

Contents

Contributors	ix
Preface	xi
1. Plant Breeding and Biotechnological Advances	1
<i>Aluizio Borém, Valdir Diola, and Roberto Fritsche-Neto</i>	
Introduction	1
Evolution of Genetics and Plant Breeding	2
The Impacts of Advances During the Twentieth Century	3
Advances and Expected Benefits of Biotechnology	7
Improvement of Tools in the Third Millennium	7
Combined Classic Breeding and Biotechnology	12
Perspectives	13
References	16
2. Molecular Markers	19
<i>Eveline Teixeira Caixeta, Luis Felipe Ventorim Ferrão, Eunize Maciel-Zambolim, and Laércio Zambolim</i>	
Introduction	19
PCR-Based Markers	19
Hybridization-Based Markers	30
Markers Based on Sequencing	33
Choice of Molecular Marker	41
References	43
3. Biometrics Applied to Molecular Analysis in Genetic Diversity	47
<i>Cosme Damião Cruz, Caio César Salgado, and Leonardo Lopes Bhering</i>	
Introduction	47
Genetic Diversity Between Accesses or Within Populations	49
Diversity and Population Structure	74
Statistic Tests of the Variance Components and Statistics Φ	80
References	80

4.	Genome-Wide Association Studies (GWAS)	83
	<i>Marcos Deon Vilela de Resende, Fabyano Fonseca e Silva, Márcio Fernando R. Resende Júnior, and Camila Ferreira Azevedo</i>	
	Introduction	83
	QTL Analysis and Genomic Selection: Concepts	83
	Genome-Wide Association Studies (GWAS)	88
	Genome-Wide Mapping via Single Marker Regression	94
	Statistical Power and Significance of Association for QTL Detection	95
	Genome-Wide Mapping with Haplotype Mixed Models	98
	GWAS in Humans	99
	Capturing h^2 in Humans with Imperfect LD Between SNPs and Causal Variants	101
	References	102
5.	Genome-Wide Selection (GWS)	105
	<i>Marcos Deon Vilela de Resende, Fabyano Fonseca e Silva, Márcio Fernando R. Resende Júnior, and Camila Ferreira Azevedo</i>	
	Introduction	105
	Genome-Wide Selection (GWS)	105
	Accuracy of GWS	108
	Estimation, Validation, and Selection Populations	110
	Relationship Between Genetic Variance and Marker Variance	123
	Increase in the Efficiency of Selection for Plant Breeding	129
	References	131
6.	Genes Prospection	135
	<i>Valdir Diola and Roberto Fritsche-Neto</i>	
	Introduction	135
	Principles of Genetic Mapping	136
	Isolation of Genes by Using Techniques for Structural Genome	143
	Relationship Between Genetic and Physical Maps	148
	Physical Mapping and Isolation of Loci of Interest	148
	The Isolation of Genes From the Functional Genome	150
	Choosing a Technique for Functional Gene Cloning	150
	The Cloning of Genes Using Bioinformatics Resources	152
	Validation of Candidate Genes	154
	Prospects for the Isolation of Genes of Interest	155
	References	156
7.	Tissue Culture Applications for the Genetic Improvement of Plants	157
	<i>Moacir Pasqual, Joyce Dória Rodrigues Soares, and Filipe Almendagna Rodrigues</i>	
	Introduction	157
	Somaclonal Variation	157
	Mutagenesis	162

Protoplast Fusion	163
Embryo Rescue	166
Production of Double Haploid Lines	168
Synthetic Seed Production	170
<i>In Vitro</i> Selection	172
Germplasm Conservation and Exchange	173
References	176
8. Transgenic Plants	179
<i>Francisco Murilo Zerbini, Fábio Nascimento da Silva, Gloria Patricia Castillo Urquiza, and Marcos Fernando Basso</i>	
Introduction	179
Organization and Gene Expression in Eukaryotes	180
Manipulation of Nucleic Acids	181
Methodologies for the Development of Transgenic Plants	184
Laboratory Steps for the Development of Transgenic Plants	190
Identification of Transgenic Plants	192
Use, Effects, and Management of Transgenic Cultivars	193
References	199
9. Double Haploids	201
<i>Roberto Fritsche-Neto, Deoclecio Domingos Garbuglio, and Aluizio Borém</i>	
Haploid Production	203
Ploid Identification and Chromosome Counting	211
Double-Haploid Production	215
Double Haploids in Breeding	217
Advantages and Disadvantages in the Use of Double Haploids	220
Application on the Genomic Statistics	220
Economical Aspects	222
References	222
10. Tools for the Future Breeder	225
<i>Valdir Diola, Aluizio Borém, and Natália Arruda Sanglard</i>	
Introduction	225
Genomic Tools	226
Techniques Applied to Structural Genome	226
Techniques Applied to Functional Genome	231
Average- and Large-Scale Attainment of Markers	235
Bioinformatics Tools	242
Biotechnology in Plant Breeding	246
Perspectives of Genome-Assisted Plant Breeding	247
References	247