

Contents

Contributors	ix
Preface	xi
1. Introduction	1
<i>Vaughan A. Hilder, Donald Boulter and Angharad M.R. Gatehouse</i>	
2. Methodologies of Plant Transformation	7
<i>K. Judith Webb and Phillip Morris</i>	
1. Target cells for genetic transformation	8
2. Genes and their construction	9
2.1 Basic organization of plant genes	
2.2 Promoters and other regulatory DNA sequences	
2.3 The use of reporter genes to study gene expression	
2.4 Selectable marker genes	
3. Genetic transformation by <i>Agrobacterium</i> species	14
3.1 <i>Agrobacterium</i> species as plant pathogens	
3.2 Transfer of genes of interest	
4. Transformation of monocots by <i>Agrobacterium</i> species and viruses	18
4.1 Agroinfection with gemini viruses	
4.2 Transformation with viruses	
5. Transformation by direct gene transfer	20
5.1 Direct gene transfer to protoplasts	
5.2 Direct gene transfer to cells and tissues	
5.3 DNA uptake into protoplasts and transfer to the nucleus	
6. Expression, integration and inheritance of inserted genes	32
6.1 Transient expression of genes introduced by direct gene transfer	
6.2 Integration of genes introduced by direct gene transfer	
6.3 Stable integration of introduced genes	
6.4 Inheritance of introduced genes	

3. The Development of Genetically Modified Varieties of Agricultural Crops by the Seeds Industry	45
<i>Richard J.A. Connett and Peter D. Barfoot</i>	
1. Plant breeding and the seeds industry	46
2. Applications of biotechnology in plant breeding	49
2.1 Techniques for increasing the efficiency and effectiveness of selection	
2.2 Techniques for broadening the genetic base for selection	
3. Intellectual property protection for innovations in plant biotechnology	53
3.1 Plant variety rights	
3.2 Patent protection	
3.3 Potential conflict between PVR and patent protection	
3.4 Resolution of the potential legal conflict between PVR and patent protection	
4. Regulation of the release of genetically modified crops into the environment	60
4.1 Safety assessment	
4.2 International aspects of regulation	
4.3 Regulation in the European Community	
4.4 Regulation in the USA	
4.5 Further use of GMO plants in plant breeding	
5. Regulation of the food use of genetically modified crops	65
5.1 What should be regulated?	
5.2 The decision-making process	
5.3 Food labelling	
5.4 Consumer acceptance of novel foods	
6. The marketing of genetically modified crop varieties	70
4. Genetically Engineered Plants for Herbicide Resistance	75
<i>Philip M. Mullineaux</i>	
1. Strategies	76
2. Overexpression of target proteins	77
2.1 Resistance in cultured plant cells	
2.2 Engineering glyphosate resistance by overexpressing an EPSP synthase cDNA	
3. Mutation of target proteins	80
3.1 Glyphosate resistance	
3.2 Engineered glyphosate resistance in plants using the <i>aroA</i> gene	
3.3 Asulam resistance	
3.4 Engineered asulam resistance in plants	
3.5 Atrazine resistance	
3.6 Engineered atrazine tolerance in tobacco	
3.7 Resistance to sulphonyl urea herbicides	
3.8 Engineered resistance to chlorsulphuron	
4. Detoxification genes from bacteria	93
4.1 Engineered bialaphos resistance	
4.2 Engineered bromoxynil resistance	
4.3 Engineered resistance to phenoxyacetic acid herbicides	
5. A plant detoxification system: glutathione- <i>S</i> -transferase	99
5. Fungal Resistance: The Isolation of a Plant R Gene by Transposon Tagging	109
<i>H. John Newbury</i>	
1. Aspects of resistance to fungal infection	109
2. Isolation of R genes	114

3. Gene cloning using insertional inactivation by T-DNA	116
4. Transposon-tagging plant genes	117
5. Transposon-tagging an R gene in antirrhinum	120
6. Engineering of Insect-resistant Plants with <i>Bacillus thuringiensis</i> Crystal Protein Genes	135
<i>Marnix Peferoen</i>	
1. <i>Bacillus thuringiensis</i> , the insecticidal bacterium	135
1.1 The history	
1.2 The classification	
2. <i>Bacillus thuringiensis</i> , the crystal proteins	136
2.1 A family of proteins	
2.2 The search for new crystal proteins	
3. Mechanism of action and insect resistance	139
3.1 A receptor-mediated specificity	
3.2 The development of resistance in insects	
4. Engineering of insect-resistant plants	142
4.1 Plant engineering	
4.2 Expression of crystal proteins	
5. Insect-resistant plants	144
5.1 Laboratory evaluation	
5.2 Field evaluations	
6. Perspectives	146
7. Potential of Plant-derived Genes in the Genetic Manipulation of Crops for Insect Resistance	155
<i>Angharad M.R. Gatehouse, Donald Boulter and Vaughan A. Hilder</i>	
1. Potential candidates in engineering insect resistance	160
1.1 Enzyme inhibitors	
1.2 Lectins	
1.3 Lectin-like proteins	
8. Genetic Engineering of Virus Resistance	183
<i>Brian Reavy and Michael A. Mayo</i>	
1. Steps in the production of transgenic plants	185
2. Coat protein-mediated resistance	186
2.1 Extent of coat protein-mediated resistance	
2.2 Effects of inoculum pressure and the amount of coat protein expressed	
2.3 Patterns of expression of coat protein in transgenic plants	
2.4 The action of coat protein in transgenic plants	
2.5 Coat protein-mediated protection operating at a number of different levels	
3. Attempts to obtain resistance with other virus genes	195
4. Satellite RNA-mediated resistance	196
5. Defective virus genomic nucleic acid	198
6. Antisense RNA	199
7. Ribozyme-mediated protection	201
8. Field testing of transgenic resistance	202
8.1 Cultivar characteristics	
8.2 Resistance in the field	
9. Future prospects	204

9. Potential of Secondary Metabolites in Genetic Engineering of Crops for Resistance	215
<i>David L. Hallahan, John A. Pickett, Lester J. Wadhams, Roger M. Wallsgrove and Christine M. Woodcock</i>	
1. Secondary metabolites in plant defence	215
1.1 Overview	
1.2 Toxicants	
1.3 Semiochemicals	
2. Biosynthetic pathways for crop protection compounds	230
2.1 Glucosinolate biosynthesis	
2.2 Polygodial and related terpenoid antifeedants	
2.3 Iridoid sex pheromones	
3. Future strategies	236
3.1 Targeting and control of defence gene expression	
10. Promoting Crop Protection by Genetic Engineering and Conventional Plant Breeding: Problems and Prospects	249
<i>Harold W. Woolhouse</i>	
1. Insect control	251
2. Virus resistance	252
3. Herbicide resistance	253
4. Some ecological considerations	254
5. The position of plant breeding	255
Index	257