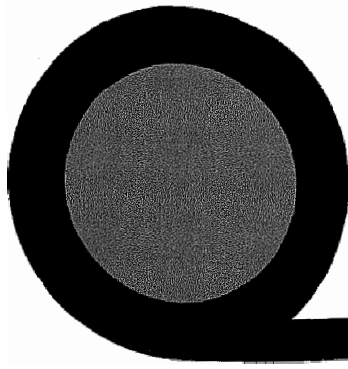




Contents

Preface	xiii
About the Authors	xv
Contributors	xvii
Acknowledgements	xix
Introduction	xxi
PART I GENERAL PLANT PATHOLOGY	1
1 What is a Plant Disease?	3
<i>Anne Marte Tronsmo, Lisa Munk, Annika Djurle, Jonathan Yuen and David B. Collinge</i>	
Introduction	3
The Host Plant	4
The Pathogen	5
Abiotic Stress Factors	7
Koch's Postulates	7
The Disease Triangle	7
Phytobiomes and Microbiomes	9
Impacts of Plant Diseases	9
Further Reading	10
2 History of Plant Pathology	11
<i>Jonathan Yuen, Annika Djurle and David B. Collinge</i>	
Early History of Plant Diseases	11
The Modern Era: Evolution of the Germ Theory	12
Plant Pathology Becomes a Science	15
Further Reading	18
3 The Disease Cycle and Lifestyles	19
<i>Anne Marte Tronsmo, Lisa Munk, Annika Djurle and David B. Collinge</i>	
Introduction	19
Lifestyles in Plant–Pathogen Interactions	19
The Disease Cycle	22
Survival of the Pathogen	32
Monocyclic and Polycyclic Pathogens	34
Further Reading	35

PART II PLANT PATHOGENS	37
4 Plant Pathogenic Fungi	41
<i>Anne Marte Tronsmo, Arne Tronsmo, Hans Jørgen Lyngs Jørgensen and Lisa Munk</i>	
What are Fungi?	41
Classification of Kingdom Fungi (Eumycota)	44
Phylum Chytridiomycota	45
Phylum Zygomycota	46
Phylum Glomeromycota	46
Phylum Ascomycota (Sac Fungi)	48
Phylum Basidiomycota (Club Fungi)	61
From 'Imperfect Fungi' to 'One Fungus, One Name'	73
Further Reading	74
5 Fungal-Like Plant Pathogens	75
<i>Anne Marte Tronsmo, Arne Tronsmo, Hans Jørgen Lyngs Jørgensen and Lisa Munk</i>	
What are Fungal-Like Plant Pathogens?	75
Kingdom Chromista	75
Phylum Oomycota	75
Phylum Cercozoa	84
Kingdom Protozoa	85
Further Reading	88
6 Bacterial Plant Pathogens	89
<i>Paula Persson, Minna Pirhonen and David B. Collinge</i>	
Plant-Associated Bacteria	89
Taxonomy of Plant Pathogenic Bacteria	90
Symptoms Caused by Plant Pathogenic Bacteria	92
Dispersal of Plant Pathogenic Bacteria	95
Stages of Infection	95
Infection Mechanisms and Pathogenicity Determinants	97
Lifestyles of Model Plant Pathogenic Bacteria	98
Important Bacterial Diseases	101
Further Reading	106
7 Plant Viruses	107
<i>Dag-Ragnar Blystad, Anders Kvarnheden and Jari Valkonen</i>	
What is a Plant Virus?	107
Plant Virus Genera and Families	109
The Virus Infection	113
Symptoms in Plants	115
Detection and Identification	116
Virus Transmission and Epidemiology	121
Control of Plant Viruses	126
Further Reading	131



8 Nematodes as Plant Pathogens	132
<i>Christer Magnusson</i>	
General Characteristics of Nematodes	132
Systematics of Plant-Parasitic Nematodes	134
Morphology of a Plant-Parasitic Nematode	134
Feeding Groups of Plant-Parasitic Nematodes	136
Plant-Parasitic Nematodes as Plant Pathogens	149
Field Symptoms of Nematodes	152
Nematodes as Parts of Disease Complexes	159
Plant Resistance	160
Nematode Management	162
Further Reading	163
9 Diagnosis of Plant Diseases	164
<i>Lisa Munk, David B. Collinge, Annika Djurle and Anne Marte Tronsmo</i>	
Introduction	164
Abiotic Causes of Disorders	166
Koch's Postulates	170
Classical Procedures for Diagnosis	171
Detection of Seedborne Pathogens	175
Molecular Diagnosis Using Laboratory Facilities	175
In-field Diagnostic Tests	179
Diagnostic Laboratories and Plant Clinics	180
Further Reading	180
Part III PLANT–PATHOGEN INTERACTIONS FROM GENES TO POPULATIONS	183
10 Mechanisms of Pathogenicity	185
<i>David B. Collinge and Philip Taylor</i>	
Why Study Pathogenicity?	185
Pathogenicity Genes and their Products	185
The Pathogenicity Factors	189
Further Reading	203
11 Plant Defence Against Pathogens	205
<i>David B. Collinge</i>	
Disease Resistance and Defence Against Pathogens	205
Physical Barriers	207
The Hypersensitive Response: Programmed Cell Death	209
Antimicrobial Metabolites: Phytoalexins and Phytoanticipins	209
Antimicrobial Proteins	212
Genes/Proteins of Unknown Function	213
Further Reading	214
12 Race Specificity and Plant Immunity	216
<i>David B. Collinge</i>	
The Regulation and Inheritance of Plant Defences	216
Plant Immunity	216

Cloning of Resistance Genes	222
Mutation as a Tool for Studying Disease Resistance	229
Further Reading	232
13 Population Genetics in Plant-Pathogen Interactions	234
<i>Jonathan Yuen and Lisa Munk</i>	
Introduction	234
Definitions	234
Population Biology of Plant Pathogens	235
Genetic Structure of a Pathogen Population	235
Measurement of Genetic Variation in Pathogen Populations	236
The Five Evolutionary Forces	238
Population Genetics of <i>Phytophthora infestans</i>	239
Population Genetics of Rusts	240
Further Reading	242
14 Epidemiology: Disease in Plant Populations	243
<i>Jonathan Yuen and Annika Djurle</i>	
What is Epidemiology?	243
Monocyclic Processes	247
Polycyclic Processes	249
Modifications of the Logistic Equation: Back to Biology	252
Applications	255
Further Reading	259
Part IV DISEASE MANAGEMENT	261
15 Cultural Practices for Disease Management	265
<i>Annika Djurle, Dag-Ragnar Blystad and Lisa Munk</i>	
What are Cultural Practices?	265
Pathogen-free Propagation Material	265
Removal of Infected Plants or Infested Plant Debris	267
Removal of Alternative and Alternate Hosts	269
Soil Treatment	270
Hygiene: Tools and Machinery	270
Crop Rotation	271
Soil and Water Management	273
Fertilization	275
Sowing, Planting, Weeding, Planting Site	275
Quarantine	277
Further Reading	279
16 Chemical Plant Disease Control	280
<i>Björn Andersson and Annika Djurle</i>	
The Role of Fungicides in Plant Disease Management	280
Fungicide History	281
How are Fungicides Used?	281
Classification of Fungicides	282

Fungicide Resistance	284
Further Reading	288
17 Biological Control of Plant Diseases	289
<i>Arne Tronsmo, David B. Collinge, Claude Alabouvette and Dan Funck Jensen</i>	
Introduction and Definition of Biological Control	289
How to Select a Good Biological Control Agent?	290
Mechanisms of Biological Control	292
Direct Biological Control Interactions	294
Indirect Control of Plant Diseases	297
Importance of Understanding the Plant Host/Disease Cycle for Optimal Biological Control	299
Production, Formulation and Delivery	301
Legislation and Risk Assessment	303
Further Reading	305
18 Disease Management Strategies Using Host Resistance	307
<i>Lisa Munk, Jonathan Yuen, Annika Djurle and David B. Collinge</i>	
Host Resistance Based on Resistance Genes	307
Disease Management Strategies Using Host Resistance	314
Further Reading	320
19 Biotechnology for Plant Disease Control	321
<i>David B. Collinge</i>	
Application of Biotechnological Tools for Plant Disease Control	321
Antimicrobial Metabolites	323
Regulating Plant Immunity	324
Tools for Plant Breeding, Biological and Chemical Control	325
Mutational Approaches	326
Summary and Some Predictions	327
Further Reading	328
20 From Disease Assessment to Decision Support Systems	330
<i>Lisa Munk, Annika Djurle and Jonathan Yuen</i>	
Disease Assessment	330
Disease Forecasting	336
Decision Support Systems	342
Thresholds (Action Before Damage)	345
Yield and Yield Loss	348
Further Reading	355
21 Integrated Pest Management	357
<i>Lisa Munk, Jonathan Yuen, Annika Djurle and Arne Tronsmo</i>	
Introduction	357
Background	358
Steps of Integrated Pest Management	359
General Principles of Integrated Pest Management	360
Integrated Pest Management Guidelines	361

Evaluation of the Impact of Integrated Pest Management	363
Further Reading	365
22 Plant Health Legislation	366
<i>Anne Marte Tronsmo, David B. Collinge and Jonathan Yuen</i>	
Why do we Have a Chapter on Law and Regulations in a Book on Plant Pathology?	366
Background of International Plant Health Regulations	366
International Conventions and Organizations	367
Regional Plant Protection Regulations and Bodies in Europe	369
Quarantine Pests	372
Pest Risk Analysis and Risk Assessment	373
Further Reading	376
Part V PERSPECTIVES	377
23 Plant Pathology in a Changing World	379
<i>Jonathan Yuen, David B. Collinge, Annika Djurle and Anne Marte Tronsmo</i>	
Introduction	379
Agriculture in the Future	379
Challenges for Future Food Security	380
Future Plant Disease Challenges	381
Future Disease Management – Educated Guesses	382
Closing Words	386
Appendix 1 Glossary	387
Appendix 2 Molecular Methods and Terms Relevant for Plant Pathology	414
Taxonomic Index of Pathogens, Vectors and Biocontrol Agents	417
General Index	421

Online supplementary material

Please visit www.cabi.org/openresources/43185 to access Powerpoint slides of the figures.

