Advances in Plant Breeding Strategies: Agronomic, Abiotic and Biotic Stress Traits

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Volume 2

Springer

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ISBN 978-3-319-22517-3 ISBN 978-3-319-22518-0 (eBook)
DOI 10.1007/978-3-319-22518-0

Library of Congress Control Number: 2016933868

Springer Cham Heidelberg New York Dordrecht London

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media (www.springer.com)

Preface

Thus far conventional plant breeding methods have been successfully used for sustainable food production worldwide. Human population is increasing at an alarming rate in developing countries, and food availability to feed the additional mouths could gradually become a serious problem. Moreover, agriculture production is being adversely affected as a result of environmental pollution, rapid industrialization, water scarcity, erosion of fertile topsoil, limited possibility of expanding arable land, lack of improvement of local plant types, erosion of genetic diversity, and dependence on a relatively few crop species for the world's food supply. According to FAO, 70 % more food must be produced over the next four decades to feed the projected 9 billion people by the year 2050. Only 30 plant species are used to meet 95 % of the world's food requirements, which are considered as the *major crops*. The breeding programs of these crops have been very much dependent on the ready availability of genetic variation, either spontaneous or induced. Plant breeders and geneticists are under constant pressure to sustain and expand food production by using innovative breeding strategies and introducing minor crops which are well adapted to marginal lands and provide a source of nutrition as well as crops having abiotic and biotic stress tolerances. In traditional breeding, introgression of one or a few genes in a cultivar is carried out via backcrossing for several generations. Now, new innovative additional plant breeding tools, including molecular breeding and plant biotechnology, are available to plant breeders, which have a great potential to be used along with the conventional breeding methods for sustainable agriculture. With the development of new molecular tools such as genomics, molecular marker-assisted backcrossing has made possible rapid introgression of transgenes, reduction of linkage drag, and manipulation of genetic variation for the development of improved cultivars. For example, molecular breeding has great potential to become a routine standard practice in the improvement of several crops. However, a multidisciplinary approach of traditional plant breeding, plant biotechnology, and molecular biology would be strategically ideal for developing new improved crop varieties worldwide to feed the world. This book highlights the recent progress in the development of plant biotechnology, molecular tools, and their usage in plant breeding.

The basic concept of this book is to examine the use of innovative methods augmenting traditional plant breeding toward the development of new crop varieties, grown under different environmental conditions, to achieve sustainable food production.

This book consists of two volumes: Volume 1 subtitled *Breeding, Biotechnology and Molecular Tools* and Volume 2 subtitled *Agronomic, Abiotic and Biotic Stress Traits*. This volume contains 18 chapters highlighting breeding strategies for specific plant traits including improved nutritional and pharmaceutical properties as well as enhanced tolerance to insects, diseases, drought, salinity, and temperature extremes expected under global climate change. Chapters addressing these topics are grouped into four parts: Part I Sustainability, Nutrition and Pharmaceuticals; Part II Forage and Tree Traits; Part III Abiotic Stress Tolerance; and Part IV Biotic Stress Resistance.

Each chapter begins with an introduction covering related backgrounds and provides in-depth discussion of the subject supported with high-quality color photos, illustrations, and relevant data. The chapter concludes with prospects for future research directions and a comprehensive list of pertinent references to facilitate further reading.

The book is an excellent reference source for plant breeders and geneticists engaged in breeding programs involving biotechnology and molecular tools together with traditional breeding. It is suitable for both undergraduate and postgraduate students specializing in agriculture, biotechnology, and molecular breeding, as well as for agricultural companies.

Chapters were written by internationally reputable scientists and subjected to a review process to assure quality presentation and scientific accuracy. We greatly appreciate all chapter authors for their participation toward the success and quality of this book. We are proud of this diverse collaborative undertaking, especially since the two volumes represent the efforts of 105 scientists from 29 countries. We are also grateful to Springer for giving us an opportunity to compile this book.

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