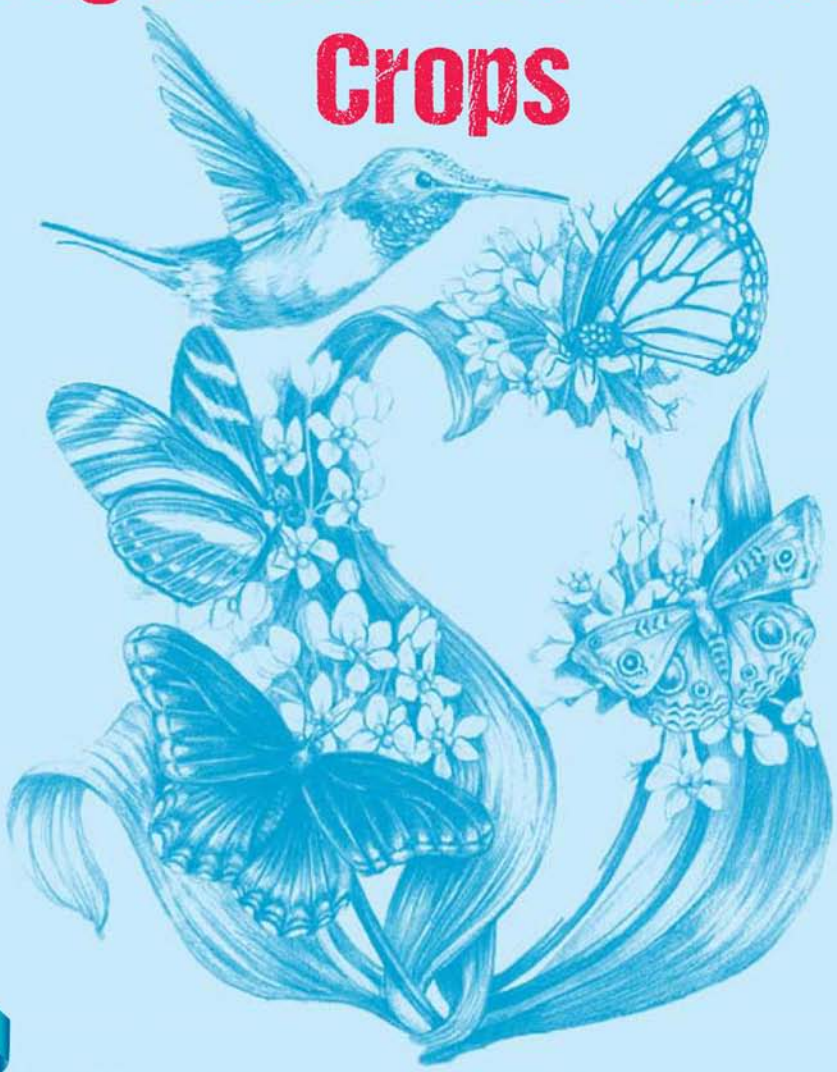
Pests and Pollinators of Vegetable and Oilseed Crops



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PESTS AND POLLINATORS OF VEGETABLE AND OILSEED CROPS

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Dedication

I dedicate this book in the everlasting memory of my respected brother late Sh. Raj Kumar, who was a man with broad vision, open heartness, humanity, modesty and vigour. His memory encourages me to strive to the best of my ability to follow in his foot steps. I ofter this book dedicating to his pure soul and everlasting immortal memory.

M.S. SWAMINATHAN RESEARCH FOUNDATION

M.S. Swaminathan
Founder Chairman
Ex-Member of Parliament (Rajya Sabha)

29 November 2017

Foreword

Fruits and vegetables play a significant role in economic development, nutritional security, employment generation and overall economic growth of a country. They provide a dynamic tool for enhancing economic returns, creating employment avenues and ensuring ecological sustainability. The widespread use of pesticides in modern agriculture throughout the world has become necessary for the protection of the plants against insect pests and diseases to obtain higher yields to meet the food requirement of an increasing population, but the injudicious use of pesticides has resulted in contamination of agro-ecosystem and agriculture produce including nectar and pollen and caused heavy losses to the pollinators.

Most of the vegetable crops are highly cross-pollinated and depend upon insects or benefit from insect pollination for fruit set. Insect pests, on the other hand, cause major economic damage not only quantitatively but qualitatively rendering the vegetable unfit for marketing. Evidently, pest management in vegetable crops on the one hand and providing safety to the pollinators on the other is a challenging task in the context of increasing vegetable productivity without upsetting the ecological balance. The book Pests and Pollinators of Vegetable and Oilseed Crops aims to integrate and develop pest control strategies in a way to minimize their impact on beneficial insect species such as natural enemies and pollinators to enhance fruit production and quality.

The book Pests and Pollinators of Vegetable and Oilseed Crops covers interplay between pest management strategies and safety of pollinators in vegetable crops. Detailed information is provided on pests and pollinators of vegetable and oilseed crops.

The aim of this book is to fill the gap by providing the synthesis and critical analysis of different management strategies having a bearing on agriculture, sustainability and environmental protection. The proposed book provides complete information and fulfils the gap in literature, putting all the information about vegetables in one book. The present publication is an excellent reference book for students, teachers, researchers, extension functionaries and policy makers.

The book aims to promote a large, diverse, sustainable and dependable bee pollinator workforce that can meet the challenge for optimizing food production well into the twenty-first century. I congratulate the author for his efforts to provide the timely contribution.

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Preface

Fruits and vegetables play a significant role in economic development, nutritional security, employment generation and overall economic growth of a country. They provide a dynamic tool for enhancing economic returns, creating employment avenues and ensuring ecological sustainability. Production constraints include two diverse but mutually interlinked approaches such as attack of pests on the one hand and inadequate pollination on the other. The widespread use of pesticides in modern agriculture throughout the world has become necessary for the protection of the plants against insect pests and diseases to obtain higher yields to meet the food requirement of an increasing population, but the injudicious use of pesticides has resulted in contamination of agro-ecosystem and agriculture produce including nectar and pollen and caused heavy losses to the pollinators. Such contaminated nectar and pollen when brought to hive may cause damage to brood besides the contamination of the stored honey.

The world human population disproportionately growing at an alarming rate is a major challenge facing agriculture in the twenty-first century. The human population has already crossed the seven billion mark and is expected to rise to nine billion or more during the middle of this century requiring raising of food productivity by some 70–100 % through horizontal expansion. Production in the developing countries would have to be doubled as compared to the present. The cropping systems and pollinator demographics are changing throughout the world, and any deviation in pollinator sufficiency will prove increasingly inadequate for meeting the demands for an abundant, high-quality food supply in the twenty-first century. Evidence for decline of pollinators throughout the world is a matter of serious concern for agricultural productivity. It is manifestly clear that bee pollinators are a valuable and limited natural resource that should be conserved and encouraged at all costs. This awareness owes its origin to an apparent decline of domesticated honeybees throughout the globe due to several causes such as attack of parasitic mites such as *Varroa destructor,* which has a devastating effect. The parasite occurs now in every continent on which *A. mellifera* is kept, except Australia, and it is considered the most serious health threat to apiculture.

Most of the vegetable crops are highly cross-pollinated and depend upon insects or benefit from insect pollination for fruit set. Insect pests, on the other hand, cause major economic damage not only quantitatively but qualitatively rendering the vegetable unfit for marketing. Evidently, pest management in vegetable crops on the one hand and providing safety to the pollinators on the other is a challenging task in the context of increasing vegetable productivity without upsetting the ecological balance. The book *Pests and Pollinators of Vegetable and Oilseed Crops* aims to integrate and develop pest control

strategies in a way to minimize their impact on beneficial insect species such as natural enemies and pollinators to enhance fruit production and quality.

The book *Pests and Pollinators of Vegetable and Oilseed Crops* covers interplay between pest management strategies and safety of pollinators in vegetable crops. The introductory chapter gives an overview of pest problems and pollinator needs of the crops followed by information on pollination scenario and mechanism of pollination in vegetable crops. Detailed information is provided on pests and pollinators of oilseed crops, Cruciferous, Solanaceous, Umbelliferous, Cucurbitaceous, Malvaceous Leguminous and Alliaceae crops.

The aim of this book is to fill the gap by providing the synthesis and critical analysis of different management strategies having a bearing on agriculture, sustainability and environmental protection. The compilation of this book is unique in the sense that it does not deal with the conventional way of discussing pest management for different crops but also takes into consideration the role of pollinators and their profitable utilization in the larger context of ecologically based pest management for management of pests on the one hand and safety of pollinators on the other.

Though number of books on pests as well as pollinators on vegetable and oilseed crops are available, they have a limited approach covering one aspect or the other. The proposed book provides complete information and fulfils the gap in literature, putting all the information about vegetables in one book.

The goal of this book is to synthesize the latest scientific literature into principles and practices that are relevant to workers in crop pollination in tropical and temperate areas. The book aims to promote a large, diverse, sustainable and dependable bee pollinator workforce that can meet the challenge for optimizing food production well into the twenty-first century.

A vast spectrum of people has helped in one way or the other in the writing of this book, which would have remained a distant dream without their active help and support. This book is the outcome of my personal experiences and the contributions of several workers which have been incorporated. I express my humble and profound thanks to all of them whose hard work has enabled me to compile the suitable information in such a manner that it would be useful to those interested in basic and applied pollination and pest management. The illustrations and figures are either original or redrawn from other sources, which have been cited individually in the figure legends. All the authors whose work has been used/referenced deserve special appreciation and heartiest acknowledgements. I am particularly thankful to Professor Dr. Raghavendra Gadagkar, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, who has always been a source of inspiration, needed help, guidance and encouragement. I thank my university authorities for the excellent working atmosphere and needed encouragement for compiling such a voluminous book. I also thank Dr. Uma Shankar and Dr. Debjyoti Chatterjee for their help and support. I am also extremely thankful to Scientific Publishers Jodhpur, India who took great pains and keen interest in the publication of this book in a very impressive way. I am also highly thankful to Prof. Dr. M. S. Swaminathan, the father of green revolution in India, for writing the foreword of this book.

Last but not the least, my sincere thanks are due to my wife Professor Dr. Asha Abrol, daughter Er. Vitasta and son Er. Rajat for their endurance and help while writing this book.

Jammu, India **D.P. Abrol**

Contents