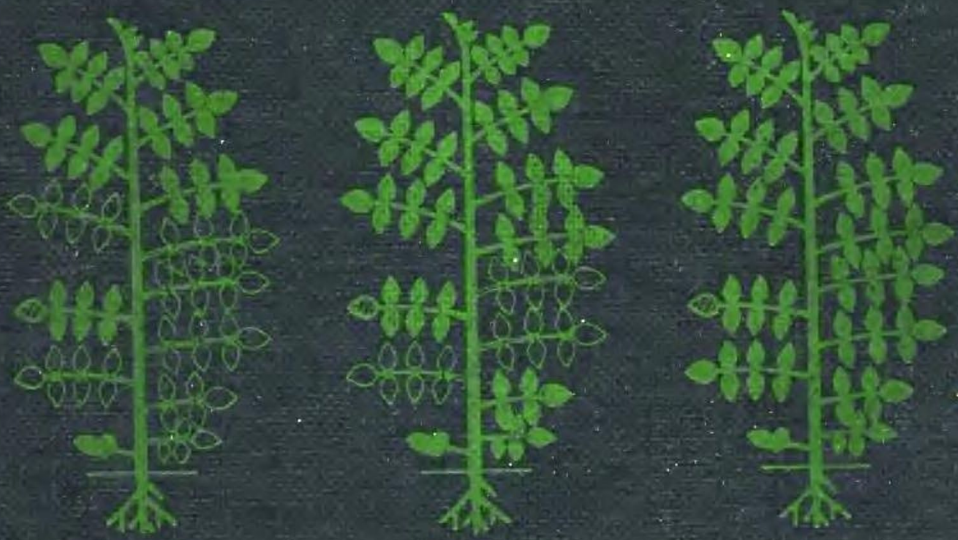
Plant Virology

Third Edition



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Preface

In the 10 years since the second edition was written there have been major developments in the field of plant virology. Most of these developments stem from the application of gene manipulation technology. Two groups of plant viruses have DNA genomes, but the great majority contain RNA. Thus the major influence in the 1980s has been the development of procedures whereby DNA copies of RNA genomes can be made and DNA sequencing techniques applied to them. Complete nucleotide sequences are now known for representatives of over half the groups of plant viruses with RNA genomes. The ability to prepare *in vitro* infectious RNA transcripts of RNA viral genomes from cloned viral cDNA has been of particular importance. For example it has allowed techniques such as site-directed mutagenesis to be applied to the study of genome function. Nucleotide sequence information has had, and continues to have a profound effect on our understanding of many aspects of plant virology. We now know the number, location, size and functions of the genes in many representative viruses.

The ability to introduce DNA copies of single viral genes into the genome of host plants has opened up new possibilities for the control of some important viral diseases. Methods for the assay and detection of viruses and the diagnosis of diseases have improved greatly in sensitivity, specificity and convenience. These advances have been due mainly to advances in serological procedures and in the application of nucleic acid hybridization technology.

The deluge of nucleotide sequence information becoming available opens up the possibility that we can develop a classification system for viruses based on their evolutionary relationships. This sequence information emphasizes more than ever the essential unity that exists between viruses infecting all groups of organisms.

These various developments have led to a very substantial rewriting of most chapters in the text. Some are entirely new. The extent of the changes can be gauged from the following data. Approximately 52% of the written text is new. Much of the remainder has been revised; of the 251 illustrations, 126 are new; of the 21 tables, 20 are new; and approximately 2,000 of the 3,000 references in the bibliography were not in the second edition.

While much of the older material has been deleted for reasons of space, I have

retained many older references to interesting but unexplained biological phenomena, because the technologies for exploring and understanding many of these at the molecular level are now becoming available.

As did the first edition, this volume covers all aspects of the subject from molecular to ecological. The bases for experimental procedures are discussed, but detailed protocols are not provided. The volume is intended primarily for graduate students in plant virology, plant pathology, general virology and microbiology, and for teachers and research workers in these fields. It should also prove useful to some people in related fields such as molecular biologists, biochemists, plant physiologists and entomologists.

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Preface to the Second Edition

There have been substantial developments in many areas of plant virology since the first edition was published.

Advances have been made in all branches of the subject, but these have been most far reaching with respect to the structure of viruses and of their components, and in our understanding of how viral genomes are organized and how viruses replicate in cells. Significant developments have also occurred in our understanding of how viruses are transmitted by invertebrates and in the application of control measures for specific diseases. The taxonomy of viruses has advanced significantly, and there are now 25 internationally approved families and groups of plant viruses. All these developments have required that most sections be entirely rewritten. The extent of the changes can be gauged from the fact that 1881 of the 2667 references in the bibliography did not appear in the first edition.

As did the first edition, this volume is written to cover all aspects of the field, and is intended primarily for graduate students in plant pathology, plant virology, general virology, and microbiology, and for teachers and research workers in these fields. It should also prove useful to some people in related disciplines—molecular biologists, biochemists, plant physiologists, and entomologists.

Preface to the First Edition

As in many other areas of biology, there has been rapid growth over the past few years in our knowledge of plant viruses and the diseases they cause. Thus there was a substantial need for a new text covering all aspects of the subject.

This book was written primarily for graduate students in plant pathology, plant virology, general virology, and microbiology and for teachers and research workers in these fields. I hope that it will also prove useful as a reference work for those in disciplines related to plant virology—molecular biologists, biochemists, plant physiologists, and entomologists.

I have attempted to cover, to some degree at least, all aspects of the subject, a difficult task in view of the wide range of disciplines involved. There is a brief historical account of the development of plant virology in the first chapter, but the general approach is not a historical one. Those interested will find this aspect well covered in earlier texts.

Topics dealt with include the structure of viruses and viral components; the replication of viruses; their macroscopic, cytological, and biochemical effects on the host plant; the nature of virus mutation; relationships with invertebrate vectors; and a discussion of ecology and control. Throughout I have attempted to indicate how progress in any particular area has been dependent on the development and application of appropriate experimental methods. Specific details of methodology have not been given since these are available elsewhere.

The subject has grown to the extent that it would be impossible to quote all papers on any given topic in a book of this size. In general I have referred to important early papers and to the most important or most suitably illustrative recent papers. From these the reader should be able to gain rapid access to the literature on any relevant topic.

In a text on a subject that draws a wide range of scientific disciplines, I believe that illustrative material is most important, particularly for students or newcomers to the field. For this reason I have gone to some pains, and have had the support of many colleagues, in selecting graphs and photographs to highlight and supplement the text.

In certain areas, particularly the molecular biology of viral replication, our knowledge of plant viruses lags behind that of animal and bacterial viruses. I have

therefore drawn on information about these viruses where it seemed appropriate to set the stage for considering more fragmentary facts about plant viruses.

One recent development that created problems was the discovery that many diseases previously thought to be caused by unstable viruses are very probably caused by mycoplasma-like organisms. Although, in general, I have not included diseases in which the probability of a mycoplasma-like organism being involved is high, one chapter on agents causing virus-like diseases is devoted mainly to a consideration of such organisms in plant disease. Other recent work of considerable general interest has resulted in the discovery that several plant viruses have their genetic material divided up between two or more particles. Thus I have devoted a chapter to the consideration of defective virus particles, dependent viruses, and multiparticle viruses.

I have followed the Commonwealth Mycological Institute list of "Plant Virus Names" (Martyn, 1968). I have not attempted to deal with individual viruses or virus diseases in any systematic or comprehensive way, so that the list of "Plant Virus Names" should be regarded as a valuable companion book for the present text, especially for those interested in the tremendous amount of literature on the plant pathological aspects of virus diseases.

In the last chapter I have outlined the various viewpoints regarding nomenclature and classification. Since, from the long-term point of view, at least, classification of viruses must take origins into consideration, some space is given to speculation on the origins of viruses.

Contents