

Contents

1	Introduction to Plant Breeding	1
	Plant Breeding and Society	2
	Genetics, Omics, and Plant Breeding	3
	Populations	4
	Genetic Diversity	5
	Distance Measures	7
	Grouping Germplasm	8
	Quantitative Variation	8
	Mapping Traits	10
	Genotype-by-Environment Interaction	11
	Phenotyping	13
	Phenomics	14
	References	15
2	Plant Genetic Resources for Food and Agriculture	19
	Crop Evolution and Plant Species Feeding the World	20
	Genebanks	22
	Gene Pools	23
	Describing Variation and Identifying Redundancy	24
	Germplasm Evaluation	25
	Descriptors	26
	Documentation and Bioinformatics	29
	Geo-documentation to Identify Germplasm	29
	Genebank Sampling and Core Subsets	30
	Genomics of Plant Genetic Resources	32
	Putting Genes into Usable Forms	34
	References	35
3	Inbred Development	41
	DNA Markers for Mapping Quantitative Trait Loci (QTL)	
	and Aided Breeding	42
	Inbreeding and Line Development	45
	Doubled Haploids	48

Adaptability: Learning for Model Plant Systems	50
Breeding for Stress-Prone Environments and Resource-Use Efficiency ...	51
Host Plant Resistance Breeding	53
Participatory and Client-Driven Plant Breeding	54
References	55
4 Population Improvement	61
Recurrent Selection and Breeding Populations	61
Genome-Wide Association and Quantitative Trait Variation	63
Plant Genomics and Marker-Assisted Selection	67
Genomic Selection and Prediction of Breeding Values	70
References	72
5 Heterosis and Interspecific Hybridization	79
Heterotic Groups	80
Hybrid Vigor	81
Heterosis in Plant Breeding	81
Understanding Hybrid Vigor in Model Plants and Crops	82
Omics Research on Heterosis	83
Hybrids in Selfing Species	85
Polyloid Heterosis	86
Interspecific Hybridization	87
References	88
6 Mutations and Epigenetics	93
Induced Mutations and Plant Breeding	93
Induced Mutations and Genomics-Led Plant Breeding	94
Targeting Induced Local Lesions in Genomes (TILLING)	95
Epigenetics	97
References	99
7 Genetic Engineering and Transgenic Breeding	103
Plant Genetic Engineering “Issues”	104
Transgenic Crops “Risks”	105
Transgene Flow	106
Pest Resistance and Impacts on Non-target Organisms	108
Detecting Genetically Modified Organisms and Other Safety Assessments	110
Transgenic Agriculture and Coexistence	111
Plant Genetic Engineering Impacts	112
Transgenic Agriculture Outlook	113
New Plant Breeding Techniques	114
References	116
8 DNA Sequencing, Other Omics and Synthetic Biology	125
DNA Sequencing	126
Next-Generation Sequencing	127

Genotyping-by-Sequencing	128
Other Relevant Omics for Plant Breeding	129
Breeding Informatics	131
Case Study: Omics-Led Legume Breeding	132
Plant Synthetic Biology: Another Tool for Plant Breeding?	134
References	134
9 Breeding Self-Fertilizing Plants: From Inbred to Hybrid Cultivars ...	141
Rice	141
Wheat	151
Tomato	159
References	162
10 Breeding Open-Pollinated, Hybrid and Transgenic	
Outcrossing Species	173
Maize	173
Cotton	185
Cassava	188
References	192
11 Polyploidy and Plant Breeding	201
Potato	205
Banana/Plantain	213
References	217
12 Seeds, Clones, and Perennials	225
Seed Development: Learning from a Model Plant System	227
Inbred and Open Pollinated Seed Cultivars	228
Hybrid Seed	228
Rapid Multiplication of Healthy and Improved Planting Material	
of Vegetatively Propagated Crops	229
Seed Health	230
Apomixis; Procreation Without Recreation	231
Perennial Crops	231
References	233
13 Diversity, Intellectual Property, and Plant Variety Protection	235
Plant Genetic Resources	239
The Question of Derivatives	239
Multinational Private and Public Seed Sectors	240
Managing Agro-biotechnology Intellectual Property Rights	242
References	243
Index	247

Plant Breeding in the Omics Era

Ortiz Ríos, R.

2015, XI, 249 p. 1 illus., Hardcover

ISBN: 978-3-319-20531-1