Preface

Plant breeding, the science for plant genetic improvement, made great progress in the twentieth century with the rediscovery of Mendelian genetic principles in 1900. Most of the traditional breeding methods were established before the 1960s leading to the development of high-yielding varieties in cereal crops which brought the "Green Revolution" during the 1960s–1980s. Recent progress in biotechnology and genomics has expanded the breeders' horizon providing a molecular platform on the traditional plant breeding, which is now known as "plant molecular breeding." Under a new paradigm of plant breeding in the twenty-first century, breeders try to create new variation through the direct manipulation of target genes instead of phenotype-based trait selection. Genetic resources are extended to the unrelated species because transgenic technologies break through the sexual limit for gene transfer. In addition, selection and genetic fixation in the progeny can be performed by monitoring of genes and genomics information by which breeders can develop new varieties precisely and quickly.

Although diverse technologies for molecular breeding have been developed and applied individually for plant genetic improvement, the common use in routine breeding programs seems to be limited probably due to the complexity and incomplete understanding of the technologies. This book is intended to provide a guide for researchers or graduate students involved in plant molecular breeding by describing principles and application of recently developed technologies with actual case studies for practical use.

This book is organized in nine chapters. In Chap. 1, a brief history and perspectives of plant breeding are presented, including the directions of future development of breeding methods. In Chap. 2, the basics on genetic analysis of agronomic traits are described, including how to construct molecular maps and how to develop DNA markers. In Chap. 3, methods of detecting QTLs are illustrated, while in Chap. 4, the application of molecular markers in actual plant breeding is described in detail with case studies. In Chap. 5, genome sequencing and how to analyze the association between sequencing data and phenotype are introduced, including the epigenome and its possible application to plant breeding. In Chap. 6, genome-wide association studies are explained so that researchers can analyze the data following

the manual including the introduction of software for analysis of population structure. In Chap. 7, methods for mutation screening and targeted mutagenesis are described. In Chap. 8, how to isolate the genes of interest and how to analyze the gene function are presented with case studies. In Chap. 9, the basics of gene transfer in major crops and the procedures for commercialization of GM crops are explained.

We attempted to cover most of the molecular tools applicable in plant breeding; however, due to the limitation of the book volume, we had to skip some skills that are still under development. Therefore, in this book, only key technologies which are currently used in plant breeding are mentioned. Since technologies per se are being advanced, we may add newly emerging ones with a chance given later. We hope this book would be a valuable reference for plant molecular breeders and, in addition, will become a cornerstone for the development of new technologies in plant molecular breeding for the future.

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