Biological and Molecular Approaches in Pest Management

Balwinder Singh
Ramesh Arora
S. S. Gosal

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Editors

Balwinder Singh

Director of Research

Ramesh Arora

Senior Entomologist
Department of Entomology

S S Gosal

Director of Research (Retd)

Punjab Agricultural University
Ludhiana – 141 004, India

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About the Editors

Dr Balwinder Singh is Director of Research at Punjab Agricultural University, Ludhiana. He did his Ph.D. in Entomology with specialization in Insect Toxicology in 1984 from PAU, Ludhiana. He was Commonwealth Fellow at Rothamsted Research, Harpenden, U.K. for six months. He has more than 28 years experience in teaching and research in the field of pesticide residues. He has handled many research projects funded by various international and national agencies. He has more than 200 publications to his credit. He has also edited three books and contributed 11 chapters in different books. He is acting as a reviewer for number of International Journals related to field pesticide residues. He is associated with a number of professional societies at the National Level and is the President of the Indian Society for Advancement of Insect Science.

Dr Ramesh Arora is Senior Entomologist in the Department of Entomology, Punjab Agricultural University, Ludhiana. He obtained his M.Sc. and Ph.D. in Entomology from the same institute in 1978 and 1990, respectively. He has been working on development and dissemination of IPM technologies for the last more than 35 years. His current research interests include climate resilient IPM and management of insect pests in vegetable crops. He has more than 250 publications including 80 research articles in refereed journals, 15 books and 40 book chapters to his credit. He is associated with a member of professional societies and served as Editor-in-Chief of Indian Journal of Ecology (1996-2003). He is Vice President, Society of Pesticide Science India, General Secretary, Indian Society for the Advancement of Insect Science, and Editor, Entomology Reporter.

Dr S S Gosal served as Director of Research (2010-1014) at Punjab Agricultural University, Ludhiana. He obtained his M.Sc. and Ph.D. degrees in the discipline of Plant Breeding from the same university. He joined PAU as Assistant Breeder in 1984 and contributed towards strengthening the education and research in the area of plant biotechnology. During 1993, he was awarded a unique Biotechnology Career Fellowship by the Rockefeller Foundation, USA for 6 years, to conduct research in the area of transgenesis at University of Nottingham, England and John Innes Centre Norwich, UK for three months each year. He is elected Member/Fellow of three professional societies and member of several other scientific societies. Dr Gosal is founder Director of School of Agricultural Biotechnology at PAU, Ludhiana. To put his ideas into motion he has competitive research grants for more than 20 adhoc research projects. Besides, he has served as a member of Board of Assessors, Australian Research Council, Canberra. He has undergone a rigorous training on environment risk assessment of GM crops at Danforth Centre for Plant Science Research, St. Louis; APHIS, EPA (USDA) and USTDA, Washington DC, USA. His contributions in the field of plant biotechnology can be gauged from the volume of over 155 original research papers in refereed Indian and foreign journals. He has been the examiner, member of the advisory board and selection committees in more than 15 Universities and Institutes. Dr Gosal has co-authored a text book, two dozen chapters in books, many Practical Manuals and has supervised thesis research as major/co-major advisor/member of advisory committee of more than 70 post graduate students.

Preface

Despite great advances in agricultural productivity and economic well-being in much of the world over the past 50 years, food insecurity and poverty continue to be serious issues in many regions of the world. Since most of the cultivable land is already under cultivation, future increases in food, feed and fibre production have to be achieved with increased productivity and improved crop protection. Ironically, more than a third of the global agricultural production is lost to the activity of animal pests and diseases. Further, the losses are significantly higher in the tropical areas where the food shortages are already serious. The strategy of exclusive reliance on chemical pesticides for minimizing crop losses caused by pests has led to human health and safety hazards and caused a number of ecological and economic problems. The concept of integrated pest management was propounded to minimize these side-effects. But inspite of its inspirational value, most IPM programmes still include economic threshold level based application of chemical insecticides as a major input. In this context, the wide range of biological and molecular approaches discussed in 15 Chapters in this book offer a plethora of environmentally benign alternatives to these chemical insecticides.

The introductory Chapter outlines the role of molecular techniques in improving the efficacy of a diverse range of pest management options including genetically engineered plants, insects and microorganisms as well as host plant resistance and chemical insecticides. The second Chapter discusses the role the biotechnological approaches have played in development of rice genotypes resistant to planthoppers. The third Chapter highlights the importance of molecular taxonomy in studies on fruit flies. The RNAi has emerged as a powerful gene-silencing technique and its potential for utilization in pest management is revealed in Chapter 4. The persistence of pesticide residues in the environment poses significant ecological risks. Bioremediation is emerging as the method-of-choice for dealing with such residues and its potential is explored in Chapter 5.

Insects, like other organisms, are prone to diseases caused by a diverse range of microorganisms. The exploitation of these microbes as a tool in pest management offers immense possibilities which are highlighted in Chapter 6. The gall midge, a major pest of rice, is notorious for evolving new biotypes to overcome plant resistance genes. Chapter 7 explains how an understanding of the molecular basis of these interactions can help in development of durable gall midge resistant genotypes. The wide range of molecular markers and their applications in entomological research are concised in Chapter 8. The success story of *Bt* cotton which has transformed India from a net importer to a major exporter of 'white gold' is highlighted in Chapter 9. The potential of biotechnological techniques in developing pest-resistant fruit plants is outlined is Chapter 10.

Insects being highly versatile organisms have the ability to develop resistance to any pest management tactic which exerts sufficient selection pressure on their populations. Chapter 11 focuses on the strategies for management of resistance in insects to microbial control agents. Chapters 12 and 13 highlight the role of biological and molecular approaches in management of mites and *Conogethes* spp., respectively. Bee diseases and pests present a serious challenge to commercial apiculture. The utilization of molecular techniques for precise identification of these organisms is explained in Chapter 14. There is now a wide array of techniques available to replace the use of conventional insecticides in IPM programmes. But it is essential that all the non-chemical approaches are combined within the framework of IPM. The emergence of biointensive IPM as the preferred alternative to conventional IPM is explained in the concluding Chapter of the book.

It is hoped that the book will fill the wide gap in literature on utilization of biotechnological approaches in biointensive IPM as an alternative to chemical insecticide based IPM for sustainable insect pest management in future. We trust that you, the reader, will find the subject matter interesting and informative. We hope that this compilation answers questions you might have, and serves to stimulate further development of this fascinating science of pest management.

Balwinder Singh
Ramesh Arora
S S Gosal

Contributors

P K Arora
PAU Regional Research Station
Abohar-152 116, India

Ramesh Arora
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

J S Bentur
Directorate of Rice Research
Rajendranagar,
Hyderabad 500 030, India

Manmeet B Bhullar
Department of Entomology
Punjab Agricultural University
Ludhiana – 141 001, India

D S Brar
School of Agricultural Biotechnology
Punjab Agricultural University
Ludhiana – 141 004, India
(Former Head, Plant Breeding,
Genetics & Biotechnology Division
International Rice Research Institute,
Manila, Philippines)

P S Burange
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

A K Chakravarthy
Department of Entomology
University of Agricultural Sciences
Bangalore-560 065, India

Chandrashekharaiah
Department of Entomology
University of Agricultural Sciences
Bangalore-560 065, India

Pardeep K Chhuneja
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

A K Dhawan
Department of Entomology
Punjab Agricultural University
Ludhiana-141 004, India

B Doddabasappa
Department of Entomology
University of Agricultural Sciences
Bangalore-560 065, India

D Fujita
Plant Breeding, Genetics &
Biotechnology Division
International Rice Research Institute
Manila, Philippines

Arshdeep K Gill
Department of Entomology
Punjab Agricultural University
Ludhiana – 141 001, India

P D Kamala Jayanthi
Division of Entomology and Nematology
Indian Institute of Horticultural
Research
Bangalore -560 089, India

K K Jena
Plant Breeding, Genetics &
Biotechnology Division
International Rice Research Institute
Manila, Philippines

S B Kandakoor
Department of Entomology
University of Agricultural Sciences
Bangalore-560 065, India

Uma Kanta
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

Paramjit Kaur
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

Krishan Kumar
PAU Regional Research Station
Abohar-152 116, India

Vijay Kumar
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

Sujan Mamidi
Genomics and Bioinformatics Program
North Dakota State University
Fargo, ND 58102, U.S.A.

Kousik Mandal
Department of Entomology
Punjab Agricultural University
Ludhiana-141 004, India

Prashant Mohanpuria
School of Agricultural Biotechnology
Department of Entomology
Punjab Agricultural University
Ludhiana-141 004, India

G Nagalakshmi
Division of Entomology and Nematology
Indian Institute of Horticultural Research
Bangalore -560 089, India

P C Pathania
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

M A Rashmi
Department of Entomology
University of Agricultural Sciences
GKVK, Bangalore-560 065, India

Surinder K Sandhu
Department of Plant Breeding & Genetics
Punjab Agricultural University
Ludhiana-141 004, India

P S Sarao
Department of Plant Breeding and Genetics
Punjab Agricultural University
Ludhiana – 141 004, India

H C Sharma
International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)
Patancheru - 502 324, India

P R Shashank
Department of Entomology
University of Agricultural Sciences
Bangalore-560 065, India

P S Shera
Department of Entomology
Punjab Agricultural University
Ludhiana 141 004, India

Balwinder Singh
Department of Entomology
Punjab Agricultural University
Ludhiana-141 004, India

Kuldeep Singh
School of Agricultural Biotechnology
Punjab Agricultural University
Ludhiana – 141 004, India

Abraham Verghese
National Bureau of Agriculturally Important Insects
Hebbal, Bangalore – 560 024, India

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