

CONTENTS

About the Editors	xiii
Contributors	xv
Preface	xvii
Chapter 1. A Historical Outline of Plant Virology	1
<i>J. P. H. van der Want</i>	
Early Concepts of Virus	1
Virus As Pathogen	3
Virus As Infectious Macromolecule	6
Chapter 2. Plant Virus Taxonomy	11
<i>Mike A. Mayo</i>	
<i>Allan A. Brunt</i>	
Introduction	11
Nomenclature	12
Virus Species	14
Orthography	16
The Current Genera and Families of Plant Viruses	16
The Mechanics of Virus Classification	20
Chapter 3. Symptomatology	23
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Introduction	23
Internally Visible Symptoms	24
Externally Visible Symptoms	25
Chapter 4. Isolation and Purification of Plant Viruses	33
<i>Sara Hughes</i>	
<i>Nicola Spence</i>	
Introduction	33
Plant Material	33
Extraction of Infected Plant Material	34

Clarification of Plant Extract	36
Concentration of the Virus and Further Purification	36
Assaying the Virus in Purified Preparations	38
Maintenance of Purified Virus	38
Case Studies	38
Chapter 5. Architecture of Plant Viruses	43
<i>Ayala L. N. Rao</i>	
<i>Vijay Reddy</i>	
Introduction	43
Capsid Morphology	44
Interactions Promoting Virus Assembly	47
Pathways	49
Genome Packaging	50
Chapter 6. Replication and Gene Expression of Plant RNA Viruses	53
<i>Kook-Hyung Kim</i>	
Introduction	53
Genome Structure	53
Expression Strategies	57
Viruses with Divided Genomes	64
Regulation of Replication	65
Synthesis of RNA	66
Viruses with Incomplete RNA Genomes	70
Concluding Remarks	72
Chapter 7. Replication and Gene Expression of DNA Viruses	75
<i>Crisanto Gutierrez</i>	
Introduction	75
Genome Structure	75
Transcription Strategies	81
Genome Replication	84
Regulation of DNA Replication/Virus-Host Interactions	87
Viruses with Incomplete Genomes	89

Chapter 8. Viroids **93**

Ricardo Flores

Vicente Pallás

Structure	93
Replication	97
Movement	101
Pathogenesis	102
Diseases	103
Diagnosis and Identification	104

Chapter 9. Transmission of Plant Viruses by Arthropods **107**

Dick Peters

Introduction	107
The Vectors	108
The Biology of Aphids	108
Noncirculative Transmission of Viruses by Aphids	112
Viruses Transmitted in the Semipersistent Way	114
Circulative Transmission of Plant Viruses	115
Transmission of Geminiviruses by Whiteflies and Planthoppers	119
Circulative/Propagative Transmission of Plant Viruses	120
Thrips Transmission of Tospoviruses	121
Noncirculative/Circulative Transmission of Plant Viruses by Beetles	123
Virus Transmission by Mites	124

Chapter 10. Plant Virus Transmission: Fungi, Nematodes, and Seeds **127**

Jeanne Dijkstra

Jawaid A. Khan

Transmission by Fungi	127
Contact Between Virus and Fungus	128
Molecular Interactions Between Virus and Fungus	129
Transmission by Nematodes	130
Contact Between Virus and Nematode	130
Molecular Interactions Between Virus and Nematode	131
Seed Transmission	132
Contact Between Virus and Seeds	132

Molecular Interactions Between Virus and Seed	133
Transmission Through Pollen Grains	135
Chapter 11. Mechanical Transmission of Plant Viruses	137
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Experimental Mechanical Transmission	137
Susceptibility of the Test Plant	139
Inoculation of Isolated Protoplasts	140
Natural Mechanical Transmission	140
Transmission by Grafting	141
Transmission by Vegetative Propagation	142
Transmission by Dodder	143
Chapter 12. Serology	145
<i>Marc H. V. van Regenmortel</i>	
Introduction	145
Antibodies	145
Viral Antigens and Epitopes	147
Antibody Production	149
Precipitation Tests	152
Immunodiffusion Tests	153
Enzyme-Linked Immunosorbent Assay	154
Other Immunoassays	154
Serological Differentiation Index	156
Chapter 13. Detection and Identification of Plant Viruses and Disease Diagnosis	157
<i>Francisco J. Morales</i>	
Introduction	157
Detection	157
Identification	161
Diagnosis	166
Conclusion	168
Chapter 14. Ecology and Epidemiology	171
<i>Michael J. Jeger</i>	
Introduction	171
Sources of Infection	172

Vectors and Mode of Spread	173
Epidemiological Cycles of Infection	175
Quantifying Virus Spread	176
Cultural Practices	178
Environmental Conditions	180
Forecasting Disease Development	181
Chapter 15. Recombination in Plant Viruses	185
<i>Chikara Masuta</i>	
<i>Masashi Suzuki</i>	
Introduction	185
Classification of RNA Recombination	185
Natural Recombination	187
Recombination Between Viral RNA and Transgenes	189
Pseudorecombination (Reassortment)	189
Mechanism of RNA Recombination	190
Identification of Recombination	192
Significance in RNA Recombination	194
Recombination in DNA Viruses	195
Chapter 16. Virus Variability and Evolution	199
<i>Fernando García-Arenal</i>	
<i>José M. Malpica</i>	
Introduction	199
Mutation	199
Genetic Exchange	200
Strains	201
Selection	202
Genetic Drift	205
Genetic Polymorphism and Population Diversity	206
Chapter 17. Recombinant DNA Technology in Plant Virology	211
<i>Huub J. M. Linthorst</i>	
Introduction	211
Reverse Genetics	211
Genetic Transformation	212
Transgenic Plants	213

Construction of Infectious cDNA Clones of RNA Viruses	215
Transient Gene Expression	216
Plant Virus Gene Vectors	217
Recombinant Proteins	218
Antibody Expression	219
Chapter 18. Resistance to Viral Infections in Plants	221
<i>Jennifer L. Miller</i>	
<i>Tessa M. Burch-Smith</i>	
<i>S. P. Dinesh-Kumar</i>	
Introduction	221
Resistance-Gene-Dependent Responses	222
Homology-Dependent Resistance Responses	227
Pathogen-Derived Resistance	228
Discussion	233
Chapter 19. Virus Diseases: Economic Importance and Control Strategies	235
<i>A. F. L. M. Derks</i>	
Direct and Indirect Crop Losses	235
Sources of Infection	236
Disease Forecasting	238
Direct Control	239
Indirect Control	240
Vector Control	241
Cultural Practices	242
Breeding for Resistance	244
Transgenic Plants	246
Meristem Tip Culture	247
Virus-Free Stocks	248
Certification Schemes	248
Import and Quarantine	249
Appendix 1. Description of Positive-Sense, Single-Stranded RNA Viruses	253
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Family <i>Potyviridae</i>	253
Family <i>Sequiviridae</i>	263

Family <i>Comoviridae</i>	268
Family <i>Luteoviridae</i>	275
Family <i>Tymoviridae</i>	282
Family <i>Tombusviridae</i>	289
Family <i>Bromoviridae</i>	311
Family <i>Closteroviridae</i>	322
Family <i>Flexiviridae</i>	330
Unassigned Genera	348
Appendix 2. Description of Double-Stranded RNA Viruses	389
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Family <i>Reoviridae</i>	389
Family <i>Partitiviridae</i>	396
Unassigned Genus	399
Appendix 3. Description of Negative-Sense, Single-Stranded RNA Viruses	403
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Family <i>Rhabdoviridae</i>	403
Family <i>Bunyaviridae</i>	407
Unassigned Genera	410
Appendix 4. Description of Single-Stranded DNA Viruses	419
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Family <i>Geminiviridae</i>	419
Family <i>Nanoviridae</i>	424
Appendix 5. Description of Reverse-Transcribing Viruses	431
<i>Jeanne Dijkstra</i>	
<i>Jawaid A. Khan</i>	
Family <i>Caulimoviridae</i>	431
Family <i>Pseudoviridae</i>	438
Family <i>Metaviridae</i>	440
Index	443