

## Molecular Plant Breeding

Y. Xu. CAB International, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, UK. 2010. Hardcover, 734 p. \$240.00. ISBN 978 1 84593 392 0.

**Y**UNBI XU, who works as a molecular maize breeder and head of the Applied Biotechnology Center at the International Maize and Wheat Improvement Center (CIMMYT), El Batan, Mexico, provides a comprehensive overview of molecular plant breeding in this timely book. The late Norman E. Borlaug, and Regents and McKnight Professor Ronald L. Phillips (Univ. of Minnesota) wrote two independent forewords for welcoming this single-authored book. Its 15 well-written chapters include topics such as DNA marker technology, “omics” science, gene mapping, quantitative genetics, plant genetic resources, marker-aided breeding methodology (both theory and practices), genotype-by-environment interaction, genetic transformation, breeding informatics, decision support tools, and intellectual property rights (emphasizing plant variety protection). Each chapter, which underwent a comprehensive peer-review process, includes a wealth of up-to-date information with supporting tables, figures, and cited references, whose list is included at the end of the book.

The introductory chapter sets the scene for reading the book. It gives an appropriate overview on various issues, from domestication of crop plants through major developments in the history of plant breeding—including the Green Revolution—to modern genetic enhancement methods aided by molecular tools. This first chapter also provides a summary on quantitative genetics and selection theory. The next two chapters on breeding tools explain the theory behind genetic markers and maps (Chapter 2), as well as “omics” and arrays (Chapter 3). Table 2.4 on genetic maps in plants should have reference to other crops beyond those 11 listed (mostly cereals). Chapter 3 could have benefitted the readership if a table was given summarizing the completed or ongoing plant genome sequencing projects and their web links for further infor-

mation. The fourth chapter on populations will be very useful for those searching for offspring options for their further research in plant genetics and breeding. Plant genetic resources management, evaluation, and enhancement are the subject of Chapter 5, which condenses the available wealth of information for each in crisply written sub-sections. Table 5.1 on core collections (focusing on cereals and a couple of root and tuber crops) misses many others known for legumes, fruits, and vegetables.

Chapters 6 to 10 are the core of this book. Two chapters each (one about theory and the other on practice) are devoted to molecular dissection of complex traits and marker-assisted selection (MAS). The various approaches and statistical methods for mapping quantitative trait loci (QTL) receives significant attention in Chapter 6, whereas Chapter 7 answers questions on number of genes controlling QTL in segregating populations, separating closely linked QTL into single units, comparing QTL across different genetic backgrounds and developmental stages, epistasis, or handling multiple traits and expression QTL. The components of MAS, marker-aided gene introgression and pyramiding, selection for quantitative traits and long-term selection are included in Chapter 7. This chapter could have benefitted by including examples for each of the above topics, thereby illustrating for readers how they can apply the theory of MAS into their genetic research or plant breeding program. The practice of MAS is discussed amply in Chapter 9, which highlights the diverse selection schemes available to plant breeders, the bottlenecks that may limit its application in plant breeding, its cost-benefit analysis, and traits suitable for MAS. Although Tables 9.1

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and 9.3 give a few examples of successful MAS—mostly for host plant resistance—in grains, it would have been better if they included more recent cases from other crops and traits. Chapter 10 deals with the analysis, interpretation, molecular-aided understanding, and management of genotype-by-environment interactions (GEI). The importance of GEI is clearly shown by this chapter that gives details of the various methods available for its analysis and ends with the molecular dissection of GEI. It also highlights the need for defining mega-environments for cultivar development. Table 10.1 lists grain yield data from a multi-environment trial that are cited once in the text but not used thereafter as an example for analyzing such a trial. The author does not indicate in Table 10.2 that the expected mean squares of the analysis of variance refer to a random model for all sources of variation.

The isolation and functional analysis of genes is the subject of Chapter 11, whereas the next chapter focuses on gene transformation technology and its use for producing transgenic crops. Perhaps some extra graphs would have been useful to illustrate the methods used for isolating genes and doing their functional analysis as it was done for Chapter 12. The latter gives a good treatment of trait stacking for producing a new generation of transgenic crops. It ends with an overview on the commercialization of transgenic crops and analyzing some of the issues (risk assessment, regulatory systems, monitoring transgenes) affecting it. Chapter 13 on intellectual property rights and plant variety protection, although comprehensive, may be regarded as the weakest in this book. It was not surprising since it was written by a non-specialist in the subject, who lists—using a wordy style rather than synthesizing—

the many issues affecting proprietary plant breeding and genetic resources exchanges and flows. The author and publisher may wish to consider inviting a specialist to contribute to this chapter in a new edition of this book. The content of last two chapters, to the best of my knowledge, can be regarded as new topics in a plant breeding book: breeding informatics and decision support tools. They are unique, worth reading, and the author does well by integrating them in such a textbook because they are essential tools for modern plant breeding.

This book benefits from Xu's previous work on rice genetic enhancement, ongoing maize research, and teaching of molecular plant breeding. His previous book *Molecular Quantitative Genetics* co-authored by L. Zhu (1994, Chinese Agricultural Press, Beijing, China, 291 p.) has been used extensively as a textbook by many Chinese universities. Xu, by publishing this book, has been able to bridge the gap between the advances in plant biotechnology and its use in the genetic betterment of crops. This book can be recommended as a source of information for the state-of-the art in molecular plant breeding. Researchers and students involved in plant breeding and genetics are the intended readership of this new encyclopedic handbook on molecular breeding. They will be well served by reading this book, which may become a standard reference for breeding new crops in the “omics” era.

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