

Genetics, Genomics and Breeding of Potato

Editors:

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About the Book

Potato ranks among the world's most significant human food crops. Breeding, genetics, and genomics have contributed significantly to the improvement of this important crop. In this volume, world leaders in potato research review historical and contemporary potato research resulting in advances in nutritional quality, yield, disease and insect resistance, processability, plant growth and development, and other aspects. Also reviewed is research yielding significant molecular resources facilitating breeding, linkage and gene mapping, cytology, functional and structural genomics, and proteomics and metabolomics. Finally, future research developments that are likely to significantly advance efforts to understand and improve the potato are explored.

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Introduction to Potato: *J.M. Bradeen and K.G. Haynes*

- A Brief History of the Potato • Potato Morphology • Potato Taxonomy, Related Species, and Crossability
- Potato Production Statistics • Potato Nutritional Content • Future Prospects for Potato Research and Production

Classical Genetics and Traditional Breeding: *D. Carputo and L. Frusciante*

- Introduction • Conventional Breeding Methods • Breeding Objectives

Molecular Breeding for Potato Improvement: *D. De Koeper, H. Chen and V. Gustafson*

- Introduction: Molecular Breeding—the Beginning of a New Era • Germplasm and Variety Characterization
- Marker-assisted Gene Introgression • Breeding Strategies Incorporating DNA Markers • Transgenic Breeding • Conclusions

Molecular Linkage Maps: Strategies, Resources and Achievements: *H. Mann, M. Iorizzo, L. Gao, N.D'Agostino, D. Carputo, M.L. Chiusano and J.M. Bradeen*

- Introduction • Brief History of Mapping Efforts in Potato • Evolution of Marker Types: RFLPs to SNPs • Potato Mapping Populations: Structures and Strategies • Linkage Maps as Tools for Comparative Genomics: Accessing Biodiversity

Mapping and Tagging of Simply Inherited Traits: *J.C. Kuhl*

- Introduction • Virus Resistance • Nematode Resistance • Late Blight Resistance • Conclusions

Mapping Complex Potato Traits: *G.J. Bryan*

- Introduction • Complex Traits in Potato • Quantitative Pest and Disease Resistance • Tuber Life-cycle Traits: Dormancy and Tuberization • Tuber Morphological Traits: Tuber Shape and Eye Depth • Tuber Quality Traits • How Can the Genes for Potato Quantitative Traits be Identified?

Population Genetics and Association Mapping: *C. Gebhardt*

- Introduction • Potato Populations for Association Mapping • Phenotypic Variation • Detection and Scoring of DNA Variation
- Association Test Statistics • Association Studies in Potato • Conclusions and Outlook

Cloning of Late Blight Resistance Genes: Strategies and Progress: *J.M. Bradeen*

- Introduction • Potato R Gene Cloning Strategies • Progress Towards Cloning Late Blight R Genes: A Timeline • Future Prospects

Application of Molecular Cytogenetics in Fundamental and Applied Research of Potato: *T. Gavrilenko*

- Introduction • FISH Karyotyping and Physical Mapping of Potato Chromosomes • Studying Natural and Artificial Polyploids by Genomic *In Situ* Hybridization • Practical Applications of Molecular Cytogenetics

Functional Genomics: Transcriptomics: *X.-Q. Li*

- Introduction • Transcriptomics Technologies and Resources Generated • Regulation of the Transcriptome
- Application of Transcriptomics Resources • Concluding Remarks and Prospects

Proteomics and Metabolomics: *A.D. Hegeman*

- Introduction • Methodology • Current State of (Untargeted) Potato Proteomics and Metabolomics • Potato Protein and Metabolite Quality Traits • Evaluation of Potato Tuber Nutrition, Safety and Genetic Modifications • Conclusions

Future Challenges and Prospects: *T. Wendt and E. Mullins*

- Introduction • Challenges • Prospects • Conclusion

