

Preface

World agriculture has shown phenomenal growth in recent past due to biotechnological application, innovations in agricultural technologies, development of disease resistant varieties, adoption of plant protection measures including integrated disease management and adaptation/development of crop varieties to suit climatic changes. Globally, wheat, rice, maize, other cereals, pulses, oil seed crops, fiber crops, cash crops, and other such economically important plants have been offering food and nutritional security to world population. However the growing population world over and particularly in developing countries require around 50 % more crop production than the existing food production. Problems of hunger, poverty, malnutrition, and economic crisis arising out of unpredicted growth of world population are to be solved. It is estimated that more than 800 million people will be suffering due to inadequate food supply. Approximately 10 % global food production is lost due to plant diseases caused by fungi, bacteria, viruses, mycoplasma, nematodes, and others.

Fungal diseases cause huge losses in crop yields thus affecting world economy and causing shortage of food. The late blight of potato in 1840 caused by *Phytophthora infestans* in Ireland and Europe has been a bolt from the blue, causing a million deaths of starvation and more than a million tried to migrate. Coffee rust in Ceylon, Great Bengal famine in 1943 caused by *Cochliobolus miyabeanus* in rice and southern corn leaf blight during 1970–1971 in the USA caused by *Cochliobolus heterostrophus* have emphasized the role of fungi affecting crops. The control of plant pathogens has become a problem because their populations are variable in time and space. Accurate identification of the pathogen, proper estimate of the severity of disease, impact on crop productivity, recognition of virulence mechanisms, host–pathogen interaction, inoculum, potential, epidemiological aspects, role of environmental/meteorological conditions, and related issues and challenges are of utmost importance.

Incidence of crop diseases can be minimized by reducing pathogen inoculum, inhibition, or inactivation of virulence strategies, and also by prevention of genetic diversity in the crop and conventional breeding mechanism for resistance, as it is

facilitated by marker-assisted selection. The transgenic approach and its modification with gene that offer resistance will also offer crop protection to disease.

Approximately 700 viruses are reported to cause devastating diseases in crop plants and often possess wide host range. Pathogenic bacteria belonging to several genera are reported to infect crop plants and cause huge losses in yield. Pathogenic Xanthomonads are reported to cause 350 and above plant diseases. Interesting problems of disease epidemics, distribution of fungal inoculum, failure to combat certain diseases and related issues or challenges are more in tropics and remain as unsolved.

It is predicted that world's population will be 8.3 billion by 2030 and it represents a global challenge to meet the requisite food demand. In this contest crop protection is a necessity in order to achieve greater crop productivity by the use of fungicides and pesticides. The future challenges to be taken in this area are as follows: (1) Concern for environment and public safety. (2) Tackling problem of fungicide resistance. (3) Novel modes of action. However the future success of disease control using fungicides will depend on maintaining a major commitment to research and field experiment database. Integrated disease management, through well-thought disease management practices and IPM to become sustainable approach in crop protection, it must integrate the rational and environmental friendly safe use of chemical control products. Modern disease diagnostic tools may also help in the proper use of fungicides.

A number of microbial and fungal bio-agents, non-fungicidal chemicals, and many other practices will help in the induction of resistance in the crop plants. Thermolabile genes have been identified in crop plants and it is essential to evaluate the effect of such genes in the tolerance of temperatures. Transgenic resistance can be achieved by modifying the plants with resistance imparting transgenes derived from either pathogens/host or other sources. Suppression of disease cum disease-causing pathogens forms the key factor in healthy and vigorous growth of plant. This can be achieved by enhancing beneficial and antagonistic microbes and fungi which probably balance the disease resistance and nutrient supply to the host plant. This has a positive effect on plant's vitality and resistance level. Exclusion of pathogens through plant quarantines is the first step towards reducing the pathogen inoculum followed by healthy and good cultural practices (crop rotation, phytosanitation, maintaining soil health, etc.) besides judicious use of fungicides, exploiting gene pools of plants in relation to breeders programme of disease resistance, combating virulence, improving plant performance, and maintaining genetic diversity in crop plant which has overriding importance.

Plant pathogens create even more problems, challenges, and issues for achieving global food security and some are listed below:

1. There is no database of many damaging pathogens that currently exist.
2. Measurement of the severity of disease symptoms is often subjective and qualitative rather than objective and quantitative.
3. Prediction of obtainable yields needs to be on scientific basis as the globe has witnessed many failures.

4. Scientifically accurate data has to be generated in the field of inoculum quality, its multiplication, virulence, effectiveness, and spread along with innovation of disease forecasting methodologies and creation of models.
5. It is necessary to know the potentiality of most dangerous plant pathogens that are genetically variable.
6. Problems in predicting the origin of next generation plant pathogens.
7. To face the unplanned shocks from pathogens which have evolved new virulence.
8. Minor diseases have become major and one has to know more about them.
9. Strengthening of integrated disease management along with varieties performing well in all geographic regions of a country or globe along with their tolerance to different agroclimatic conditions/soil conditions and levels of disease tolerance.
10. Expectation on the role of climate change with reference to plant pathogens and crop protection.
11. Success rate of transgenics in crop protection and global food security.
12. Farmers need to be educated about crop protection practices including IDM and use of biocontrols agents along with their demonstration in field.
13. More information is essential about abiotic stress upon plant pathogens and also during process of crop protection.
14. Implications involved in the application of nanotechnology for crop protection.
15. Positive and negative impacts of organic farming in relation to crop production and crop protection.
16. Creation of global network of stake holders in crop protection.
17. Creation of proper and modern disease diagnostic tools which are less time consuming and scientifically accurate.
18. Regular review of plant quarantines and other regulations/legislations of crop protection.
19. Culturing of non-culturable plant pathogens.
20. Strengthening of studies on biodiversity, conservation, taxonomy, and control of plant pathogenic fungi.
21. Data strengthening through application of bioinformatic tools including transcriptomics, proteomics, metabolomics, and other aspects of phytopathogens besides the application of DNA-based assay.
22. Elaborated studies are to be made on immunological and molecular detection of plant pathogens.
23. Reliable identification of the causal organisms of disease to the level of species, formae specialis, pathovar, biovar, and races.

Basic and applied/advanced research in the above aspects will pave the way in understanding intricate problems associated with host–pathogen interaction and pathogen biology in offering solutions pertaining to crop protection.

This book has got 12 chapters emphasizing the issues and challenges of crop pathogens and plant protection. Each chapter has been written by experienced and

internationally recognized scientists in the field. The topics have been assembled with basic and advanced knowledge in such a way that it will be useful to the beginner as well as to experienced scientists. The need for this kind of books/volume has become imminent as no such book has been published on these aspects. The chapters in this volume include new approaches, new knowledge, and worthy information.

We are grateful to Series Editors-in-Chief Dr. V. K. Gupta and Dr. Maria Tuhoy, Editor (Botany) Eric Stannard, Developmental Editor Elizabeth Orthmann, and others concerned with Springer for their help in various ways. Many minds have helped in the preparation of this volume to which we are indebted. We are grateful to all the contributors for their concern and concerted effects in making knowledge volume. Since the chapters have been independent, written by the author(s), there may be minor overlap or repetition; it is difficult to avoid at this stage.

It is our earnest hope that information presented in this book/volume will make a valuable contribution to the science of Plant Pathology. We believe and trust that it will stimulate further discussions in the pursuit of new knowledge. We also hope that it will be useful to all concerned.

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