

Contents

<i>Acknowledgements</i>	<i>page xi</i>
1 Bacteria as plant pathogens	1
Bacteria–plant associations	1
Evolution of bacterial plant pathogens and the origins of disease	2
Bacteria and plant disease	4
Bacterial and fungal pathogens	4
Criteria of pathogenicity	6
Plant pathogenic bacteria and crop monoculture	7
Economic importance	9
2 Bacterial structure and function	13
Characteristic morphology and fine structure	13
Variation in prokaryote structure	27
Chemical analysis of bacterial cells	30
Compartmentation and function of bacterial cells	33
3 Taxonomy of plant pathogenic bacteria: classification, nomenclature and identification	41
Bacterial classification and nomenclature	42
Bacterial isolation and identification from different sites	50
Identification by pathogenicity testing	52
<i>In vitro</i> diagnosis of plant pathogenic bacteria	53
Computer identification by numerical analysis	71
4 Plant pathogenic bacteria in the environment	77
The aerial environment	77
The soil–water environment	84
Environmental interactions at the micro-level	88
Bacterial associations with invertebrates and their importance in disease transmission	97

5	The infection process	107
	Build-up and activity of epiphytic populations	107
	Bacterial entry into plant tissue	114
	Movement of bacteria within the plant	121
6	Compatible and incompatible interactions: the hypersensitive response	126
	Inoculation of intact plants	126
	Use of <i>in vitro</i> systems	132
	Induction of the hypersensitive reaction	133
	Bacterial recognition and activation of the hypersensitive reaction	139
	Biochemical interactions during the HR: elicitors and phytoalexins	142
	Pathogenic changes in plant cells	152
	Bacterial changes during the hypersensitive reaction	161
	The mechanism of resistance during the hypersensitive reaction	165
7	Bacterial virulence and plant disease	172
	<i>The induction of bacterial disease</i>	172
	Environmental and physiological factors affecting disease development	172
	Pathogenicity and virulence factors	173
	<i>Major types of plant disease</i>	
	Necrotic diseases	174
	Vascular wilt and yellows diseases	178
	Soft rot diseases	180
	Tumour diseases	183
	<i>Virulence factors</i>	187
	Bacterial toxins	187
	Extracellular enzymes	197
	Extracellular polysaccharides	202
	Plant hormones	206
8	Genetical analysis of plant pathogenic bacteria	212
	<i>Molecular genetics: identification and investigation of bacterial genes</i>	212
	Preparation of a DNA fraction	214
	Formation of a gene library	215
	Identification of cloned genes by complementation	220
	Mapping of cloned DNA	222
	DNA sequence analysis and homology	222

<i>Contents</i>	ix
Identification of the gene product	222
<i>Genes for compatibility or incompatibility</i>	223
Race–cultivar interactions	223
Mutation studies on single pathogens in host/non-host situations	229
Comparison of <i>hrp</i> and <i>avr</i> genes in the determination of incompatibility	232
<i>The role of virulence genes in the determination of plant disease</i>	233
Loss of virulence by mutagenesis	233
Cloning of virulence genes	236
Evolutionary conservation of pathogenicity and virulence genes	247
Control of gene activity: plant regulation of bacterial gene expression	248
<i>Genes which determine non-pathogenic characteristics</i>	248
Genetic determination of ice nucleation activity	249
Genetic control of siderophore metabolism	250
<i>The occurrence and genetic importance of plasmids in plant pathogenic bacteria</i>	252
Plasmid isolation and characterisation	252
Electron microscope examination of bacterial plasmids	254
The role of plasmids in the determination of pathogenicity and virulence	255
Plasmid determination of non-pathogenic characteristics	263
Introduction of novel genes into plant pathogenic bacteria using genetically engineered plasmids	266
9 Disease control	273
<i>Chemical control</i>	273
Bactericides	273
Antibiotics	276
General aspects of chemical control: advantages and disadvantages	276
<i>Biological control</i>	278
General range of biological control agents	279
Strategy for biological control	279
Mode of action of biological control agents	283
<i>Genetic control of plant disease</i>	303
The search for resistant germplasm	303
Breeding for resistance	305
Screening and evaluation of resistant cultivars	308

x	<i>Contents</i>	
	<i>Sanitary procedures in the control of plant disease</i>	309
	Use of disease-free plants and seed	310
	New types of propagation procedure	312
	Crop growth and culture conditions	312
	Equipment and product handling	313
	<i>Index</i>	318