

NEMATODE MANAGEMENT IN PLANTS

Editor

Pravin Chandra Trivedi

Ph.D., Post Doct. (U.S.A.), F.L.S. (London), F.B.S.,
F.P.S.I., F.N.S.I., F.B.R.S., F.M.A., F.E.S.
Professor of Botany,
University of Rajasthan,
Jaipur - 302 004, India



SCIENTIFIC PUBLISHERS (INDIA)

P.O. BOX 91

JODHPUR

Published by
PAWAN KUMAR
Scientific Publishers (India)
5-A, New Pali Road, P.O. Box 91
JODHPUR - 342 001
Tel.: +91-291-433323
Fax.: +91-291-512580
E-mail: artrans@tantramail.com
artrans@satyam.net.in
website : www.scientificpub.com

© Trivedi, P.C., 2003

ISBN: 81-7233-333-1

Laser typeset : Rajesh Ojha
Printed in India

***Dedicated to
Prof. B.N. Mathur***

PREFACE

Plant parasitic nematodes are hidden enemies of crops and represent a unique challenge to agricultural research, in that they combine their potential for serious reduction in growth and yield in a wide range of crop plants, often with, rather, non-specific and easily mis-diagnosed symptoms. Equally, nematode populations themselves are comparatively difficult to identify and quantify and their relationship between nematode population size and crop damage are subject to many environmental and crop specific factors. Finally, nematodes are system pests, rather than single crop pest-particularly in the tropics, where cropping sequence may support similar species when cropping intensity is high and conditions favourable for large population build-up. Control or management systems are therefore, likely to be much more complex in tropical agriculture than monocrop temperate agriculture.

The science of nematology has developed only during the last 40 years in India. The importance of nematodes as a constraint to successful crop production was first realized with the prevalence of the *cyst nematodes* on wheat in 1958 and on potato in 1961. Root-knot nematodes are prevalent in 90% of agricultural crops and are considered to be the number one problem. Cyst-forming nematodes are restricted to wheat, barley, rice, maize, sorghum, potato and pulses. Reniform and lesion nematodes are associated with a wide range of agricultural crops. These nematode pests have assumed a highly damaging role on a variety of crops, comprising cereals, vegetables, fruits, pulses, oilseeds, fiber, plantation, spices, horticultural, medicinal, aromatic, ornamental and forest crops.

Development of the concept of pest-management and their implementation have led to a greater appreciation of the need for a wide range of tactics for nematode control. The objective of nematode control is to improve growth and yield of plant without adversely affecting the environment. The increasing environmental, economic and human health problems, resulting from traditional control of nematodes is a clear signal for serious examination of practices regarded as biological control.

The present book “Nematode Management in Plants” incorporates critical review articles on nematode pest-management with special emphasis on biocontrol management practices over other control practices in the present scenario. The volume contains 18 articles by leading Plant Nematologist who have contributed immensely in the area of their research. Articles on application of cropping sequences, plant products and botanicals, latex, bioagents and biological control practices for the management of nematode pests have been included. Information has been compiled on the use of *Azotobacter*, *Bacillus thuringiensis* and VAM Fungi for reducing nematode pests. Detailed account on the integrated nematode management practice has been incorporated for the economical management of the pest.

This Festschrift — “Nematode Management in Plants” is a humble dedication to Prof. B.N. Mathur and to commemorate his outstanding contributions in the field of Plant Nematology. Dr. Mathur worked extensively on the “Molya” disease of wheat and barley in Rajasthan and suggested economical management practices for *Heterodera avenae*. He has published more than hundred research papers, completed many research projects and participated in many national and international Conferences. He established a Nematology laboratory at Durgapura Agricultural Station, Jaipur. For his excellent contribution in the field of Nematology, he was awarded and honoured by many societies including Nematological Society of India, New Delhi and Bioved Research Society, Allahabad.

I am thankful to all the contributors for writing authoritative and informative articles for this volume. The opinions and text contained herein are those of the authors and I have tried to honour their ideas in the original shape. I am sure, the information given in this volume will prove helpful to those interested in nematology and plant protection for many years to come and generate interest in an upcoming nematologist. I would very much appreciate receiving suggestions from readers so that shortcomings, if any, are corrected in future editions.

I wish to thank my wife Kusum, daughter Priyanka and son Rohit for their endurance during the compilation work of this volume. I appreciate the co-operation and support of Mr. Pawan Kumar of Scientific Publishers (India), Jodhpur for publishing the volume with patience, care and interest.

I am confident that the volume will be widely accepted by all the students, teachers and researchers in the field of plant nematology and plant pathology.

LIST OF CONTRIBUTORS

A. Kalra

Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow - 226 015

A.K. Singh

Scientists (SS) Nematology, Crop Protection Programme, D.W.R. Karnal - 132 001

Akhtar Haseeb

Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh - 202 002

Archana Mittal

Indian Agricultural Research Institute, New Delhi 110 012

B.K. Goswami

Indian Agricultural Research Institute, New Delhi 110 012

B.N. Shukla

Department of Plant Pathology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

D.C. Gupta

Department of Nematology, CCS Haryana Agricultural University, Hisar - 125 004

H.B. Singh

National Botanical Research Institute, Lucknow

Hebsybai

College of Agriculture, Kerala Agricultural University, Vellayani - 695 522

I. Vadhera

Department of Plant Pathology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

I.J. Paruthi

Department of Nematology, CCS Haryana Agricultural University Hisar - 125 004

J. Bhatt

Department of Plant Pathology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

K. Sitaramaiah

Dept. of Plant Pathology, Acharya N.G. Ranga Agricultural University, S.V. Agricultural College, Tirupati - 517 502

M. Mashkoor Alam

Department. of Botany, Aligarh Muslim University, Aligarh 202 002

M. Nagesh

Division of Entomology, Indian Institute of Horticultural Research, Hessaraghatta Lake, Bangalore - 560 089

M.S. Rao

Division of Entomology, Indian Institute of Horticultural Research, Hessaraghatta Lake
P.O., Bangalore - 560 089

M.S. Sheela

College of Agriculture, Kerala Agricultural University, Vellayani - 695 522

Mansoor A. Siddiqui

Department of Botany, Aligarh Muslim University, Aligarh - 202 002

N. Hasan

Indian Grassland and Fodder Research Institute, Jhansi - 284 003

P. Harinath Naidu

Dept. of Plant Pathology, Acharya N.G. Ranga Agricultural University, S.V. Agricultural
College, Tirupati - 517 502

P. Parvatha Reddy

Division of Entomology, Indian Institute of Horticultural Research, Hessaraghatta Lake,
Bangalore - 560 089

P. Sivaprasad

College of Agriculture, Kerala Agricultural University, Vellayani - 695 522

P.C. Trivedi

Department of Botany, University of Rajasthan, Jaipur - 302 004

P.P.K. Chahal

Department of Microbiology, Punjab Agricultural University, Ludhiana - 141 004

Prabhat Kumar Shukla

Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim
University, Aligarh - 202 002

R.A. Sikora

Institut Fur Pflanzenkrankheiten, der Universitat Bonn., Nessallee - 9, 53115, Bonn,
Germany

R.K. Jain

Department of Nematology, Haryana Agricultural University, Hissar - 125 004

Rakesh Pandey

Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow - 226 015

S. Nageswari

Division of Nematology, Indian Agricultural Research Institute, New Delhi - 110 012

S. Pandey

Division of Plant Pathology, Indian Institute of Sugarcane Research, Lucknow

S.D. Mishra

Division of Nematology, Indian Agricultural Research Institute, New Delhi - 110 012

V.P.S. Chahal

Department of Microbiology, Punjab Agricultural University, Ludhiana - 141 004

CONTENTS

	<i>Preface</i>	<i>vii</i>
	<i>List of Contributors</i>	<i>ix</i>
1.	Wheat Seed Gall Nematode (<i>Anguina tritici</i>) in India — A Problem and Approaches for its Eradication — I.J. Paruthi and D.C. Gupta	1-7
2.	Novel Approaches in Management of Nematode Problems in Wheat and Barley — A.K. Singh	9-17
3.	<i>Aphelenchoides besseyi</i> — A Major threat to Rice Cultivation — B.N. Shukla, I. Vadhera and J. Bhatt	19-30
4.	Plant Parasitic Nematodes of <i>Mentha</i> and their Management — Akhtar Haseeb and Prabhat Kumar Shukla	31-56
5.	Plant Parasitic Nematodes — Management Opportunities and Challenges — K. Sitaramaiah and P. Harinath Naidu	57-80
6.	Cropping Sequences for the Management of Plant Parasitic Nematodes — Mansoor A. Siddiqui and M. Mashkoor Alam	81-101
7.	Plants and their Products Act as Major Nematode Inhibitory Agents — Rakesh Pandey, R.A. Sikora, A. Kalra, H.B. Singh and S. Pandey	103-131
8.	Antagonistic Botanicals to Plant Parasitic Nematodes and their use in Nematode Management — Archana Mittal and B.K. Goswami	133-143
9.	Non-Pesticidal Management of Nematodes in Forage Crops — N. Hasan	145-172
10.	Management of Plant Parasitic Nematodes with Latex Bearing Plants — Mansoor A. Siddiqui and M. Mashkoor Alam	173-183

11.	Management of Phytonematodes by Bioagents	185-201
	— M.S. Sheela, Hebsybai and P. Sivaprasad	
12.	Current Trends in Biological Control of Nematode Pests in India	203-239
	— M. Nagesh and P. Parvatha Reddy	
13.	Azotobacter for the Control of Plant Parasitic Nematodes and for other Benefits	241-250
	— P.P.K. Chahal and V.P.S. Chahal	
14.	<i>Bacillus thuringiensis</i> for the Control of <i>Meloidogyne incognita</i>	251-257
	— V.P.S. Chahal and P.P.K. Chahal	
15.	Current Options for the Management of Plant - Parasitic Nematodes	259-268
	— S.D. Mishra and S. Nageswari	
16.	Current Trends in Integrated Nematode Management in Fruit Crops	269-291
	— P. Parvatha Reddy and M.S. Rao	
17.	Integrated Pest Management for Plant Parasitic Nematodes	293-304
	— R.K. Jain	
18.	Application of VAM Fungi in the Management of Plant Parasitic Nematodes	305-318
	— P.C. Trivedi	
	INDEX	319-332

**NEMATODE MANAGEMENT IN
PLANTS**

About the Book

Nematodes represent a unique challenge to agricultural research, in that they combine the potential for serious reductions in growth and yield in a wide range of crop plants, often with rather non-specific and easily mis-diagnosed symptoms. Development of the concept of pest management and their implementation have led to a greater appreciation of the need for a wide range of tactics for nematode control.

The present book "Nematode Management in Plants" provides an authoritative review of many aspects of nematode control and progress in the field of nematode management programme. The volume contains eighteen articles covering application of cropping sequences, plant products and botanicals, latex, bioagents and biological control practices for the management of nematode pests. Topics covering use of *Azotobacter*, *Bacillus thuringiensis* and VAM Fungi for reducing nematode pests have been specially included to project their role in the present century. Information on Integrated Nematode Management have been included with special emphasis on biocontrol management practices.

This book will be useful to Plant Pathologist, Nematologist, research and extension workers, teachers and students.