COMPARATIVE PLANT VIROLOGY

SECOND EDITION
BSMV genome: The infectious genome (BSMV) is divided between 3 species of positive sense ssRNA that are designated α, β, and γ. Image courtesy of Roger Hull.

BSMV particles. Image courtesy of Roger Hull.

Diagram showing systemic spread of silencing signal: The signal is generated in the initially infected cell (bottom, left hand) and spreads to about 10–15 adjacent cells where it is amplified. It moves out of the initially infected leaf via the phloem sieve tubes and then spreads throughout systemic leaves being amplified at various times. Image courtesy of Roger Hull.
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This book has been developed from and is a revision to *Fundamentals of Plant Virology* written by R. E. F. Matthews in 1992. Since then major advances have been made in the understanding of the molecular biology of viruses, how they function and how they interact with their hosts. This has revealed similarities and differences between viruses infecting members of the different kingdoms of living organisms, plants, animals, fungi, and bacteria. In this changing environment of teaching virology, this book does not just deal with plant viruses alone but places them in context in relation to viruses of members of other kingdoms.

This book has been written for students of plant virology, plant pathology, virology, and microbiology who have no previous knowledge of plant viruses or of virology in general. An elementary knowledge of molecular biology is assumed, especially of the basic structures of DNAs, RNAs, and proteins, of the genetic code, and of the processes involved in protein synthesis. As some of these students may not have a grounding in the structure and function in plants including the main subcellular structures found in typical plant cells, these features which are important to the understanding of how viruses interact with plants are illustrated. In each chapter there is a list of further reading to enable the student to explore specific topics in depth.

The fifteen chapters in this book can be divided into four major sections that form a logical progression in gaining an understanding of the subject. The first four chapters introduce plant viruses describing: what is a virus, giving an overview of plant viruses, discussing other agents that cause diseases that resemble plant virus diseases, and considering factors that are involved in virus evolution. The points raised in this latter chapter are equally relevant to viruses of other kingdoms. The next four chapters deal with what viruses are made of. The chapter on virus architecture and assembly is also very relevant to viruses of other kingdoms as are the major points raised in chapters on plant virus genome organization, genome expression, and genome replication. The next section on how do plant viruses work is more specific to plant viruses and highlights differences and similarities between virus interactions with plant, animal, and bacterial hosts.
These interactions are described at the plant level (movement of the virus within the plant and effects on plant metabolism) and at the molecular level including a chapter devoted to the newly understood host defence system of RNA silencing. The last four chapters deal with plant viruses and agriculture and industry. The description of how plant viruses move between hosts which often involves specific molecular interactions leads into discussion of the epidemiology of viruses in the field and how they are controlled. The last chapter is on the use of recombinant DNA technology in controlling viruses and also in using them commercially in, for instance, the pharmaceutical and nanotechnology industries.

A unique feature of this book is a series of “profiles” on 32 plant viruses that feature in the text. These profiles describe briefly the major properties of the viruses including their taxonomic position, their biology, their particles, and their genomes. References are given to enable students to acquire even more information on these targeted viruses.

I am very grateful to a large number of colleagues for their helpful discussion on various topics and in providing material prior to publication. I am especially indebted to John Carr, Andy Jackson, Mark Stevens, and Peter Waterhouse for their helpful comments on various sections of the book and on providing illustrative material. My eternal gratitude goes to my wife who has tolerated “piles of paper” around the house and who has given me continuous encouragement.

Roger Hull
Norwich, UK
July, 2008
## List of Abbreviations

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>3’OH</td>
<td>3’ hydroxyl group</td>
<td>HR</td>
<td>Hypersensitive response</td>
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<td>Å</td>
<td>Angström (10⁻¹⁰ meter)</td>
<td>HSP</td>
<td>Heat-shock protein</td>
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<td>AAB</td>
<td>Association of Applied Biologists</td>
<td>ICR</td>
<td>Inter-cistronic region</td>
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<tr>
<td>DPV</td>
<td>Descriptions of Plant Viruses</td>
<td>ICTV</td>
<td>International Committee on the Taxonomy of Viruses</td>
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<tr>
<td>ADP</td>
<td>Adenosine diphosphate</td>
<td>IRES</td>
<td>Internal ribosome entry site</td>
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<td>AR</td>
<td>Aberrante ratio</td>
<td>ISEM</td>
<td>Immunoabsorbent electron microscopy</td>
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<td>ATP</td>
<td>Adenosine triphosphate</td>
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<td>cDNA</td>
<td>Complentary (or copy) DNA</td>
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<td>CI</td>
<td>Cylindrical inclusion</td>
<td>kb</td>
<td>Kilobase</td>
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<td>DdDp</td>
<td>DNA-dependent DNA polymerase</td>
<td>kDa</td>
<td>Kilodalton</td>
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<tr>
<td>D RNA/DNA</td>
<td>Defective RNA or DNA</td>
<td>LRR</td>
<td>Leucine-rich repeat</td>
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<td>DdRNA</td>
<td>Double-stranded DNA</td>
<td>Mab</td>
<td>Monoclonal antibody</td>
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<td>dsDNA</td>
<td>Double-stranded DNA</td>
<td>MP</td>
<td>Movement protein</td>
</tr>
<tr>
<td>dsRNA</td>
<td>Double-stranded RNA</td>
<td>mRNA</td>
<td>Messenger RNA</td>
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<td>EDTA</td>
<td>Ethylene diamino tetra-acetic acid</td>
<td>mRNA</td>
<td>MicroRNA</td>
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<td>ELISA</td>
<td>Enzyme-linked immuno-sorbent assay</td>
<td>MiRNA</td>
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<td>EM</td>
<td>Electron Microscope</td>
<td>MTR</td>
<td>Methyl transferase</td>
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<td>ER</td>
<td>Endoplasmic reticulum</td>
<td>MW</td>
<td>Molecular weight</td>
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<tr>
<td>GTP</td>
<td>Guanosine triphosphate</td>
<td>NBS</td>
<td>Nucleotide binding site</td>
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<td>GM</td>
<td>Genetically modified</td>
<td>NI</td>
<td>Nuclear inclusion</td>
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<tr>
<td>HC-Pro</td>
<td>Helper component protease</td>
<td>nm</td>
<td>Nanometer</td>
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<tr>
<td>HEL</td>
<td>Helicase</td>
<td>ORF</td>
<td>Open reading frame</td>
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<td>PCD</td>
<td>Programmed cell death</td>
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<td>PCR</td>
<td>Polymerase chain reaction (IC-PCR, immune-capturePCR; RT-PCR, reverse transcriptionPCR)</td>
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<td>PDR</td>
<td>Pathogen-derived resistance</td>
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<tr>
<td>Pol</td>
<td>Polymerase</td>
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<td>PR</td>
<td>Pathogenesis-related (protein)</td>
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<td>PRO</td>
<td>Protease</td>
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<td>PTGS</td>
<td>Post-transcriptional gene silencing</td>
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<td>Rb</td>
<td>Retinoblastoma (protein)</td>
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<td>RdRp</td>
<td>RNA-directed RNA Polymerase</td>
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<td>RF</td>
<td>Replicative form</td>
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<td>RFLP</td>
<td>Restriction fragment length polymorphism</td>
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<td>RI</td>
<td>Replicative intermediate</td>
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<td>RISC</td>
<td>RNA-induced silencing complex</td>
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<td>RNAi</td>
<td>RNA interfering</td>
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