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Biocontrol and Utilization of Insects for North East India

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About Book

The North- East region of India has a rich biodiversity of life and natural resources. Modern agricultural practices have established a fact that excessive and indiscriminate use of synthetic inputs including insecticides, fungicides, weedicides, fertilizers, etc., have endangered biodiversity, biosecurity, natural resources, and human wellbeing. Biological control is the utilization of one living organism to control another. This is an age-old practice and since the time immemorial, man is using cats to control rats. Similarly, to control insect pests also, the biological method is being successfully implemented almost for three decades. This method is safe, eco-friendly, cheap and long-lasting. To overcome the hazards associated with chemical pesticides, the use of biocontrol agents is increasingly being adopted. A great deal of knowledge has been gathered on the use of biocontrol agents for the management of pests and diseases. Biocontrol agents have offered some realistic alternatives to chemical pesticides when used as part of an ecologically based integrated pest management or area-wide pest management strategy. Great successes have been made by the farmers in India by adopting biocontrol-based technologies. Biocontrol is aiming to create a platform for national researchers to project their results, ideas or concepts on how to integrate more and more biocontrol methods, technologies or products into the existing pest and disease management programmes. Also, there is an urgent need to address the challenges of invasive insect pests such as Fall Army Worm (FAW) in Maize, Rugose Spiralling Whitefly in Coconut, etc., through biological control as a component of IPM.

In this book, several such interventions are given to inform of various chapters which will be of immense use improving the productivity and profitability of North-East region crops commodities through biological control. In this endeavour, useful information has been generated on identification of bioagent, cutting edge technology to workers already engaged in production of bio-agents, mass production of biological control agents, biocontrol of rugose whitefly through biological control, biocontrol of Fall Army Worm in North-East region and collection and utilization of edible insect for various research institutions and SAUs of the country. Earnest efforts have, therefore, been made to compile information on the identification of bioagent, mass production of bioagent and biocontrol of pests in a systematic manner, grouped in different chapters and presented in the form of a book entitled **"Biocontrol and Utilization of Insects for North East India"**. This publication contains excellent colored photographs depicting salient identification of bioagent, mass production of bioagent and biocontrol of pests in field conditions to update the knowledge of extension agencies and farmers.

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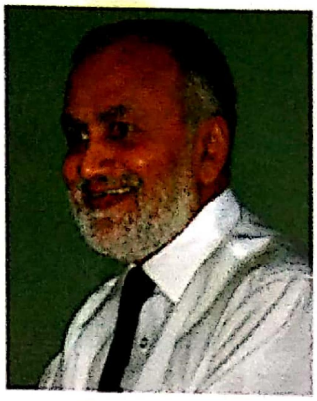

Chancellor

FOREWORD

Natural biological control by predators, parasitoids and pathogens of agricultural pests has been occurring since the beginning of the evolutionary process of crop plants. After the Second World War, however, the use of chemical pesticides such as DDT and 2, 4-D increased exponentially as the control was cheaper and better. However, these pesticides started affecting human health, prompting the public to look for better pesticides for effective control of various pests and diseases. Agenda 21 of Earth Summit in 1992, clearly defined the need for corrective measures to contain the use of pesticides for attaining sustainable agriculture and environmental safety. This rekindled interest in biological control methods.

Several classical biological control agents have been scientifically examined and introduced by several countries. Information concerning progress in this discipline has, therefore, become important both for the scientists and farmers. Biological control needs concerted efforts by all stakeholders and it is important for both the developed and developing countries to lay greater emphasis on large scale demonstrations of biological control methods as a part of an integrated pest management (IPM) strategy.

Central Agricultural University on its part, is formulating technologies of biocontrol by developing appropriate protocols, formulations and the Directorate of Extension Education is making efforts to popularize the technologies for the benefit of stakeholders. The present compilation is one such effort that contains the current status of biocontrol of pests and diseases for higher productivity by limiting environmental damages. I am sure that this compilation on 'Biocontrol and Utilization of Insects for North East India' would be highly useful for researchers, students and farmers alike.

(S. Ayyappan)

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The Authors

Dr. Shravan M Haldhar (MSc, PhD) joined January 2020 as Associate Professor (Entomology) in Department of Entomology, College of Agriculture, Central Agricultural University, Imphal, Manipur. He started his career as Scientist (Agril Entomology) in ICAR in 2009 at CIAH, Bikaner. He born on 13th October, 1979 in Jaipur (Rajasthan), obtained M. Sc. Agricultural Entomology (2004) from RAU, Bikaner and Ph. D. (2008) from MPUAT, Udaipur. He has collected and identified around ninty five insect species of horticultural importance in arid and semi-arid region, of which eleven species occurred on new hosts. He also developed 05 varieties of ridge gourds (Thar Karni); long melon (Thar Seetal); sponge gourd (Thar Tapish); palak (Thar Hariparna) and ivy gourd (Thar Sundari) and registered two trait specific muskmelon genotype (AHM/BR-8) and watermelon genotype (AHW/BR-5) in NBPGR, New Delhi. He has published 12 international and 44 national research papers; 14 books/ compendium; 06 technical bulletin, 02 technical folder; 21 book chapters; and delivered 50 lectures. He is fellow of 'The Entomological Society of India' and is the recipient of several awards and recognitions including Dr. B. Vasantharaj David Young Scientist Award 2019; Agriculture Today Young Scientist Award 2019; SAAER-Young Scientist Award 2016; AIASA-Scientist of the Year Award 2016 and IIFS-Rastriya Gaurava Award 2012. Dr. Haldhar has developed 31 technologies related to insect-pests management strategies in arid horticulture crops and applied one patent on biopesticde "Thar Jaivik 41 EC" for insect-pests management. Submitted 07 new DNA Bar-coding sequence data of arid horticulture crops insects to Gen Bank NCBI, USA. Guided 05 Ph. D. and M. Sc. scholar. He has participated international symposium (TAAO) at University Putra Malaysia in 2016. In a short career span of 13 years, this young researcher has established himself in the field of arid horticulture and holds a promising future.

Dr. Pranab Dutta (MSc, PhD, MBA(PM), Post Doctorate Training): Presently Associate Professor (Plant Pathology) in School of Crop Protection, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam. Earlier he served AAU, Jorhat, KVK-West Tripura (Now Khowai), CMER&TI (CSB) etc. He completed MSc and PhD in Biological Control. Dr. Dutta completed his Post Doctorate training on "Application of Nanotechnology in food and agriculture" at UK as DBT Overseas Associates. He has been actively involved in teaching, research and extension for the last 2 decades. More than 100 research papers in national and international journal of repute, 13 proceedings paper, 81 popular

articles, 22 training manuals/hand books, 36 book chapters, 9 practical manuals/ teaching aids, 12 books (Edited) are in his credit. He has delivered 20 invited/ lead lectures in the national premier establishment like IARI (New Delhi), AAU (Jorhat), BCKV (WB), UBKV(WB), Tezpur University (Assam), ICAR-RC (Umiam), NRC-Mithun (Nagaland), CoA (Tripura), CIH (Nagaland), PCIL (WB) etc and internationally reputed institute/bodies like FERA (UK), ICPP-2018 (Boston, USA) etc. He is the recipient of meritorious contribution award in sericulture (CMER&TI, Central Silk Board,) ICPP-2018 Bursary award (The American Phytopathological Society, USA), Young Scientist Award- 2018(At NAU), Distinguished Scientist Award-2019 (AETDS, UK), Prof. K S. Bilgrami Award-2016 (ISMPP), Stanford Research Award-2015 etc. Developed 7 bioformulations with native isolates, filled 5 patents and commercialized five bioformulatuon products. He has supervised 3 PhD and 11 MSc students as Major adviser and more than 100 students as member of advisory committee. His research area includes nanotechnology, biological control, ecotoxicology and plant defence.

Prof. Ratan Kumar Saha (MSc, IFDA, DFSc, PhD, FZS) joined as Director (Extension Education), Central Agricultural University, Lamphelpat, Imphal, Manipur on November 10, 2017. Prior to joining this post, he served as Assistant Professor, Associate Professor, Professor & Head (AHE), and Dean (Acting) in the College of Fisheries, CAU (I), Lembucherra, Tripura, India. Before joining CAU, Imphal he served Divodaya Krishi Vigyan Kendra (ICAR Financed) as Training Associate (Fisheries), Khowai, Tripura and Fishery Officer (Lecturer) in Tripura Fisheries Training Institute (TFTI), Department of Fisheries, Government of Tripura. He has more than 35 years of professional experience including administrative as well. Prof. Saha has conducted a number of research projects sponsored by DST, NAIP (ICAR), DBT, NFDB, and CAU till date. He also guided a number of PG and PhD students. He published a series of research papers in journals of national and international repute, number of books, the review article in books, and also a number of training manuals, practical manuals, popular articles, leaflets, Pond Health Card, Fish Health Card, Fish Farming Calendar, Fish Breeding Calendar, Soil & Water Management Calendar, Digital Album, and Video Clippings etc. Dr. Saha has developed/identified ten novel technologies/concepts/ methodologies/ bioflok technology in the area of fisheries and aquaculture. He has organized a number of training programmes on soil and water quality management, fish based farming system, fish health management, new species (*Bosmina tripurae*) etc. four CAU Regional Agri Fair, two CAU-Intercollegiate Games and Sports Meet, one CAU Youth Festival and one National Seminar at different campuses of CAU, Imphal. He is also an external member of different committees in various institutions. He is the life members of several national and international scientific fisheries and ecological societies. He is the chief editor of CAU Farm Magazine, CAU Newsletter and CAU Kisan Diary.

Dr. Nagesh Mandadi holds a Ph. D. degree in Plant Protection science – Nematology from the Indian Agricultural Research Institute and Post-Doctorate with Prof. HS Savithri, Department of Biochemistry, Indian Institute of Science, Bengaluru, India, with over 29 years' work experience in entomopathogenic nematodes for insect pest management, biological control of plant parasitic nematodes etc. He commenced his research career at ICAR-Central Potato Research Institute, Shimla from 1991 to 1994; subsequently continued at ICAR-Indian Institute of Horticultural Research, Bengaluru till 2001 and ICAR-National Bureau of Agricultural Insect Resources (erstwhile, ICAR-Project Directorate of Biological Control, Bengaluru). He did under-graduation in Agricultural Sciences from ANGRAU (earstwhile APAU), Bapatla college of Agriculture, PG and PhD in Nematology from IARI.

His current research interests are biological control of crop insect pests using entomopathogenic nematodes with special emphasis on molecular mechanisms of tritrophic relationships among insect host, entomopathogenic nematode and symbiotic bacteria. He and his team primary contribution includes whole genome sequencing of bacterial symbionts of entomopathogenic nematodes and Mitochondrial genomes of native entomopathogenic nematodes & transcriptomes of EPN-infected insect tissues. Nagesh and his team developed formulations of entomopathogenic nematodes with 12 months shelf-life, technologies for scale-up, post-production processing of microbial bioagents and transferred the technologies to the industry. He has three patents granted and published the results of his and his team studies in more than 70 papers in peer reviewed journals. Currently, he works as Principal Scientist & Head I/C, Division of Genomic Resources, ICAR-National Bureau of Agricultural Insect Resources.

Dr. K. Selvaraj, Scientist (Entomology) working at ICAR-National Bureau of Agricultural Insect Resources, Bengaluru and has 8 years' experience in the field of biological control, ecology, assessment of impact of climate change on crop-pest interaction in rice and jute and whitefly taxonomy. He was teaching for two years in the Ramakrishna Mission Vivekananda Educational and Research Institute, Kolkata. Outstanding contribution has been reporting three invasive whiteflies *viz.*, *Rugosespiralling* whitefly, *Aleurodicus rugioperculatus,* Palm infesting whitefly, *Aleurotra chalusatratus*, woolly whitefly, *Aleurothrixus floccosus* for the first time in India as well as Oriental region. He has developed the augmentation and conservation strategies for *Encarsia guadeloupae* for management of RSW. He has identified and field evaluated a potential entomopathogenic fungus, *Isaria fumosorosea* for the management of RSW in coconut and oil palm and identified and characterized two genetic groups of *B. tabaci viz.*, Asia-I and Asia-II 1 in India using molecular techniques. He has determined the

multiple species economic injury levels and iso-loss line in rice and jute for precision pest management and determined thermal constant and development threshold of *Sesamia inferens* in rice and *Spilasomao bliqua* in jute to develop phenology model based on degree day pest management decision making and pest dynamics under changing climatic scenarios. Developed and validated a simulation model for assessment of impacts of climate change on pink stem borer in rice. Expert system (JAFexpert): A web-based client-server developed for jute and allied fibre crops and he has involved in identification unique jute germplasm (WCIN 179; KC/AK/DS-54) of wild jute (INGR18023) showing complete resistance to *S. obliqua.* He is recipient of Young Entomologist Award, Eco-friendly pest management award, awarded certificate of merit and gold medal by District Collector, Krishnagiri district, Tamil Nadu. Guided one M. Sc. student and published above 50 research papers. Visited Bangladesh and Australia and trained in advance in integrated pest management, invasive pest management and whitefly parasitoid mass production.

Prof. M. Premjit Singh, Vice-Chancellor, Central Agricultural University, Imphal obtained his M. Sc. (Life Sciences) degree from Jawaharlal Nehru University, New Delhi; M. Phil. and Ph. D. Degree in Zoology with specialization in Entomology from Himachal Pradesh University, Shimla. He started his career as Assistant Professor (Entomology) in 1986 in the erstwhile Manipur Agricultural College, Imphal and became Associate Professor in 1990, Professor in 1998, Director of Extension Education in 2009 and Vice-Chancellor in 2015 in Central Agricultural University (CAU), Imphal. Besides professional positions, he also served as Registrar, Deputy Registrar (Academic), Assistant Registrar (Academic) and Research Coordinator (Oilseed Crops) in CAU, Imphal for more than a decade. He has undertaken 10 (ten) mega research projects and supervised 5 Ph.D. and 10 M.Sc. (Ag.) students and attended 8 international conferences, 82 national conferences and 5 advance training courses. He has published 100 research papers, 55 research communications, 6 books, 11 technical bulletins, 34 popular articles and 2 success stories. He was the Chief Editor of CAU Farm Magazine and CAU Kisan Diary published in 7 languages. Dr Singh has developed/identified 14 novel technologies/ concepts/methodologies in the area of plant protection. Large scale demonstration on "Zero tillage cultivation of rapeseed-mustard in rice fallow with bee pollination and non-chemical method of plant protection" with cost-benefit ratio of 1:3.4 covering more than 1000 ha for 6 consecutive years; Front Line Demonstration on location specific IPM in rice using gall midge and blast resistant rice variety with cost-benefit ratio of 1:2.1 in 200 ha for 5 consecutive years; construction of many water harvesting structures in Farmers' field with micro-irrigation facilities and quality seed production of rice and oilseeds under seed village concept are some of the exemplary contributions of Dr. Singh for the resource poor farmers of North-Eastern region. After joining as Vice-Chancellor on 27.03.2015, Dr. Singh established 6(six) new colleges, 6(six) Multi-Technology Testing Centres and 6(six) Vocational Training