Insect Pathology

– Textbook and Practical Manual –

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SCIENTIFIC PUBLISHERS

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PREFACE

This work is originally destined principally for the use of students enrolled in the course in Insect Pathology being given at the Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Allahabad. The need of a concise textbook in this subject felt necessary as not only did the students find the literature on the diseases and other pathological conditions of insects, but also no reasonably complete treatment of the subject from the student's standpoint was available. To fill this need is the first objective of this project.

Considering the field as a whole, however, it was realized that, in addition to a textbook for classroom use, the subject was also greatly in need of a reference work. For most of the information the research worker has been forced to consult widely scattered and often almost inaccessible articles or incomplete accounts in larger volumes. In 1946 Edward A. Steinhaus published "Insect Microbiology," purely a reference book, dealing in a general way with the microbiology of insects. Way back in 1949, Edward A. Steinhaus published first edition of “Insect Pathology,” which is vast and immensely cover the subject. Since then, so much advancement has been made in the subject that should need to be incorporated. Accordingly, the author kept his attention to the preparation of the present book, which deals specifically with insect pathology, *i.e.,* with the microbial diseases of insects as well as with certain amicrobial diseases, injuries, and abnormalities. The task has not been an easy one. The accomplishments of workers in this field frequently are difficult to evaluate and present in a logical, easily readable form. Also, the field of insect pathology is much larger than most persons realize. Furthermore, the subject matter is peculiarly difficult to present both as a textbook and as a reference book. This nevertheless is what authors have attempted to accomplish.

Although, pertinent references have been cited throughout the book, no attempt has been made to make the volume completely bibliographic. The literature contains over 250 odd references dealing with the diseases of insects. However, care has been taken to list those references which will lead the reader to most of the significant contributions made in each particular phase of the subject.

Chapters 1 and 2, dealing with the introduction and history of insect pathology, have intentionally been held to a minimum, and the emphasis of the book has been placed on the microbial diseases of insects. A substantial portion of Chapters 5 and 7 may be considered as belonging to the fields of insect

physiology and insect toxicology, respectively. Nevertheless, the pathologies and abnormalities concerned are too frequently ignored by textbook writers in these fields. Since it is important for purposes of orientation that the student in insect pathology be fortified with information dealing with a microbic pathologies, a brief discussion of the latter is included in the present work, but the treatment given them is not intended to be comprehensive.

A book of this kind, dealing with several large and distinct groups of microorganisms as well as with insects, is likely to be subjected to peccadilloes concerning the synonymies and forms of names. An attempt to avoid them has been made by following the nomenclature used by the leading authorities in the various fields concerned. In spite of constant vigilance, errors probably have crept in; and, with regard to the book as a whole, we can but echo Chaucer's humble petition that "If there is anything that displeases them [the readers], I pray also that they ascribe it to the fault of my lack of skill, and not to my intention, which would gladly have expressed it better if I had had the skill to do so."

To write a scientific book, it is usually necessary first to have an environment in which such work may be prepared and nurtured. Credit for supplying this environment belongs to Professor **Dr. Sunil Zachariah**, of the SHUATS, Allahabad, who, more than anyone else, made possible not only this book but also provided basic idea of Draft. Without the warm encouragement and kind understanding of Professor Zachariah, the writing of this book probably would not have been attempted.

Authors are also greatly indebted to others who have been generous in their help and advice. For critically reading portions of the manuscript, wish to express my deep appreciation to other colleagues at the SHUATS Allahabad. Authors are particularly indebted to **Dr. Ashwani Kumar** for reading the entire manuscript and thankful to **Dr. Anurag R. Tayde** and **Mr. D. Vamsi Krishna** for providing assistance in writing this project warm heartedly.

Thanks to the numerous persons who provided prints of photographic material and permitted their reproduction in this book. Acknowledgments of these courtesies are made at the places where the material has been used. Also wish to thank **Mr. Suryadatt Pandey,** who painstakingly typed the manuscript, and who assisted in much of the work of indexing.

Authors

Allahabad
October 20, 2019

BEFORE WE START…

Second section of this book describes a number of techniques which will be useful to insect pathologists working in the laboratory. Most of the techniques will be familiar to plant or medical pathologists. The reader is strongly advised to seek advice and assistance from their course teacher or specialists trained in this fields. The techniques described herein assume that the pathologist has access to a reasonably well-equipped laboratory, including autoclave or pressure cooker, microscope, glassware, and chemicals.

To study or identify non-occluded viruses you will need access to an electron microscope. For bacteria and occluded viruses, use a compound microscope with an oil-immersion objective lens. Fungi and protozoa can be observed under a compound light microscope. Nematodes can usually be seen with the naked eye.

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Section - 1
Theory

Chapter 1

INTRODUCTION

The "Insect Pathology" refers to that branch of entomology which deals with the general principles of pathology as they may be applied to insects. In a broad sense, it refers to observations concerning the cause, Symptomatology, and Epizootiology of the diseases of insects, and to a study of the structural, chemical, and functional alterations in the body of the insect resulting from disease or injury. The words "Insect Pathology" may be thought of as referring to insects in a manner similar to that in which "Plant Pathology" refers to plants. (Steinhaus, 1949)

Scope of Insect Pathology

Insects through their diversity in types, numbers, life cycles, and habitats, expose themselves to a large number of pathogens. Whatever goes wrong with an insect may be considered pathology or disease. This aspect will be discussed in details in following chapters of this book.

Insect pathology is a branch of invertebrate pathology. However, its scope and development are much more extensive than other areas of invertebrate pathology because two third of invertebrates are insects. Also, insects are economically and medically more important to human than any other invertebrate; hence a large number of pathologists work in insect pathology than in any other area of invertebrate pathology.

Same as in the case of plant and vertebrate pathologies, the general principal of pathology apply to disease of insect. They involve the etiology (Cause), symptomatology and Epizootiology of disease, and also the structural, chemical and functional alterations that results from disease. In addition to entomology, other sciences, such as virology, bacteriology, mycology, protozoology, nematology, pathology, immunology etc. are closely interrelated in the study of insect disease (Tanada and Kaya, 2012). This means that an insect pathologist should have a very broad background. He or she may be specialized in one or few areas along with a general understanding of the different types of disease in insects.

Interrelation of Insect Pathology with other Branches of Entomology

Perhaps the first apparent application of insect pathology that comes to the mind of the student in entomology is its use in the field of biological control, since insects are subject to diseases just as are other animals, the possibility of

controlling serious insect pests by the dissemination of disease organisms among them not only appears plausible, but in several instances has proved to be entirely possible and practicable. Of even greater significance, than the artificial use of these diseases is the very effective control of insects, that takes place in nature through the agency of disease without the help of man.

Insect pathology may be valuable to economic entomology in ways other than that of artificial biological control. The entomologist studying the ecology of insects frequently finds himself depending on the insect pathology for an understanding of disease outbreak before he can correctly interpret his other observations. Those who rear insects in the laboratory or in insectaries are finding that the control of disease in their insects frequently presents problems for which the field of insect pathology may offer solutions.

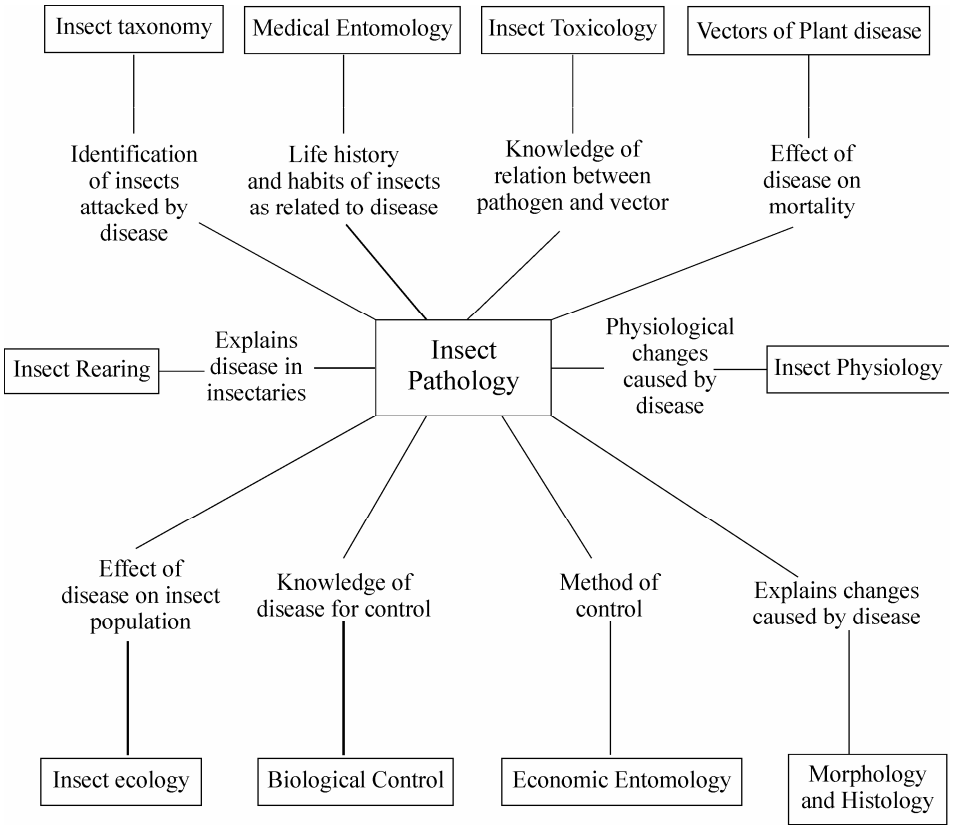

Fig. 1. A diagrammatic representation of the Interrelation of insect pathology with other branches of entomology

The value of insect pathology to medical entomology in particular, and to parasitology generally, is probably fairly obvious, but it is surprising how little correlation is made between the two. One of the basic maxims of insect pathology is the gaining of an understanding of the biological relationships between insects and microorganisms. This is just the type of information and study so greatly needed in medical entomology.