

Contents

Contributors	XVIII
Abbreviations	XXIII

1 Apple

S. E. Gardiner, V. G. N. Bus, R. L. Rusholme, D. Chagné, E. H. A. Rikkerink	1
1.1 Introduction	1
1.1.1 Origin of the Domesticated Apple	1
1.1.2 Apple Production and Exports	2
1.1.3 Breeding Strategy	2
1.1.4 Breeding Objectives	3
1.1.5 Molecular Markers and Genetic Maps	4
1.2 Construction of Genetic Maps	6
1.2.1 Brief History of Genetic Mapping in Apple	6
1.2.2 First-Generation Maps	6
1.2.3 Genome Organization and Homeology	8
1.2.4 Comparative Mapping Across Genera	10
1.3 Gene Mapping	11
1.3.1 Methods Used to Map Major Genes in Apple	11
1.3.2 Target Traits	12
1.4 QTL Trait Mapping	31
1.4.1 QTL Identification and Mapping in Apple	31
1.4.2 Mapping QTLs for Disease Resistance	32
1.4.3 Mapping QTLs for Tree Growth and Development	38
1.4.4 Mapping QTLs for Fruit Quality	41
1.4.5 Conclusions	44
1.5 Marker-Assisted Breeding	45
1.5.1 Germplasm Screening	45
1.5.2 Marker-Assisted Selection	45
1.5.3 Marker-Aided Introgression	46
1.6 Map-Based Cloning	47
1.6.1 <i>Vf</i>	48
1.6.2 <i>Sd-1</i>	49
1.7 Advanced Work	49
1.7.1 Tools Developed: Transformation, ESTs, Microarrays and Functional Genomics	49
1.7.2 Third-Generation Maps: Physical	50
1.8 Future Scope of Work	50
1.8.1 Association Mapping and Other Ways to Link Genotype to Phenotype	50
1.8.2 Structural Genomics and Whole Genome Sequencing	51
References	53

2 Grape

S. Riaz, A. Doligez, R. J. Henry, M. A. Walker	63
2.1 Introduction	63
2.1.1 Origin and Early History of Domestication	63

2.1.2	Genetic Diversity	65
2.1.3	Advanced Breeding Objectives	66
2.1.4	Classical Breeding Efforts: Obstacles and Achievements	67
2.1.5	New Genetic Tools for Grape Improvement	69
2.2	Genome Mapping	74
2.2.1	History and Current Status of Grape Genetic Linkage Mapping	75
2.2.2	Mapping and Tagging of Major Genes	76
2.2.3	Detection of QTLs	86
2.3	Whole Genome Projects	87
2.3.1	Australia	88
2.3.2	France	88
2.3.3	Germany	89
2.3.4	Italy	89
2.3.5	South Africa	89
2.3.6	USA	89
2.4	Marker-Aided Selection and Breeding	90
2.5	Cultivar Identity	91
2.6	Conclusions and Future Prospects	92
2.7	Grape Research Resources on the Web	93
2.8	Databases	94
	References	94

3 Cherry

	E. Dirlewanger, J. Claverie, A. Wünsch, A. F. Iezzoni	103
3.1	Introduction	103
3.1.1	Brief History of the Crop	103
3.1.2	Botanical Descriptions	104
3.1.3	Genome Contents	104
3.1.4	Economic Importance	105
3.1.5	Breeding Objectives	105
3.2	Construction of Genetic Maps	106
3.3	Gene Mapping and QTLs Detected	107
3.4	Marker-Assisted Breeding for Self-Incompatibility and Molecular Cloning	111
3.4.1	Self-Incompatibility	111
3.4.2	S-Allele Typing	112
3.4.3	Self-Compatibility	113
3.5	Conclusion and Future Scope of Works	114
3.5.1	Genome Mapping and QTL Detection	114
3.5.2	Self-(in)compatibility: Molecular Cloning and MAS	115
	References	115

4 Plum

	D. Esmenjaud, E. Dirlewanger	119
4.1	Introduction	119
4.1.1	History, Diversity, Domestication, Ploidy Level	119
4.1.2	Economic Importance	119
4.1.3	Breeding Objectives	120
4.2	Selection for Resistance to PPV	120
4.2.1	Classical Breeding Approach	120
4.2.2	Genetically Engineered Plums	120

4.3	Breeding Efforts for Rootstocks	121
4.3.1	Genetics of RKN Resistance in <i>Prunus</i> Sources	121
4.3.2	Mapping of the RKN <i>Ma</i> Gene in Plum – Comparison with Peach RKN Genes	123
4.4	Construction of Maps for the 3-Way Interspecific Cross Myrobalan Plum × (Garfi × Nemared)	124
4.4.1	SCAR Analysis	124
4.4.2	SSR Analysis	127
4.4.3	Inheritance and Map Construction	127
4.4.4	Comparison of the <i>P2175</i> and <i>GN22</i> Maps	128
4.5	Strategy for Map-Based Cloning of the <i>Ma</i> Gene	128
4.5.1	Detection of AFLP Markers by BSA, Development of PCR Markers and High-Resolution Mapping of the <i>Ma</i> Gene	129
4.5.2	BAC Library Construction	130
4.5.3	Construction of Physical Contigs Spanning the <i>Ma</i> Region and Chromosome Landing	130
4.6	Conclusion and Future Scope of Works	131
4.6.1	Resistance to Plum Pox Virus	131
4.6.2	Genome Mapping	131
4.6.3	Towards Map-Based Cloning of <i>Ma</i>	132
	References	132

5 Peach

	A. G. Abbott, P. Arús, R. Scorza	137
5.1	Introduction	137
5.1.1	Peach [<i>Prunus persica</i> (L.) Batsch]	137
5.1.2	Center of Origin and History of Dispersal	137
5.1.3	Peach production	137
5.1.4	Breeding	137
5.1.5	Breeding Goals	138
5.2	Construction of Genetic Maps	140
5.2.1	Peach Genetics, a Brief History	141
5.2.2	Molecular Genetic Mapping in Peach	141
5.2.3	Comparative Mapping of Peach and Other <i>Prunus</i> Species	143
5.2.4	Comparative Mapping of Peach to <i>Arabidopsis</i>	145
5.3	Genomics	145
5.3.1	Construction of the Peach Physical Map and its Use in Gene Discovery	145
5.3.2	Functional Genomics	146
5.3.3	Comparative Physical Mapping of Peach and Other Model Genome Species	147
5.4	Peach Tissue Culture and Transformation	148
5.5	Future Directions	149
	References	150

6 Pear

	A. Itai	157
6.1	Introduction	157
6.1.1	Origin and Early Development	157
6.1.2	Evolution of <i>Pyrus</i>	157
6.1.3	Morphology and Growth Habitat	158
6.1.4	Production and Economic Importance	159

6.1.5	Nutritional Composition	159
6.1.6	Breeding Objective	159
6.2	Construction of Genetic Maps	162
6.2.1	Development of Molecular Markers	162
6.2.2	Constructing Linkage Maps	163
6.3	Gene Mapping and QTL Detection	166
6.4	Marker-Assisted Breeding	166
6.5	Future Scope of Works	167
	References	168

7 Apricot

J. I. Hormaza, H. Yamane, J. Rodrigo	171
7.1 Introduction	171
7.1.1 History of the Crop	171
7.1.2 Botanical Description	172
7.1.3 Economic Importance	173
7.1.4 Breeding Objectives	175
7.1.5 Classical Breeding Achievements	176
7.2 Construction of Genetic Maps	177
7.3 Marker-Assisted Breeding:	182
7.3.1 Germplasm Screening	182
7.3.2 Marker-Assisted Selection and Gene Identification	183
7.4 Future Scope of Works	184
References	184

8 Strawberry

T. M. Davis, B. Denoyes-Rothan, E. Lerceteau-Köhler	189
8.1 Introduction	189
8.1.1 Origin of the Cultivated Strawberry	189
8.1.2 Systematics and Phylogenetics	189
8.1.3 Karyotype	190
8.1.4 The Strawberry Plant	190
8.1.5 Breeding	191
8.1.6 Nutritional Composition	192
8.1.7 Economic Importance	192
8.2 Genetic Characterization	192
8.2.1 Genome Composition	192
8.2.2 Genome Size	193
8.2.3 Gene Nomenclature	193
8.2.4 Morphological Markers	194
8.2.5 Isozymes and Molecular Markers	194
8.3 Linkage Mapping	195
8.4 Gene Mapping	199
8.5 QTL Detection	199
8.6 Marker-Assisted Selection	201
8.7 Development of Genomics Resources	201
8.8 Conclusion and Future Prospects	201
References	202

9 Raspberry

J. Graham, I. Hein, W. Powell	207
9.1 Introduction	207
9.2 Construction of Genetic Linkage Maps	210

9.3	Gene Mapping	211
9.4	Analysis of Quantitative Trait Loci	211
9.5	Marker-Assisted Breeding	212
9.6	Map-Based Cloning	212
9.7	Advanced Works	213
	References	214

10 Blueberry

M. B. Ratnaparkhe	217
10.1 Introduction	217
10.1.1 Cytology	217
10.1.2 Commercial Blueberries	218
10.1.3 Breeding Objectives	218
10.1.4 Blueberry Breeding	219
10.2 Application of Marker Technologies	220
10.2.1 Protein Markers	220
10.2.2 Molecular Markers	220
10.3 Genetic Linkage Mapping	221
10.4 In Vitro Culture and Genetic Engineering	222
10.5 Future Scope of Works	224
References	224

11 Almond

P. Martínez-Gómez, R. Sánchez-Pérez, F. Dicenta, W. Howad, P. Arús, T. M. Gradziel	229
11.1 Introduction	229
11.2 Variability Analysis with Molecular Markers	231
11.3 Construction of Genetic Linkage Maps	232
11.4 Major Gene and QTL Mapping, and Gene Cloning	233
11.5 Marker-Assisted Breeding	236
11.6 Advanced Works and Future Scope	237
References	238

12 Pistachio

J. I. Hormaza, A. Wünsch	243
12.1 Introduction	243
12.1.1 History of the Crop	243
12.1.2 Botanical Description	244
12.1.3 Economic Importance	244
12.1.4 Breeding Objectives	245
12.1.5 Classical Breeding Achievements	246
12.2 Marker-Assisted Breeding	246
12.2.1 Germplasm Screening	246
12.2.2 Marker-Assisted Selection	248
12.3 Future Scope of Works	248
References	249

13 Olive

S. Doveri, L. Baldoni	253
13.1 Introduction	253
13.1.1 Brief History of the Crop	253
13.1.2 Botanical Description	253
13.1.3 Economic Importance	255

13.1.4	Breeding Objectives	256
13.1.5	Breeding Achievements	256
13.2	Construction of Genetic Maps	257
13.3	Gene Mapping	257
13.4	Marker-Assisted Breeding	260
13.5	Future Scope of Works	260
	References	261

14 Citrus Fruits

F. G. Gmitter, Jr., C. Chen, M. N. Rao, J. R. Soneji	265
14.1 Introduction	265
14.1.1 Background	265
14.1.2 Early Knowledge of Citrus Genome and Genetics.....	267
14.2 Mapping of the Citrus Genome	268
14.3 Molecular Tagging and Cloning of Specific Genes and QTLs	271
14.4 Citrus Genome Plan and Future Trends	274
References	275

15 Banana

M. Pillay, L. Tripathi	281
15.1 Introduction	281
15.1.1 Botanical Origin and Distribution of Banana	281
15.1.2 Taxonomy of <i>Musa</i>	282
15.1.3 Botanical Description and Morphology of Banana	283
15.1.4 Importance of Bananas and Major Areas of Production	284
15.1.5 Genome Groups and Genome Size of <i>Musa</i>	285
15.1.6 Banana Breeding Objectives	286
15.1.7 Limitations of Classical Breeding of Bananas	286
15.1.8 Overcoming <i>Musa</i> Breeding Difficulties	287
15.1.9 Banana Breeding Achievements	288
15.2 Gene Mapping in <i>Musa</i>	289
15.3 Identification of Quantitative Trait Loci (QTL) in <i>Musa</i>	290
15.4 Marker-Assisted Breeding in <i>Musa</i>	291
15.5 Marker-Assisted Introgression	293
15.6 Map-Based Cloning	294
15.7 Genes and Gene Expression in <i>Musa</i>	295
15.8 Future Scope of Works	296
References	297

16 Mango

H. K. N. Vasanthaiah, K. V. Ravishankar, G. K. Mukunda	303
16.1 Introduction	303
16.1.1 Origin and Distribution	303
16.1.2 Taxonomy	304
16.1.3 Crop Improvement	305
16.2 Application of Molecular Markers for Genetic Analysis in Mangoes	311
16.2.1 Isozymes	312
16.2.2 DNA Markers	313
16.3 Linkage Mapping	315
16.4 Gene Isolation and Analysis	317
16.5 Gene Manipulation by Genetic Engineering	319
16.6 Future Scope	319
References	320

17 Avocado

V. E. T. M. Ashworth, H. Chen, M. T. Clegg	325
17.1 Introduction	325
17.1.1 Crop Production	325
17.1.2 Botanical Races	325
17.1.3 Classical Breeding	325
17.2 Molecular Beginnings	326
17.2.1 SSR Markers	326
17.3 QTL Analysis	328
17.4 Comparative Sequencing Study	328
17.5 Prospects	328
References	328

18 Pineapple

J. D. Carlier, G. Coppens d'Eeckenbrugge, J. M. Leitão	331
18.1 Introduction	331
18.1.1 Economic Importance	331
18.1.2 Taxonomy	331
18.1.3 Natural Habitat and Origin	332
18.1.4 Chromosome Number and Genome Size	332
18.1.5 Propagation and Floral Biology	333
18.1.6 Pineapple Breeding	333
18.2 Molecular Systematics	333
18.3 Construction of Genetic Maps	334
18.3.1 F ₁ -Based Genetic Maps	334
18.3.2 F ₂ -Based Genetic Map	335
18.3.3 Integrated Genetic Maps of Pineapple	335
18.4 Germplasm Resources and GeneBank Data	335
18.5 Future Prospects	340
References	340

19 Papaya

M. Mishra, R. Chandra, S. Saxena	343
19.1 Introduction	343
19.2 Molecular Characterization	344
19.3 Marker-Assisted Selection	345
19.4 Construction of Genetic Maps	346
19.5 Recombinant DNA Technology	347
References	350

20 Persimmon

S. Kanzaki, K. Yonemori	353
20.1 Introduction	353
20.2 Nature of Natural Astringency-Loss in Persimmon Fruit and Its Inheritance	354
20.3 Identification of Molecular Markers Liked to the PCNA/non-PCNA Trait and Polysomic Segregation of the Markers	355
20.4 Future Scope for Persimmon Breeding	357
References	357

Subject Index



<http://www.springer.com/978-3-540-34531-2>

Fruits and Nuts

Kole, C. (Ed.)

2007, XXVI, 370 p., Hardcover

ISBN: 978-3-540-34531-2