

Contents

Section 1 Aspects of Plant Pathology	1	3.4 The “Arms Race” Between Plants and Pathogens	43
Chapter 1 Concepts and Principles	3	3.5 Infection Process of Plant Pathogens	45
1.1 Impact of Plant Pathogens on Humans	4	Fungal Pathogens	45
1.2 Plant Pathology and Pathogens	9	Biotrophic Fungi	45
1.3 Summary	17	Necrotrophic Pathogens	49
1.4 What You Will Learn in This Book	17	3.6 Bacterial Pathogens	50
Further Reading	18	Introduction	50
		Infection Strategies	51
Chapter 2 Characterization and Taxonomy of Plant Pathogens	19	3.7 Viral Pathogens	52
2.1 Naming the Disease	19	Infection by Viruses: Nature’s Own Genetic Engineers	52
2.2 Relating Name to Form and to Function	20	Vectors	52
2.3 Fungi	21	Virus Replication	52
Introduction	21	Color-Break Virus in Tulips	55
Fungal Structure	21	3.8 Other Pathogens	55
Classification of Fungi	22	3.9 Summary	57
2.4 Bacteria	25	Further Reading	57
Introduction	25		
Bacterial Structure	25	Chapter 4 Plant Responses to Pathogens	59
The Bacterial Cell Wall	26	4.1 Categories of Plant Defense Against Disease	59
Classification of Bacteria	26	Disease Escape	59
Systems for Bacterial Taxonomy	27	Disease Tolerance	60
2.5 Viruses	29	Disease Resistance	60
Introduction	29	4.2 Disease Resistance	61
Nature’s Own Genetic Engineers	29	4.3 Gene-for-Gene Theory	65
Viral Structure	29	4.4 Suicide Genes?	66
Classification of Viruses	30	4.5 Endophytes	66
2.6 Other Plant Pathogens	31	4.6 Endophytes and Farmers	67
Introduction	31	4.7 Plant Host Cell Responses to Viral Infection	67
Fungus-Like Pathogens	32	4.8 RNA Silencing	70
Pathogens in the Domain Bacteria (Non-Eubacteria) With No Cell Wall	33	4.9 Resistance, Counter-Resistance, and Counter-Counter-Resistance	70
A Note on Nematodes and Nutrient Deficiency	33	4.10 Summary	70
2.7 Summary	34	Further Reading	71
Further Reading	34		
Chapter 3 Infection Processes	35	Chapter 5 Epidemiology	73
3.1 Review of Plant Anatomy	36	5.1 Components of Epidemics	75
3.2 Structure and Anatomy of Fungal Pathogens	38	Impact of Environmental Factors on Pathogens	75
3.3 The Rise and Evolution of Fungal Plant Pathogens	41	Temperature	75
		Relative Humidity	76

Leaf Wetness and Temperature	77	6.22 <i>Pycnostysanus azaleae</i>	116
Light Intensity	78	6.23 <i>Rhynchosporium secalis</i>	117
Temporal and Cultural Impacts	79	6.24 <i>Rhytisma acerinum</i>	118
5.2 Host Factors	79	6.25 <i>Zymoseptoria tritici</i> (syn. <i>Septoria tritici</i>)	118
Plant Reproduction and Cultivation Material	79	6.26 Sooty Molds of Wheat	119
Race-Specific Issues	81	6.27 <i>Venturia inaequalis</i>	120
Plant Age and Susceptibility to Disease	81	Further Reading	121
Pathogen Factors	87		
5.3 Modeling Disease Epidemics	89	Chapter 7 Bacteria Diseases	123
The Role of Mathematical Models in Plant Pathology	89	7.1 <i>Agrobacterium tumefaciens</i>	123
Patterns of Epidemics	92	7.2 <i>Bacillus pumilus</i>	124
5.4 Summary	93	7.3 <i>Burkholderia caryophylli</i>	125
Further Reading	93	7.4 <i>Clavibacter michiganensis</i> subsp. <i>michiganensis</i>	125
		7.5 <i>Erwinia amylovora</i>	126
Section 2 Compendium of Plant Diseases	95	7.6 <i>Pectobacterium atrosepticum</i>	127
		7.7 <i>Pseudomonas syringae</i>	127
Chapter 6 Fungal Diseases	97	7.8 <i>Ralstonia solanacearum</i>	128
6.1 <i>Alternaria brassicicola</i>	98	7.9 <i>Streptomyces scabies</i>	129
6.2 <i>Aspergillus niger</i>	98	7.10 <i>Xanthomonas campestris</i>	129
6.3 <i>Blumeria graminis</i> f. sp. <i>tritici</i>	99	7.11 <i>Xanthomonas fragariae</i>	130
6.4 <i>Botrytis cinerea</i>	100	7.12 <i>Xylella fastidiosa</i>	131
6.5 <i>Botrytis fabae</i>	101	Further Reading	132
6.6 <i>Choanephora cucurbitarum</i>	102	Useful Websites	132
6.7 <i>Cylindrosporium concentricum</i> Grev. and <i>Pyrenopeziza brassicae</i>	103		
6.8 <i>Diplocarpon rosae</i>	104	Chapter 8 Viral Diseases	133
6.9 <i>Fusarium culmorum</i> and <i>Microdochium nivale</i>	105	8.1 African Cassava Mosaic Virus (ACMV)	134
6.10 <i>Fusarium graminearum</i> and other <i>Fusarium</i> species	105	8.2 Barley Yellow Dwarf Virus (BYDV)	135
6.11 <i>Fusarium oxysporum</i> f. sp. <i>narcissi</i>	106	8.3 Beet Leaf Curl Virus (BLCV)	135
6.12 <i>Gaeumannomyces graminis</i> var. <i>tritici</i>	107	8.4 Cauliflower Mosaic Virus (CaMV)	136
6.13 <i>Hymenoscyphus fraxineus</i> (also known as <i>Chalara fraxinea</i>)	107	8.5 Color-Breaking Potyviruses	136
6.14 <i>Leptosphaeria maculans</i> and <i>L. biglobosa</i>	108	8.6 Grapevine Vitiviruses A, B, D, E, and F	136
6.15 <i>Magnaporthe oryzae</i> (formerly called <i>M. grisea</i>)	109	8.7 Helleborus Net Necrosis Virus (HeNNV)	137
6.16 <i>Monilinia fructigena</i>	109	8.8 Peanut Clump Virus (PCV) and Indian Peanut Clump Virus (IPCV)	137
6.17 <i>Oculimacula acuformis</i> (R type) and <i>O. yallundae</i> (W type) (formerly <i>Tapesia acuformis</i> and <i>T. yallundae</i> , respectively, syn. <i>Pseudocercospora herpotrichoides</i>)	110	8.9 Plum Pox Virus	138
6.18 <i>Phoma clematidina</i>	111	8.10 Potato Virus Y (PVY)	138
6.19 <i>Puccinia graminis</i> f. sp. <i>tritici</i> and <i>P. recondita</i> f. sp. <i>tritici</i>	113	8.11 Raspberry Ringspot Virus (RRSV) (also known as RpRSV)	139
6.20 <i>Puccinia kuehnii</i>	115	8.12 Rice Tungro Spherical Virus (RTSV)	139
6.21 <i>Rhizoctonia solani</i>	115	8.13 Tobacco Mosaic Virus (TMV)	140
		8.14 Tobacco Ringspot Virus (TRSV)	141
		8.15 Tomato Bushy Stunt Virus (TBSV)	141
		Further Reading	142
		Useful Websites	142

Chapter 9 Other Diseases	143	10.6 Managing Fungal Pathogens in Wheat: A UK Model of Applied Practice	183
9.1 <i>Cephaluros virescens</i>	144	10.7 Summary	184
9.2 <i>Globodera pallida</i>	145	Further Reading	185
9.3 Peach X-Disease Phytoplasma	145	Useful Websites	186
9.4 <i>Phytoplasma staheli</i> and <i>Phytoplasma leptovascularum</i>	146		
9.5 <i>Phytophthora ramorum</i>	147	Chapter 11 Organic and Integrated Methods	187
9.6 <i>Phytoplasma asteris</i>	148	11.1 Organic Production Systems	188
9.7 <i>Pseudoperonospora humuli</i>	149	Soil Fertility Building	188
9.8 <i>Pythium</i> Species	150	Managing Disease in Organic Crops	188
9.9 <i>Sclerophthora macrospora</i>	150	Crop Rotations and Intercropping	190
Further Reading	151	Organic Fungicides and Plant Biostimulants	194
Useful Websites	151	11.2 Integrated Pest Management	194
		11.3 Summary	196
Section 3 Applied Management of Plant Diseases	153	Further Reading	197
Chapter 10 Control of Diseases	155	Chapter 12 The Future of Plant Pathology	199
10.1 Principles of Disease Management	155	12.1 Apples	199
10.2 Seed Certification	157	12.2 Food Miles	202
The Cereals	157	12.3 Import and Export of Plant Material	202
Potato	160	12.4 Global Climate Change	202
Soft Fruit and Top Fruit	161	12.5 Precision Farming	205
Strawberries	164	12.6 Genetically Modified Organisms	205
Apples	166	12.7 Wheat	206
10.3 Breeding for Disease Resistance	167	12.8 Summary	207
Approaches to Plant Breeding	168	Further Reading	207
Breeding Self-Pollinated Species	171	Useful Websites	207
10.4 Monitoring and Disease Assessment	175		
Assessing Disease	176	Glossary	209
Sampling Method and Application of Disease Assessment Keys	176	Index	213
10.5 Chemical Control of Plant Disease	180	Color Plates	
Modes of Action of Fungicides	181		
Major Groups of Contemporary Fungicides	181		