

Contents

1	Introduction	1
1.1	Quantitative Genetics	9
1.2	Population Improvement: What Do We Mean by Recurrent Selection?	11
1.3	Inbred Line Development	16
1.4	Conclusions	25
	References	28
2	Means and Variances	33
2.1	Genetically Narrow- vs. Broad-Based Reference Populations	33
2.2	Hardy–Weinberg Equilibrium	34
2.3	Means of Non-inbred Populations and Derived Families	36
2.4	Means of Inbred Populations and Derived Families	41
2.5	Mean of a Cross Between Two Populations	42
2.6	Average Effect	43
2.7	Breeding Value	45
2.8	Genetic Variance	46
2.9	Means and Variances in Backcross Populations	56
2.10	Heritability, Genetic Gain, and Usefulness Concepts	57
2.11	Generation Mean Analysis	60
	References	66
3	Resemblance Between Relatives	69
3.1	Introduction	69
3.2	Theoretical Basis of Covariance	70
3.3	Covariance Between Relatives as a Linear Function of Genetic Variances	71
	References	78
4	Hereditary Variance: Mating Designs	81
4.1	Bi-parental Progenies	86
4.2	Pure Line Progenies (Analysis in Self-Pollinated Crops)	90
4.3	Parent–Offspring Regressions	91
4.4	Design I	96

4.5	Design II	103
4.6	Design III	113
4.7	Diallel Methods	119
4.8	Partial Diallel	133
4.9	Triple Testcross	137
4.10	Triallel and Quadrallel	138
4.11	Inbred Lines	143
4.12	Selection Experiments	146
4.13	More on F_2 Populations (Special Case of $p = q = 0.5$)	148
4.14	Epistasis	159
	References	165
5	Hereditary Variance: Experimental Estimates	169
5.1	Experimental Results	170
5.2	Iowa Stiff Stalk Synthetic (BSSS)	179
5.3	Selection Experiments vs. Mating Designs for Prediction	184
5.4	Epistasis Variance and Effects	198
5.5	Correlations Among Traits and the Possibility for Indirect Selection	210
	References	216
6	Selection: Theory	223
6.1	Selection Among Populations	224
6.2	Selection of Genotypes Within Populations	225
6.3	Intra-population Improvement: Qualitative Traits	233
6.4	Intra-population Improvement: Quantitative Traits	236
6.5	Comparing Breeding Methods	260
6.6	Increasing Gain from Selection	272
6.7	Correlation Between Traits and Correlated Response to Selection	276
6.8	Multi-trait Selection	282
	References	285
7	Selection: Experimental Results	291
7.1	Measuring Changes from Selection	292
7.2	Improvement from Intra-population Selection	299
7.3	Improvement from Inter-population Selection	337
7.4	General Effects of Selection	345
7.5	Factors Affecting Efficiency of Selection	358
	References	373
8	Testers and Combining Ability	383
8.1	Theory	386
8.2	Correlations Between Lines and Hybrids	399
8.3	Visual Selection	404
8.4	Genetic Diversity	407
8.5	Testing Stage	408

8.6	General vs. Specific Combining Ability	415
	References	418
9	Inbreeding	425
9.1	The Need for Maize Artificial Pollination	425
9.2	Early Reports of Inbreeding	428
9.3	Inbreeding Systems	431
9.4	Inbreeding Due to Small Population Size	436
9.5	Estimates of Inbreeding Depression	442
9.6	Frequency of Useful Lines	456
9.7	Types of Hybrids Produced from Inbred-Lines	458
9.8	Heterozygosity and Performance	464
	References	471
10	Heterosis	477
10.1	Introduction and Major Achievements	477
10.2	Empirical Evidence	480
10.3	Genetic Basis	493
10.4	Biometrical Concept	497
10.5	Heterosis and Prediction Methods Across Genotypes	499
10.6	Components of Heterosis in Inter-varietal Diallel Crosses	515
10.7	Conclusions	519
	References	523
11	Germplasm	531
11.1	Origin of Maize	534
11.2	Classification of Maize Germplasm	538
11.3	Races of Maize in the Western Hemisphere	542
11.4	European Races of Maize	545
11.5	US Corn Belt Germplasm	548
11.6	Germplasm Improvement	552
11.7	Potential and Use of Exotic Germplasm	558
	References	570
12	Breeding Plans	577
12.1	Choice of Germplasm	581
12.2	Recurrent Selection and Germplasm Improvement	582
12.3	Integrating Recurrent Selection with Cultivar Development	591
12.4	Intra-Population Genetic Improvement	592
12.5	Inter-Population Genetic Improvement	609
12.6	Additional Considerations for Germplasm Improvement	631
12.7	Additional Considerations for Inbred Line Development	647
	References	649
	Index	655

Quantitative Genetics in Maize Breeding

Hallauer, A.R.; Carena, M.J.; Miranda Filho, J.B.

2010, XVI, 664 p., Hardcover

ISBN: 978-1-4419-0765-3