Book Reviews

Citrus: Genetics, Breeding and Biotechnology. Iqrar Ahmad Khan (editor). 2007. CABI, CABI North American Office, 875 Massachusetts Ave., 7th Floor, Cambridge, MA 02139, www.cabi.org. 370 p., incl. index. $160.00, hardback, ISBN 9780851990194.

This book has 17 chapters, each with a different author or team of authors. The idea for the book came from discussions at the International Society of Citriculture congresses at Orlando, Florida (2000) and Agadir, Morocco (2004). The preface states that nearly all active citrus breeders of the world were willing to join hands to consolidate up-to-date information to accelerate citrus breeding.

The book covers a great diversity of topics relating to citrus genetics. Two chapters discuss the origin and taxonomy of citrus and germplasm resources. There are chapters on haploidy, cytogenetics, and ploidy manipulation. About half of the chapters I would classify as biotechnology–molecular biology, including chapters on somaclonal variation, somatic hybridization, microplast-mediated chromosome transfer, mapping and marker-assisted selection, cloning genes, and two chapters on genetic transformation. In addition, there are chapters on nucellar embryony, mutation breeding, and shoot-tip grafting in vitro.

Like most edited books with chapters by numerous different authors, this one lacks the unity and organization of a single-author book. Each chapter is its own unit, with a good bit of redundancy, a few contradictions, and little evidence of coordination among the chapters. For me, this property was not a serious defect. Most chapters are well written and contain useful information not readily available elsewhere. My greatest complaint about the book is that I do not believe it presents a balanced and complete assessment of the current status and potential for genetic improvement in citrus. I am particularly amazed by the absence of a chapter assessing the potential for what I would call "conventional breeding." As a disclaimer, I am a "conventional" breeder who has worked 35 years on a crop that has a short juvenile period, little or no apomixis, a convenient small size, no thorns, and growers and marketers who are amenable to and eager for change.

In almost every major world crop, the principal method of developing new cultivars is recurrent selection. For these crops, improved cultivars are available almost on a yearly basis. In recurrent selection, the best cultivars or breeding lines are used as parents, large hybrid seedling populations are grown, and the best progeny are selected for use as parents to produce the next generation of seedlings. This cycle is repeated over and over, with progress accumulating additively with each breeding cycle. In most crops, recurrent selection has produced cultivars that have better quality and twice or thrice the genetic yield potential of cultivars of 50 years ago. Judging from this book, citrus workers are largely convinced that recurrent selection has little or no potential in citrus. Indeed, conventional breeding is used as a "whipping boy" by the authors of several chapters to explain why most current citrus scion and rootstock cultivars are based on crosses made 80 or 100 years ago. Several chapter authors have great optimism for the particular biotechnological methods they are working with. In my opinion, speed and efficiency should only be claimed for a method after it has resulted in at least one new cultivar that has been in commercial production for at least 5 years on at least 100 ha and for which growers are clamoring to plant more hectares.

Recurrent selection is difficult in citrus because the trees are large and have a long generation time. Apples present the same difficulties, yet the last 20 years have seen a profusion of new and better apple cultivars compared to very few for citrus. Two other obstacles to citrus breeding are much cited—apomixis and the fact that the most important commercial types of citrus (sweet oranges, grapefruit, lemons) do not represent biological species with a rich underpinning of useful genetic variation, but rather are interspecific hybrids that have little or no value as parents. Today, however, great progress in "conventional" breeding is possible because the nature of genetic variation in citrus is much better understood. The chapter on citrus germplasm resources states (page 50): "The three ancestral species (of *Citrus*) only reproduce sexually since they are not apomictic. Consequently, some mandarins, pummelos and citrons have higher levels of genetic diversity since many of the cultivars have arisen through sexual hybridization. On the other hand, most of the cultivars of orange, grapefruit, lemon and some mandarin groups such as satsumas and clementines originated from nucellar seedlings or budsports. Consequently, the amount of genetic diversity within these groups is relatively low, in spite of there being many named varieties with important differences in horticultural traits." On pages 60 and 61, the origin and diversity within the three "primal" species of citrus are discussed further. The importance to breeders of understanding the genetic structure of *Citrus* is reiterated by Gmitter et al. (p. 288): "Most scion cultivar groups, specifically sweet oranges, grapefruit, most lemons, and many mandarins, have diversified by somatic mutations and not through sexual recombination and segregation; these groups, by virtue of their limited genetic base in addition to the other breeding impediments, are not amenable to genetic manipulation through hybridization strategies." Clearly, the way to breed sweet oranges, grapefruit, lemons, and, to some extent mandarins (i.e., the most important citrus types in the world) is to find out what their original parent "primal" species were (most are now known) and use them to make crosses. Why this has not been done more is a mystery to me.

Some of the chapters will be quite interesting to citrus non-specialists, for example, the chapters on citrus origin and taxonomy and citrus germplasm resources. The book will be of interest to biotechnologists using the methods discussed therein with other crops. Anyone who collects or maintains germplasm collections will benefit from the chapter on citrus germplasm resources. Readers interested in the induction and use of polyploids will find the chapter on seedlessness and ploidy manipulation worthwhile. The chapter on shoot tip micrografting, probably used more with citrus than with any other crop (mainly for eliminating systemic pathogens in the scion wood) is well written and beautifully illustrated (the scions are only 0.14 mm tall).

The short but excellent chapter on mutation breeding describes what may be one of the best examples in all of plant breeding of the practical use of mutagenesis: the elimination or reduction of seediness in citrus cultivars. Many citrus genotypes have the ability to set full crops of full-sized fruit even if few or no seeds develop. Budwood of seedy cultivars, irradiated, grafted, and evaluated, has produced seedless or reduced-seed versions of several cultivars at high rates (1.5% to 13% in mandarin and grapefruit).

To summarize, many readers with a diversity of interests will find parts of this book useful. This reviewer hopes that citrus workers will stop referring to single-plant wide-hybrids as "species" and will not continue to propagate the myth that breeding citrus by recurrent selection starting with the "primal" species is wasted effort.

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Postharvest Pathogens and Disease Management. 2005. P. Narayanasamy. John Wiley, Somerset, NJ. 578 pages. $135.00. Hardcover. ISBN: 978-0-471-74303-3

Postharvest diseases are responsible for the spoilage of durable and fresh perishable commodities worldwide, particularly in developing countries or among products transported long distances or held in storage. In this book, Narayanasamy reports that postharvest losses for durable commodities are about 10% worldwide and that losses of fresh commodities are about 5% in developed countries and may average 25% in underdeveloped countries. He extensively reviews the biology, detection, and management of these diseases among seeds, plant materials for propagation, fruits, and vegetables. Related subjects, such as mycotoxins and food-borne human pathogens, are also discussed at some length. Few texts on postharvest

diseases have been published; in recent times, the sole example is Riva Barkai-Golan's *Postharvest Diseases of Fruits and Vegetables*, published in 2001 and an excellent, comprehensive treatise on postharvest pathology, although it is limited to fruits and vegetables.

Nearly 600 pages in length, the majority of subjects are reviewed thoroughly, and most statements of fact appear with copious supporting references gleaned from authors worldwide (about 2000 sources are referenced). When I examined chapters on subjects in which I thought I was well-versed, inevitably I found new and useful information. Early chapters in the book address pathogen detection and identification, pathogen ecology, disease development, and symptom expression. Middle chapters address the influence of cultural practices, handling, and storage environments on postharvest disease incidence. Later chapters discuss practical and experimental methods of disease management, including physical treatments, host resistance incorporated by conventional breeding or molecular means, biological control, and chemical control by conventional fungicides and alternatives to them, including natural products. The last chapter describes examples of integrated systems employed to minimize postharvest diseases. The index is comprehensive and useful. The book contains a modest number of black and white illustrations, figures, and tables, and would have benefited by more of them and some color images.

A particularly useful feature of this book for researchers is the inclusion, at the end of many chapters, of appendices where specific methods are described and that are appropriate for the subject of that chapter. Methods described include classical ones, such as inoculation, pathogen culture media, microscopy, and disease evaluation tests, as well as molecular and biochemical techniques, such as enzyme activity assays, antibody production, ELISA, PCR, PAGE, and many more. Narayanasamy has done a great service by authoring this book. It is a valuable reference for researchers, advanced students, or educators in this discipline. Its price is fair and relatively low.

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