBLISHERS (INDIA)**

*Published by:*

Scientific Publishers (India)  
5 A, New Pali Road, P.O. Box 91  
Jodhpur - 342 001 (India)

E-mail: [info@scientificpub.com](mailto:info@scientificpub.com)  
Website: [www.scientificpub.com](http://www.scientificpub.com)

*Branch Office*

Scientific Publishers (India)  
4806/24, Ansari Road, Daryaganj  
New Delhi - 110 002 (India)

© 2014, Editors

All rights reserved. No part of this publication or the information contained herein may be reproduced, adapted, abridged, translated, stored in a retrieval system, computer system, photographic or other systems or transmitted in any form or by any means, electronic, mechanical, by photocopying, recording or otherwise, without written prior permission from the editors.

Disclaimer: Whereas every effort has been made to avoid errors and omissions, this publication is being sold on the understanding that neither the editors (or authors of chapters in edited volumes) nor the publishers nor the printers would be liable in any manner to any person either for an error or for an omission in this publication, or for any action to be taken on the basis of this work. Any inadvertent discrepancy noted may be brought to the attention of the publishers, for rectifying it in future editions, if published.

ISBN: 978-81-7233-885-5

eISBN: 978-93-86237-49-1

Printed in India



**डा. एस. अय्यप्पन**

सचिव एवं महानिदेशक

**Dr. S. AYYAPPAN**

SECRETARY & DIRECTOR GENERAL

भारत सरकार  
कृषि अनुसंधान और शिक्षा विभाग एवं  
भारतीय कृषि अनुसंधान परिषद्  
कृषि मंत्रालय, कृषि भवन, नई दिल्ली 110 001

GOVERNMENT OF INDIA  
DEPARTMENT OF AGRICULTURAL  
RESEARCH & EDUCATION AND  
INDIAN COUNCIL OF AGRICULTURAL RESEARCH  
MINISTRY OF AGRICULTURE, KRISHI BHAWAN,  
NEW DELHI 110 001  
Tel.: 23382629, 23386711 Fax: 91-11-23386473  
E-mail: dg.icar@nic.in

## **FOREWORD**

Concerted research and development efforts have transformed Indian agriculture from subsistence to intensive farming, making India self-sufficient in foodgrains production. During this process, paradigm shift in cropping systems with focused attention to cereal crops has pushed pulses into marginal and poor lands. While the mission of increasing foodgrains production stands somehow achieved without major jump in pulses productivity and production in our country, these were accompanied by widespread problems of resource degradation. Though production of pulses has reached recently to 18.01 mt after a stagnant period of more than 10 years, there is a greater need to increase productivity using suitable management practices to improve livelihood and nutritional security of large number of Indian vegetarians. About 85% pulses are grown under rainfed conditions with less or no fertilizers. Traditional practice of tillage and clean cultivation leads to drastic decline in SOC and overall soil health. Under such situation, resource conservation practices become necessity to achieve sustainable and profitable pulse production subsequently aiming to improve the livelihood of farmers. It has assumed importance in view of the widespread natural resource degradation leading to increased production cost, unsustainable resource use, environmental pollution and health of ecosystems. Worldwide more than 100 million hectare area is under conservation agriculture, however, it is new to our country. In world conservation agriculture is more successful in rainfed areas, whereas in India it is mostly confined to irrigated agriculture. There is more efforts need to be done for popularization of these practices among Indian farmers.

This book on 'Resource Conservation Technology in Pulses' covers wide range of issues related to resource conservation in pulse based cropping systems. This book is an outcome of sincere efforts by authors who deserve great appreciation. I trust and believe that this book will serve as an important reference book for those engaged in research and extension for improving and stabilizing pulse production in the country and will simulate further research in critical aspects of conservation agriculture.

(S. Ayyappan)



## PREFACE

Indian agriculture has been successful in achieving increased foodgrains production. While the mission of increasing foodgrains production stands somehow achieved without major jump in pulses productivity and production in country, these were accompanied by widespread problems of resource degradation. Though recently production of pulses has reached to 17.09 mt (2012-13) after a stagnant period of more than 10 years, there is greater need to increase productivity using suitable management practices to improve livelihood and nutritional security of large number of Indian vegetarians. Pulses are grown on marginal and degraded land over the years under low or no inputs. Traditional or conventional agriculture bases most of its operations or practices on soil tillage; i.e., inversion tillage such as mouldboard ploughing or disk harrow, or vertical tillage such as chisel, "spiked" harrow and other tools. Soil tillage drastically alters its original structure, breaking up its natural aggregates and burying the residues of the previous crop, so that, the bare soil becomes unprotected and exposed to the action of the wind and rain. Under these circumstances water and soil erosion and sediment runoff are likely to occur. Furthermore, with tillage, soil organic matter and biodiversity content are reduced and unnecessary emissions of CO<sub>2</sub> into the atmosphere take place. Therefore, the conservation of natural resources becomes necessity to achieve sustainable and profitable pulse production system and subsequently aims to improve livelihoods of the farmers. Conservation practices have shown advantages over traditional practices by means of improving productivity and soil health in case of cereal crops in many parts of world.

Over the past 2–3 decades globally, resource conservation technology has emerged as a way for transition to the sustainability of intensive production systems. It has assumed importance in view of the widespread natural resource degradation leading to increased production costs, unsustainable resource use, environmental pollution and health of ecosystems. It permits management of water and soils for agricultural production without excessively disturbing the soil, while protecting it from the processes that contribute to degradation like erosion, compaction, aggregate breakdown, etc. Therefore, the conservation of natural resources becomes necessity to achieve sustainable and profitable pulse production system and subsequently aims to improve livelihoods of the farmers. The RCT has shown to improve, conserve and use natural resources in a more efficient way through integrated management of available soil, water and biological resources. It is now widely recognised as a viable concept for sustainable agriculture due to its comprehensive benefits in economic, environmental and social terms. Its ability to increase grain yields to provide better economic performance and reduce production risks and to improve energy use efficiency has been well documented. What is required is better understanding of its performance and requirements across wider geographic regions and environmental conditions to enable the diffusion of technology.

The present book is outcome of valuable contributions made by various scientists and researchers across the country. This book has comprehensive coverage of resource conservation practices in pulses and pulse based cropping systems and is expected to provide a valuable source book for scholars and researchers, as well as guide book to farming community and development agencies. Contents in the book are organised in nine parts, which include i) Pulses scenario and status of resource conservation technologies in India, ii) Pulses in conservation agriculture and crop diversification, iii) Genetic approaches for harnessing conservation agriculture, iv) Integrated input management, v) Climate change and carbon sequestration opportunities, vi) Residue management and farm mechanisation, vii) Resource conservation technologies for abiotic stress management, viii) Resource conservation technologies for biotic stress management and ix) Indigenous technical knowledge, socio-economic consideration and impact assessment. This book is expected to provide sound basis for sustainable pulse production and refine the research and policies related to pulses in the country.

We are extremely indebted to Dr. S. Ayyappan, Secretary, DARE and Director General Indian Council of Agricultural Research for providing necessary guidance. The authors are sincerely thankful to all the contributors for their valuable chapters to this book, thereby sharing their experiences with the readers.

**Editors**

## CONTRIBUTORS

### **A.K. Srivastva**

Emeritus Scientist and Ex-Director  
Vivekananda Parvatiya Krishi  
Anusandhan Sansthan  
Almora – 263 601 (Uttarakhand)

### **A.K. Tripathi**

Assit. Professor  
CSAUA&T, Kanpur – 208 002  
Uttar Pradesh

### **A.N. Ganeshamurthy**

Head, Division of Soil Science and  
Agricultural Chemistry  
Indian Institute of Horticultural  
Research  
Bengaluru – 560 089  
Karnataka

### **Aditya Pratap**

Senior Scientist (Plant Breeding)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

### **Ambreesh Singh Yadav**

Research Associate  
ZPD Zone IV, Kanpur

### **Andrew Green**

Director  
Zinc Nutrient Initiative and  
Environment, Health &  
Sustainability  
International Zinc Association  
1822 E NC Highway 54  
Suite 120, Durham  
NC 27713 USA

### **Anup Das**

Senior Scientist (Agronomy)  
ICAR Research Complex for  
NEH Region  
Umiam - 793 103  
Meghalaya

### **Anupam Mishra**

In-charge, ZPD, Zone VII  
JNKVV Campus, Adhartal,  
Jabalpur – 482 004  
(Madhya Pradesh)

### **Arti Yadav**

Senior Research Fellow  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

### **Asha Sahu**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

### **Ashutosh Barthwal**

Department of Agronomy  
G.B. Pant University of Agriculture  
& Technology, Pantnagar – 263145  
Udham Singh Nagar (Uttarakhand)

### **Asit B. Mandal**

Principal Scientist  
Crop Improvement Division  
Central Research Institute for Jute  
and Allied Fibres  
Kolkata

### **Asit Mandal**

Indian Institute of Soil Science,  
Nabibagh, Berasia Road,  
Bhopal - 463 038 (Madhya Pradesh)

### **B. Venkateswarlu**

Director, Central Research Institute  
for Dryland Agriculture,  
Santoshnagar, Hyderabad - 500 059  
Andhra Pradesh

### **Bansa Singh**

Principal Scientist (Nematology)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Ch. Srinivasa Rao**

Principal Scientist  
Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**Chandra Sekhar Praharaj**

Principal Scientist (Agronomy)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**D. Datta**

Principal Scientist (Plant Breeding)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Debashis Mandal**

Central Soil and Water Conservation  
Research and Training Institute  
218, Kaulagarh Road, Dehradun

**G. Pratibha**

Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**G. Ravindra Chary**

Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad, 500 059  
Andhra Pradesh

**G. Venkatesh**

Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**G.C. Munda**

ICAR Research Complex for NEH  
Region  
Umiam - 793 103, Meghalaya

**G.I. Ramkrushna**

Scientist (Agronomy)  
ICAR Research Complex for NEH  
Region  
Umiam - 793 103, Meghalaya

**G.P. Dixit**

Principal Scientist (Plant Breeding)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**G.R. Maruthi Sankar**

Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**Ganesh Kute**

Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**J. Somasundaram**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**Jagdish Singh**

Principal Scientist (Biochemistry) &  
Head  
Division of Basic Sciences  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**K. Sankaranarayanan**

Central Institute for Cotton Research  
Regional Station,  
Coimbatore, Tamil Nadu

**K. Swarnalakshmi**

Senior Scientist (Microbiology)  
Department of Microbiology  
Indian Institute of Pulses Research  
New Delhi - 110 012

**K.A. Gopinath**

Senior Scientist (Agronomy)  
Central Research Institute for  
Dryland Agriculture, Santoshnagar  
Hyderabad - 500 059  
Andhra Pradesh

**K.K. Bandyopadhyay**

Principal Scientist (Soil Physics)  
Division of Agricultural Physics  
Indian Agricultural Research Instt.  
New Delhi-110 012

**K.K. Hazra**

Scientist (Agronomy)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**K.M. Hati**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**M. Mohanty**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**M. Senthilkumar**

Senior scientist (Microbiology)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**M.C. Manna**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**M.K. Singh**

Scientist (Farm Machineries)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**M.S. Venkatesh**

Principal Scientist (Soil Chemistry)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Masood Ali**

Former Director  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Mohan Singh**

Principal Scientist (Microbiology)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Muraleedhar S. Aski**

Scientist (Plant Breeding)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**N. Nadarajan**

Director  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**N.S. Pasricha**

Ex-Director  
Potash Research Institute of India  
Gurgaon

**Naimuddin**

Senior Scientist  
Indian Institute of Pulse Research  
Kanpur - 280 024 (Uttar Pradesh)

**Narendra Kumar**

Senior Scientist (Agronomy)  
Indian institute of Pulses Research  
Kanpur – 208 024  
Uttar Pradesh

**Neelu Mishra**

Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**P. Duraimurugan**

Senior Scientist (Agri. Entomology)  
Directorate of Oilseeds Research  
Hyderabad - 500 030  
(Andhra Pradesh)

**P.K. Bandyopadhyay**

Department of Agricultural  
Chemistry and Soil Science  
Bidhan Chandra Krishi  
Viswavidyalaya  
Mohanpur -741 252 (West Bengal)

**P.K. Ghosh**

Director  
Indian Grassland and Fodder  
Research Institute  
Jhansi - 284 003 (Uttar Pradesh)

**P.S. Basu**

Principal Scientist (Plant Physiology)  
Indian institute of Pulses Research  
Kanpur – 208 024  
Uttar Pradesh

**Pramod Kumar Panda**

Senior Scientist (Agronomy)  
Directorate of Water Management  
Bhubaneswar-751023 (Orissa)

**Prasoon Verma**

Indian Institute of Pulses Research  
Kanpur - 208 024 (Uttar Pradesh)

**R. Jagdeeswaran**

Scientist (Nematology)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**R. Saha**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**R.G. Chaudhary**

Principal Scientist  
Indian Institute of Pulses Research  
Kanpur - 208 024 (Uttar Pradesh)

**R.K. Singh**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**R.S. Chaudhary**

Indian Institute of Soil Science  
Nabibagh, Berasia Road  
Bhopal 462 038 (Madhya Pradesh)

**Rajesh Kumar**

Principal Scientist (Agril. Extension)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Ranjan Bhattacharyya**

Scientist (SS), NRL  
Indian Agricultural Research  
Institute, New Delhi-110 012

**Rohit Katiyar**

Indian Institute of Pulses Research  
Kanpur - 208 024 (Uttar Pradesh)

**S.K. Chaturvedi**

Head & Principal Scientist  
Crop Improvement Division  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**S.K. Singh**

Principal Scientist (Agril. Extension)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**S.K. Yadav**

Senior Research Fellow  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**S.R.K. Singh**

Senior Scientist (AE)  
ZPD, Zone VII  
JNKVV Campus, Adhartal,  
Jabalpur – 482 004  
(Madhya Pradesh)

**S.V. Ngachan**

Director,  
ICAR Research Complex for NEH  
Region, Umiam - 793 103,  
Meghalaya

**Saumya Singh**

Senior Research Fellow  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Soumitra Das**

Director  
India Programme - Zinc Nutrient  
Initiative International Zinc  
Association  
FAI House, 10, Shaheed Jit Singh  
Marg, New Delhi – 110 067

**U.C. Jha**

Scientist (Plant Breeding)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**U.S. Gautam**

Principal Scientist (AE)  
ZPD, Zone VII, JNKVV Campus,  
Adhartal, Jabalpur – 482 004  
(Madhya Pradesh)

**Uma Sah**

Senior Scientist (Agril. Extension)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**Ummed Singh**

Senior Scientist (Agronomy)  
Indian institute of Pulses Research  
Kanpur – 208 024 (Uttar Pradesh)

**V.K. Singh**

Department of Agronomy  
G.B. Pant University of Agriculture  
& Technology, Pantnagar – 263145  
Udham Singh Nagar (Uttarakhand)

# CONTENTS

<i>Foreword</i>	<i>iii</i>
<i>Preface</i>	<i>v</i>

## **PART - I PULSES SCENARIO AND STATUS OF RESOURCE CONSERVATION TECHNOLOGIES IN INDIA**

1. An overview of pulses production in India — <i>N. Nadarajan and Aditya Pratap</i>	1
2. Constraints, issues and opportunities of RCT in pulse based cropping systems — <i>P.K. Ghosh and K.K. Hazra</i>	18
3. Success story of resource conservation technology in Indo-Gangetic plains — <i>N.S. Pasricha</i>	32
4. Resource conservation technologies in pulse based cropping systems in NEH region — <i>Anup Das, G.I. Ramkrushna, S.V. Ngachan and G.C. Munda</i>	43
5. Resource conservation technologies: A novel paradigm to magnify resource use efficiency in rainfed and drylands of India — <i>A.K. Tripathi</i>	58

## **PART - II PULSES IN CONSERVATION AGRICULTURE AND CROP DIVERSIFICATION**

6. Role of pulses in conservation agriculture — <i>Masood Ali and M.S. Venkatesh</i>	75
7. Resource conservation technologies in rice fallow — <i>Masood Ali, P.K. Ghosh and K.K. Hazra</i>	83
8. Advances in resource conservation technology in pulse production system — <i>Narendra Kumar, M.K. Singh and Saumya Singh</i>	90
9. Pulses under organic farming: Opportunities and constraints — <i>Mohan Singh</i>	103

## **PART - III GENETIC APPROACHES FOR HARNESSING CONSERVATION AGRICULTURE**

10. Plant type and varietal features of pulses for resource conservation technologies in agriculture — <i>S.K. Chaturvedi, Muraleedhar Aski and U.C. Jha</i>	115
---	-----

11	Plant type and varietal features of mungbean and urdbean in rice based cropping systems — <i>G.P. Dixit</i>	120
12	Importance of plant genetic resources in conservation agriculture — <i>Asit B. Mandal and D. Datta</i>	131
13	Protection of intellectual property rights with reference to resource conservation technologies — <i>D. Datta and Asit B. Mandal</i>	138
14	Nutritional quality traits and their improvement in pulses — <i>Jagdish Singh</i>	145
15	Quality seed maintenance of pulses in view of resource conservation agriculture — <i>S.K. Chaturvedi, Murleedhar Aski and Neelu Mishra</i>	156

#### PART - IV

#### INTEGRATED INPUT MANAGEMENT

16	Integrated nutrient management in pulse based cropping systems in different agro-ecological regions of India — <i>A.N. Ganeshamurthy</i>	169
17	Nutrient acquisition and recycling through pulses — <i>M.S. Venkatesh, K.K. Hazra and Rohit Katiyar</i>	190
18	Water management strategies under Resource Conservation Technologies — <i>Chandra Sekhar Praharaj</i>	199
19	Zinc in crops and human health – An overview — <i>Soumitra Das and Andrew Green</i>	213
20	Resource conservation and productivity enhancement of legume dominant farming systems — <i>A.K. Srivastva</i>	224
21	Natural resource conservation through watershed management in rainfed areas: Role of pulses — <i>Pramod Kumar Panda</i>	246
22	Potential and prospect of bio-fertilizers in pulse production under resource conservation technologies — <i>K. Swarnalakshmi, M. Senthilkumar and Mohan Singh</i>	257
23	Exploring pulse microbes and rhizosphere engineering — <i>Asit Mandal, Asha Sahu, M.C. Manna and P.K. Ghosh</i>	272

#### PART - V

#### CLIMATE CHANGE AND CARBON SEQUESTRATION OPPORTUNITIES

24	Carbon sequestration potential in conservation agriculture — <i>M.C. Manna, Asha Sahu, Asit Mandal and P.K. Ghosh</i>	295
----	--	-----

<i>Contents</i>	<i>xiii</i>
25 Role of resource conservation technologies in mitigating climate change — <i>P.K. Ghosh, Narendra Kumar and Arti Yadav</i>	312
26 Role of soil nitrogen supply in crop production under climate change perspective — <i>N.S. Pasricha</i>	326
27 Carbon sequestration to mitigate climate change — <i>K.K. Bandyopadhyay</i>	342
28 Potential for carbon sequestration through reclamation of degraded lands — <i>Debshish Mandal</i>	358
29 Carbon sequestration under soybean-wheat cropping system in the Indian Himalayas — <i>Ranjan Bhattacharya</i>	373
30 Carbon sequestration in pulse based cropping systems: Past experience and future prediction — <i>K.K. Hazra, M.S. Venkatesh, P.K. Ghosh, Narendra Kumar and Ummed Singh</i>	390
<b>PART - VI</b>	
<b>RESIDUE MANAGEMENT AND FARM MECHANISATION</b>	
31 Conservation agriculture and pulses: Impact on soil health — <i>K.M. Hati, R.S. Chaudhary, J. Somasundaram, R. Saha, M. Mohanty and R.K. Singh</i>	405
32 Residue management in pulse based cropping system under resource conservation technologies — <i>Narendra Kumar, M.K. Singh and Saumya Singh</i>	419
33 Energy budgeting in mechanised pulse production — <i>M. K. Singh, Narendra Kumar and P.K. Ghosh</i>	429
34 Role of farm mechanisation in conservation agriculture — <i>M.K. Singh and Narendra Kumar</i>	436
<b>PART - VII</b>	
<b>RESOURCE CONSERVATION TECHNOLOGIES FOR ABIOTIC STRESS MANAGEMENT</b>	
35 Resource conservation technologies in rainfed agriculture and mitigation of abiotic stress in pulse crops — <i>Ch. Srinivasa Rao and B.Venkateswarlu</i>	443
36 Improving water use efficiency and drought under RCT — <i>P.S. Basu</i>	462
37 Resource conservation technologies for soil moisture conservation in drylands — <i>R. Saha, J. Somasundaram and P.K. Ghosh</i>	478
38 Moisture stress and its management in pulses through resource conservation technologies in rainfed areas — <i>G. Ravindra Chary, K.A. Gopinath, G.R. Maruthi Sankar, G. Pratibha, G.Venkatesh, Ganesh Kute and B. Venkateswarlu</i>	483

- 39 Mitigating abiotic stresses in *rabi* pulses  
— *V.K. Singh and Ashutosh Barthwal* 494
- 40 Root distribution pattern of pulses in response to water availability  
— *P.K. Bandyopadhyay* 512

**PART - VIII**  
**RESOURCE CONSERVATION TECHNOLOGIES FOR BIOTIC STRESS**  
**MANAGEMENT**

- 41 Climate change and insect pest dynamics in pulses  
— *P. Duraimurugan* 523
- 42 Resource conservation technologies and integrated disease management strategies  
in pulses  
— *R.G. Chaudhary and Naimuddin* 535
- 43 Post harvest losses in pulses and its management  
— *Prasoon Verma* 556
- 44 Issues related to weed management in RCT  
— *Narendra Kumar, K.K. Hazra and S.K. Yadav* 567
- 45 Soil sickness due to nematodes and its management through RCTs  
— *Bansa Singh and R. Jagdeeswaran* 576

**PART - IX**  
**INDIGENOUS TECHNICAL KNOWLEDGE, SOCIO-ECONOMIC**  
**CONSIDERATION AND IMPACT ASSESSMENT**

- 46 Farmer participatory seed production through model village concept for enhancing  
pulse production  
— *S.K. Singh and Ambreesh Singh Yadav* 593
- 47 Enhancing farm income through RCT mediated village cluster approach  
— *Chandra Sekhar Praharaj and K. Sankaranarayanan* 610
- 48 Gender issues in conservation agriculture  
— *Rajesh Kumar* 629
- 49 Indigenous technical knowledge for resource conservation technologies in pulses  
production system  
— *Uma Sah* 635
- 50 Promoting resource conservation technologies in pulses through Krishi Vigyan  
Kendra  
— *S.R.K. Singh, U.S. Gautam, Anupam Mishra and Narendra Kumar* 642
- Subject Index 654
- About the Editors 659

*PART - I*

**PULSES SCENARIO AND STATUS OF  
RESOURCE CONSERVATION TECHNOLOGIES  
IN INDIA**

