Climate Change Effect on Crop Productivity

Edited by

Rakesh S. Sengar and Kalpana Sengar

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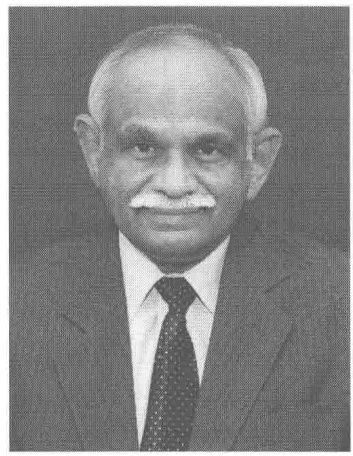
Foreword



I am happy to know Dr. R.S. Sengar, associate professor and officer-in-charge, Dr. Kalpana Sengar, women scientist fellow (DST), Department of Agriculture and Biotechnology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut and their colleagues who have taken the initiative to bring out a book to enhance the understanding of the phenomenon of climate change and crop productivity.

Climate change is impacting all aspects of our day-to-day existence and more profoundly the crop production system, which is very critical for the food security of any nation. The main objective of this book is to provide the recent developments on this subject and to increase the understanding of its readers in a very holistic manner. I am confident that this book will serve as a useful reference material for researchers, students and consultants engaged in this field, particularly those concerned with the science of biotechnology, climate change and plant productivity. It will certainly assist faculty members in improving teaching the more effectively. It will also provide a better insight and greater to all the students pursuing this subject.

I congratulate Dr. Sengar and his young and enthusiastic faculty colleagues for their sincere efforts, diligence and hard work in bringing out this all-important book.

A.K. Singh

Preface

The impact of climate change at the global level is severe, especially in the developing world, and the social and economic implications in China, India, Brazil, and the poor countries of the tropical belt in Africa and Latin America. This book about the stakes for world agriculture makes a major contribution on this score. This analysis has significant implications for all concerned about global warming effect on crop productivity due to climate change and long-term agriculture technique development. This study confirms the asymmetry between potentially severe agricultural damages such as the effect on crop yield due to variation in temperature.

Agriculture sustainability has become the basic principle of modern agriculture and it implies the successful management of agricultural resources to satisfy human needs of food, fiber, fruits, forest and fuel without endangering the environment. This has achieved relatively higher importance in the last few decades and has become an inevitable part of the syllabus of any agricultural course in universities and institutes. This book is written in the context of the 'global climate change and effect on crop yield and agriculture productivity', and all the chapters are contributed by experts scientists, professors and researchers in their respective field. This book is intended to provide relevant information and opportunities for productive engagement and discussion among government negotiators, experts, stakeholders, and others involved and interested in climate change and agriculture. For this report, the institute convened a team of international, independent expert authors, and facilitated the

work of the author's team as well as a series of informal dialogues with a broad range of country negotiators, nongovernmental organisations and agricultural experts.

We are highly thankful and obliged to Dr. H.S. Gaur, vice chancellor of SVPUA&T, Meerut, for his persistent encouragement and valuable suggestion for the successful completion of this manuscript. We have received generous help from many senior scientists and fellow teachers for the preparation of this book under the guidance of Professor Shivendra Vikram Sahi, head, Department of Biotechnology, Ogden College of Science and Engineering, Western Kentucky University, Bowling Green, Kentucky, USA. We will remain ever-indebted to our respected teacher Professor V.P. Singh, head and dean, Department of Plant Science, MJP Rohilkhand University, Bareilly, Dr. Anil Gupta, professor and head, Department of Molecular Biology and Biotechnology, College of Basic and Tech, Pantnagar, Udham Singh Nagar; Professor Vinay Kumar Sharma, Department of Bioscience and Biotechnology, Banasthali, Rajasthan; Professor R.P. Singh, Department of Biotechnology, Indian Institute of Technology (IIT) Roorkee; Professor P.K. Gupta, Chaudhary Charan Singh (CCS) University, Meerut; Professor N.S. Sikhawat, Department of Biotechnology, Jai Narayan Vyas (JNV) University, Jodhpur; Dr. N.K. Singh and Dr. T.R. Sharma, principal scientist, biotechnology, National Research Centre on Plant Biotechnology, New Delhi; Professor Akhilesh Tyagi, director, National Institute of Plant Genome Research (NIPGR), New Delhi, Chandigarh; Professor B.D. Singh, Banaras Hindu University (BHU), Varanasi; Professor R.L. Singh, Dr. Ram Manohar Lohia Avadh (RMLA) University, Faizabad; Dr. Sundeep Kumar Sharma and Dr. Rakesh Singh, National Bureau of Plant Genetic Resources (NBPGR), New Delhi; Dr. Dharmendra Singh, Indian Agriculture Research Institute (IARI), New Delhi and Dr. A.K. Sharma, Ramie Research Station (ICAR), Sorbhog, Barpeta, Assam, for their extraordinary help in shaping this book. We are highly thankful to our colleagues and faculty members of the College of Biotechnology and Department of Agriculture Biotechnology, SVPUA&T, Meerut for extending valuable comments and for helping directly and indirectly. It would be rather impossible to list all those who have provided encouragement and help in the preparation of this book. I am extremely thankful to all of them.

The first author will ever remain grateful to his reverend parents (Dr. Sanwal Singh Sengar and Smt. Kamla Sengar) who kindly inspired him for this contribution, his wife Sarita, and kids (Divyanshu and Kartikey) who gave him persistent

encouragement by their smiling faces to enable him to write the manuscript. As a first author, I express my due gratitude to my younger brother (Dr. Rajesh Singh Sengar), his better half (Smt. Kalpana Sengar) and kids (Saumya and Amranshu) for their affection, continuous help, and cooperation during the preparation of the manuscript. We are very grateful to Dr. Gagandeep Singh, Jennifer Stair, Kate Gallo, Arlene Kopeloff, Florence Kizza, Karolina, Syed Mohamad Shajahan and Taylor & Francis for their kind cooperation and support from idea to bringing out this publication in a presentable form.

I would like to express my sincere gratitude towards my mentor Late Professor H.S. Srivastav, who has always been a source of strength and moral support in all my endeavours, especially in the field of life sciences. I hope this book will satisfy the needs of the majority of academicians, scholars and students. Benediction of many dignitaries from ICAR Institute, South Asian University (SAU) and IIT has led me to the completion of this herculean task well in time. In the future, I expect their same cooperation for quality improvements and wish that I serve the society at large in a better way. I am indebted to everyone who is directly or indirectly involved in the successful completion of this book.

Dr. Rakesh Singh Sengar

About the Book

This book reports on the results of experiments to assess the effects of global climate change on crop productivity. It covers issues such as CO_2, ozone on plants, productivity fertilisation effect, UV (ultraviolet) radiation, temperature and stress on crop growth. Agriculture is a complex sector involving different driving parameters (environmental, economic and social). It is now well recognised that crop production is very sensitive to climate change with different effects according to the region. This book underlines such concerns about the current status of our environment and agriculture.

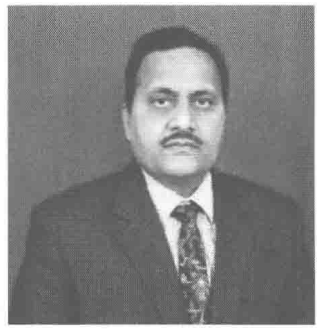
This book analyses the global consequences to crop yields, production and risk of hunger of linked socio-economic and climate scenarios. The potential impacts of climate change are estimated for use to evaluate consequent changes in global cereal production, cereal prices and the number of people at risk from hunger. The crop yield results elucidate the complex regional patterns of projected climate variables, CO_2 effects and agricultural systems that contribute to aggregations of global crop production.

This book contains 19 chapters and discusses the impact of changing climate on agriculture, environment stress physiology, adaptation mechanism, climate change data of recent years, impact of global warming and climate change on different crops such as sugarcane, wheat, rice and medicinal plants. The concluding chapter gives an idea of the overall global picture in terms of the effect already discussed in response of crops to climate change during abiotic stress. This book also

attempts to underline various strategies for reducing agriculture's vulnerability to climate change and for adaptation to the ongoing climate change.

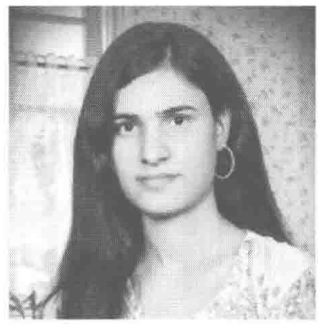
This book will be useful for agriculturists, environmentalists, climate change specialists, policy makers and research scholars engaged in research on climate agriculture-related issues.

Editors



Dr. Rakesh Singh Sengar, the editor of the book, is the associate professor, Department of Agriculture Biotechnology, College of Agriculture in Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. Dr. Sengar has 19 years of teaching, research and extension experience to his credit. He remained associated with teaching for a period of about 10 years at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand). He has supervised five PhD students and has published more than 48 research papers in India and foreign journals of repute. Dr. Sengar has contributed 105 abstracts/papers to different conferences/symposiums/workshops organised at national and international forums. He has published 780 popular articles in Hindi and English languages in important journals and magazines. He has also published four books for the scientific community and farmers. Dr. Sengar has delivered more than 200 talks at All India Radio and television at Delhi, Lucknow, Rampur and Bareilly centres. Dr. Sengar has keenly worked as one of the active members of the advisory committee of Doordarshan, New Delhi. Dr. Sengar is a life member of several professional societies. He is a member of the editorial boards and review committees of

few journals. Dr. Sengar is on the panel of examiners of several colleges/institutions and universities. He is one of the members of RDC of Uttarakhand Technical University, Dehradun (Uttarakhand). He has been the principal and co-investigator of a few projects financed by various government departments. Dr. Sengar is the recipient of the 'Best writer' award from Vishwa Agro Marketing and Communication, Kota, Rajasthan, 'Kunwar Saxena Bahadur SRDA' award from the society for Recent Development in Agriculture, Meerut, 'Man of the Year' and 'Research Board of Advisors' awards from American Biographical Institute, Inc., USA, 'Aryabhat' 2010 award from Vigyan Bharti, New Delhi and Fellow of Society of Plant Research, Bareilly. Dr. Sengar has also received a gold medal in 2011 from Hitech Horticulture Society, Meerut and Dr. J.C. Edward Medal 2012 from Bioved Research Society, Allahabad and 'Scientist of the Year—2013' from the Academy of Environmental Biology, Lucknow.



Kalpana Sengar, the co-editor of this book, is the youngest recipient of the Women Scientist Fellowship award given by the Department of Science and Technology, Government of India. She has seven years research experience to her credit in biotechnology. She completed her MSc in biotechnology at the CCS University and her PhD from MJP Roheilkhand University and is working as a young scientist at Sardar Vallabhbhai Patel University of Agriculture and Technology. She has published more than 20 papers in reputed national and international journals and has presented papers in several national and international conferences. She has received the best report diploma award by the Bioinfobank library, Poland in 2009, the Flemish Institute for Biotechnology (VIB), a PhD scholarship for attending the international symposium in Belgium in 2010 and a scholarship to attend the 17th annual conference of the International Sustainable Development Research Society (ISDRS) hosted by the Earth Institute, Columbia University. She has research interest in agriculture, human nutrition, biotechnology and plant tissue culture and so on.

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