Principles in Plant Microbe Interaction for Sustainable Agriculture

edited by
KALAIVANI NADARAJAH

Penerbit Universiti Kebangsaan Malaysia
Bangi • 2024
www.ukm.my/penerbit

Cetakan Pertama / *First Printing*, 2024

Diterbitkan di Malaysia oleh / *Published in Malaysia by*
PENERBIT UNIVERSITI KEBANGSAAN MALAYSIA
43600 UKM Bangi, Selangor Darul Ehsan, MALAYSIA
www.ukm.my/penerbit
e-mel: penerbit@ukm.edu.my

Penerbit UKM adalah anggota / *is a member of the*
MAJLIS PENERBITAN ILMIAH MALAYSIA /
MALAYSIAN SCHOLARLY PUBLISHING COUNCIL
PERSATUAN PENERBIT BUKU MALAYSIA /
MALAYSIAN BOOK PUBLISHERS ASSOCIATION
No. Ahli / *Membership No*. 198302

Atur huruf oleh / *Typeset by*
PENERBIT UNIVERSITI KEBANGSAAN MALAYSIA
43600 UKM Bangi, Selangor Darul Ehsan, MALAYSIA

Dicetak di Malaysia oleh / *Printed in Malaysia by*
PEWARIS GEMILANG SDN. BHD.
No. 27G, Jalan Putra 8, Taman Kajang Putra,
43000 Kajang, Selangor Darul Ehsan, MALAYSIA

Cataloguing-in-Publication Data

Perpustakaan Negara Malaysia

A catalogue record for this book is available from the National Library of Malaysia

ISBN 978-629-486-233-3

Contents

Preface

Comprehending the complex interactions between microbes and plants has become essential in the pursuit of sustainable agricultural practices. In-depth examination of concepts, application and possible benefits that come from understanding and applying the knowledge garnered in plant microbe interaction is crucial for the future of sustainable agriculture. A plethora of complex chemical, cellular, and ecological interactions have been revealed as our understanding of the beneficial and non-beneficial relationships between plants and microbes has grown dramatically in recent decades. The interdisciplinary nature of this book emphasizes the interconnectedness of biology, genetics, ecology, and agronomy in the the study of plant microbe interactions. This book aims to close the knowledge gap between basic science and real-world application by offering a thorough and comprehensive guide for all readers by combining theoretical underpinnings, experimental techniques, and practical applications. This book will appeal to scientists, students and readers interested in understanding the role microbes in agriculture. The content of the book is provided in brief below.

The journey begins with Chapter 1, delving into the fundamental Principles in Plant-Microbe Interaction for Sustainable Agriculture. It sets the stage for subsequent chapters, providing a solid theoretical foundation for readers from various backgrounds, whether researchers, students, or practitioners.

Chapters 2 and 3 navigate the microcosms of the Rhizosphere and Phyllosphere, respectively, unraveling the unique dynamics of plant-microbe interactions in these critical niches. These insights pave the way for a nuanced understanding of the ecological intricacies that influence plant health and growth.

Moving beyond the dichotomy of pathogenic and non-pathogenic interactions, Chapters 4 and 5 explore the myriad of ways in which plants and microbes collaborate or engage in conflict. Non-pathogenic interactions offer promising avenues for sustainable agriculture, while pathogenic interactions underscore the challenges that must be overcome to ensure crop health and productivity.

Chapter 6 zooms in on Plant Defense Mechanisms, deciphering the physical and biochemical strategies plants employ to ward off microbial threats. Chapters 7 and 8 unravel the intricate Signaling Mechanisms in Microbe Triggered Immunity and Elicitor Triggered Immunity, shedding light on the molecular dialogues that govern plant responses to microbial challenges.

Chapters 9 and 10 shift the focus to the positive sides of the interaction spectrum, exploring the potential of Plant Beneficial Microbes and Microbiome Engineering for Agriculture. These chapters showcase how harnessing the power of beneficial microbes can enhance plant growth, nutrient uptake, and overall resilience.

The latter portion of this book explores cutting-edge approaches to enhancing plant resistance. Chapters 11, 12, and 13 delve into Transgenics for Plant Resistance, Breeding for Tolerance to Diseases using Marker-assisted Selection and QTL Approach, and Breeding Plant Biotic Resistance Through Genome Editing, respectively. These chapters showcase the evolving landscape of biotechnological interventions aimed at creating crops with enhanced resistance to pests and diseases.

As we navigate these chapters, we hope readers will find inspiration, knowledge, and practical insights to contribute to the ongoing revolution in sustainable agriculture.

The authors would like to thank Universiti Kebangsaan Malaysia for the use of the research facilities within UKM. We would also like to acknowledge funding agencies for their support of the work reported in this book. Chapters 2 and 3 of this book are supported by Ministry of Higher Education, Fundamental Research Grant Scheme FRGS/1/2019/STG03/UKM/02/2. Chapters 4 and 5 are supported by Ministry of Higher Education's, Fundamental Research Grant Scheme FRGS/1/2020/STG03/UKM/02/1, and Universiti Kebangsaan Malaysia's DIP-2019-022, GGPM-2017-071 and GUP-2022-044. Chapters 7 and 8 are supported by ESciencefund MOSTI 02-01-02-SF0139, 02-01-02-SF0757, and 02-01-02-SF1232. While Chapters 9, 10 and 13 are supported by Ministry of Higher Education's, Fundamental Research Grant Scheme FRGS/1/2023/STG01/UKM/01/1 and FRGS/1/2019/STG03/UKM/01/2. Chapter 11 is supported under Ministry of Higher Education's, Fundamental Research Grant Scheme FRGS/1/2020/STG01/UKM/02/6. Lastly, Chapter 12 is supported under UKM's Internal Research Grant GGPM-2022-034. In

addition, we thank Jonathan Guyang Ling for his assistance in compiling the book. The authors would also like to thank *Jurnal Sains Malaysiana* for their support of this publication.

Kalaivani Nadarajah