AGRICULTURAL INSECT PESTS AND THEIR CONTROL

Second Revised and Enlarged Edition

V.B. Awasthi
M.Sc., Ph.D.
Former Associate Professor
Department of Zoology
J.N.V. University, Jodhpur 342 001, India
PREFACE
(2nd Edition)

I would like to thank both the teachers and the students of entomology for accepting whole heartedly the first edition of Agricultural Insect Pests and Their Control. In this, second edition, three new chapters viz., (1) Ecological tactics for management of insect pests, (2) Molecular techniques and habitat manipulation for parasitoid conservation in cropping systems and (3) Pests of Spices, Narcotics and Drugs have been added. Also at appropriate places in the text some minor corrections/alterations have been made. A large number of new illustrations have been reproduced along with original sources which were not available at the time of first edition. The selected bibliography has been updated. I hope the readers of agricultural entomology will find this edition of book more useful.

Jodhpur                     Dr. V.B. AWASTHI
This book has been written keeping in view the requirements of the students of Agricultural Entomology of various Indian Universities. The book provides a brief account on the structure, function, development and metamorphosis and a comprehensive account on almost all the methods of pest control (viz.: cultural control, physical and mechanical control, biological control including genetic sterile male methods, insect hormones as pesticides; plant quarantine and legal control, chemical control and integrated pest management). The various appliances used in the pest management have also been given. The nature of damage caused by the major insect pests of crops, their life histories and control that have been described are: Polyphagous pests, pests of cotton and fibre crops, pests of sugarcane, pests of oilseed crops, pests of pulse crops, pests of sorghum, pests of cereal crops, pests of fruits and fruit trees, pests of vegetables, pests of plantation crops, pests of soybean, insect and some other pests of floricultural crops and pests of stored grains.

Further, so far published books on Applied or Agricultural Entomology provide no information on the insect pests of soybean which has been considered as a "wonder crop" in India. Because it incorporates the qualities of pulses, oilseeds and vegetables and thus meeting important basic requirements of oil, protein and vegetables needed by man.

Some minor pests have also been described because at times, when the climatic conditions are favourable, their food habit changes and they may become injurious to several crops. It is interesting to note that the population dynamics and the outbreak of the insects in the pest form are directly influenced by (1) temperature, (2) humidity, (3) food, and (4) shelter in addition to several other factors which also control the survival and dispersal of pest species, in a particular area. This is very common in oligophagous and polyphagous insects.

Further, I would like to mention here that several chlorinated hydro-carbon insecticides like DDT, BHC aldrin, dieldrin etc, used in the past have recently been banned. In the control of pests, only those insecticides have been given that described in authentic books.

In the book, only from historical point of view, account of some of the chlorinated hydrocarbon-insecticides has been given under the footnote
"banned". Likewise, several organophosphorus compounds, systemic insecticides and fumigants are also not in use in pest control now a days.

It is hoped that the students of Entomology of Agricultural Universities and Colleges will find the book extremely useful. The book will also be useful to the Plant Protection Departments and similar Institutions. A large number of figures have also been given to facilitate easy identification of the insect pests. In the appendixes the common names and trade names of some insecticides, as well as characteristics of insect orders and their agricultural importance have been given. Every attempt has been made to provide all the necessary information that is needed by the students of Agricultural Entomology and here I would like to cite Robert E. Pfadt (1962):

"As one may surmise from what has been said, text books are not the best places for anyone to seek the latest in insect control recommendations. On the other hand, texts do serve an important role in providing both a background of information on insects, their habits, life histories, and ecology and an appreciation of the insect problems on various crops and how we go about solving these problems."

In the course of compilation of the text material several books, journals, technical bulletins, research papers and review articles have been consulted. I express my sincere thanks to the authors, publishers, reviewers and scientists whose work form the base of the book.

I am thankful to my friend Dr. Allah Noor Khan, Associate Professor of Agricultural Entomology, A.R.S. Mandore, Jodhpur for going through the manuscript and offering valuable suggestions.

I am grateful to the authorities of Scientific Publishers (India), Jodhpur, Shri Prahlad Rai Sharma and Shri Pawan Kumar Sharma for their keen interest in my work and publishing the book nicely.

I am also extremely thankful to my wife Sneh Lata and son Dr. Santosh Kumar for their constant encouragement and whole hearted support.

I am particularly grateful to my daughter Shubha, for reading the proof and suggesting necessary corrections.

I would appreciate if readers of the book will inform me of any errors or omissions that may come to their notice.

Jodhpur Dr. V.B. AWASTHI
27th March, 2007
CONTENTS

Preface 2nd edition  v

Preface 1st edition  vii

1 Introduction 1
2 Insects: structure and function 5
3 The development and metamorphosis 37
4 Cultural control 43
5 Physical and mechanical control 47
6 Biological control 49
7 Insect hormones as pesticides 62
8 Plant quarantine and legal control 67
9 Chemical control 70
10 Insecticide application equipment 89
11 Integrated pest management 94
12 Biological tactics for management of insect pests 102
13 Molecular techniques and habitat manipulation for parasitoid conservation in cropping systems 107
14 Polyphagous pests 118
15 Pests of cotton and fibre crops 127
16 Pests of sugarcane 141
17 Pests of oilseed crops 149
18 Pests of pulse crops 161
19 Pests of sorghum 170
20 Pests of cereal crops 173
21 Pests of fruits and fruit trees 188
22 Pests of vegetables 210
23 Pests of plantation crops 223
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Pests of soybean</td>
<td>232</td>
</tr>
<tr>
<td>25</td>
<td>Insect and other pests of floricultural crops</td>
<td>240</td>
</tr>
<tr>
<td>26</td>
<td>Pests of stored grains</td>
<td>250</td>
</tr>
<tr>
<td>27</td>
<td>Pests of spices, narcotics and drugs</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Selected Bibliography</td>
<td>276</td>
</tr>
<tr>
<td></td>
<td><strong>Appendix I</strong> – The common names and trade names of some insecticides</td>
<td>284</td>
</tr>
<tr>
<td></td>
<td><strong>Appendix II</strong> - Characteristics of insect orders and their agricultural importance</td>
<td>285</td>
</tr>
<tr>
<td></td>
<td><strong>Index</strong></td>
<td>291</td>
</tr>
</tbody>
</table>
About the Book

This book has been mainly written keeping in view the requirements of the students of Agricultural Entomology of various Universities. The book provides a brief account on the structure, function, development and metamorphosis, and a comprehensive account on almost all the methods of pest control. The nature of damage caused by the important insect pests of crops, their life histories and control have been described. It is hoped that the students of Agricultural Entomology, will find the book extremely useful. The book is also useful to the Plant Protection Departments and similar Institutions. The book will also be useful to those who are preparing for competitive examinations conducted by various central and state Government agencies for recruitment. Every attempt has been made to provide necessary information from the point of view of students of Agricultural Entomology, which is not available in other books.

Dr. Vidya Bhushan Awasthi, Former Associate Professor of Zoology, J. N. V. University, Jodhpur, born on 7th August, 1940 in the village Sumerpur, Distt. Unnao, UP and received his B.Sc., M.Sc. and Ph.D. Degrees from the University of Gorakhpur.

He worked on insect neuroendocrinology and published 70 research papers and review articles in the prestigious journals of international repute. He is internationally recognised as an Eminent Insect Endocrinologist. He is also the author of three other books viz.: Introduction to General and Applied Entomology, Principles of Insect Behaviour and Insect Neuroendocrines.

He is on the panel of experts of several Universities and referee of a number of prestigious journals. A number of students have received Ph.D. Degrees under his supervision and guidance.


His fundamental work on insect endocrines has been appreciated by the prominent Insect Physiologists and Endocrinologists some of them are Prof. V.B. Wigglesworth, Prof. Berta Scharrer, Prof. G. Fraenkel, Prof. M. Gersch, Prof. H. Mislin, Prof. A. Girardie, Dr. M. Raabe, Prof. B. Johnson, Prof. W. Weber and many others.