

Preface

This book begins with a discussion of the overall trends in fruit breeding, intellectual property management, the breeding for cultivars with enhanced health benefits, and an assessment of some of the emerging fruit crops that have great potential for further development. The next three sections: small fruits, tree fruits, and nut crops contain crop-specific chapters describing the economic importance, use, adaptation, origin, domestication, breeding history, accomplishments, goals, breeding techniques, and the advances in the use of biotechnology for each crop. The crops reviewed have domestication history of millennium to decades and breeding activity ranging from thousands of generations to just a few generations. Likewise, their biology and ploidy levels (diploid to octoploid) are diverse which leads to a plethora of approaches to their genetic improvement.

Breeding of perennial fruit species is a long-term activity involving a high investment as compared to annual crops due to two challenges: long juvenile periods and large plant size. In spite of these difficulties, breeding programs have been developed in all important perennial fruit crops, aimed at the improved economic profitability of the crops by increasing yields, altering the harvest window, creating new fruit types, and improving fruit quality while simplifying management. The recent increase in activity has been encouraged by the integration of the intellectual property rights (IP rights) in fruit production which has created substantial research incentive in private and public spheres for innovation in the fruit industry.

Yield is intertwined with the ease of management, as a prerequisite of high yields is excellent adaptation to the environment. This includes the ability to grow and yield under the abiotic conditions of soil, temperature, and humidity and the biotic stresses, such as fungus, bacteria, nematodes, and viruses in the production zone. This later objective has recently increased in importance with the enhanced public awareness of the negative consequences of the use of agrochemicals. This has spurred the dramatic increase of research into the development of sustainable fruit production systems. The globalization of the fruit industry is resulting in increased activity in developing cultivars of temperate fruits adapted to subtropical and tropical environments. Beyond the simplification of management by reducing the use of agrochemicals, work on the modification of tree architecture either through dwarfing

rootstock or unique scion growth habits and the conversion of self-incompatible crops to self-compatible or parthenocarpic crops continue to improve the quantity and consistency of yield and the ease of managing the crops.

The value of fruit generally increases when less is available. Thus, much breeding has been done to extend the harvest season both earlier and later when fruit supplies are lower. Consequently, there has been much progress. A good example would be the extension of the peach season from 1–2 months to 6–8 months through the breeding for shorter and longer fruit development periods. In addition to this, the shift of adaptation of cultivars to earlier and later blooming areas has contributed to these extended fruit marketing seasons. Although there has been success, much work needs to be done especially in the improvement of fruit quality at the extremes of the harvest season. Another approach to reduce the availability is to offer something unique. In the US peach industry, this has played out several times starting with the introduction of the nectarine, and then with white fleshed fruit, and now with pantao types. This work continues across all crops and involves traits, including appearance (flesh and skin color, shape, size), quality (flavor, aroma, texture, acidity, sugar, levels of health promoting phytochemicals, storability), and convenience (seedlessness, glabrous skin, ease of peeling, size, shelf life) traits.

The traditional breeding approach is the foundation of our success. Nevertheless, the integration of the new genetic and molecular tools into the breeding programs makes a major impact. These new tools increase the efficiency of the breeding programs by identifying important genes at the molecular level. Molecular markers have been developed for genetic studies and the identification of cultivars in the major fruit species. Genetic linkage maps are available in many perennial species, including stone fruits, pome fruits, strawberry, grapes, chestnut, and walnut. These maps have been key in the identification and selection of the target genes or markers linked to them. The advent of genomics, whole genome sequences (apple, peach, grape, strawberry, and citrus) and the rapidly improving DNA sequencing technologies have opened up new opportunities for developing new markers and for identifying and understanding the gene function which controls the important phenotypes in fruit breeding. In vitro technology has led to improved propagation and virus certification protocols, efficient procedures to grow out unique hybrid seedlings (embryo rescue, in vitro grafting, somatic hybridization), and to create transgenic plants.

This book tries to present a broad vision of fruit breeding to stimulate the thought process and hopefully inspire the next generation of fruit breeders to create the breakthrough cultivars of the future.

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