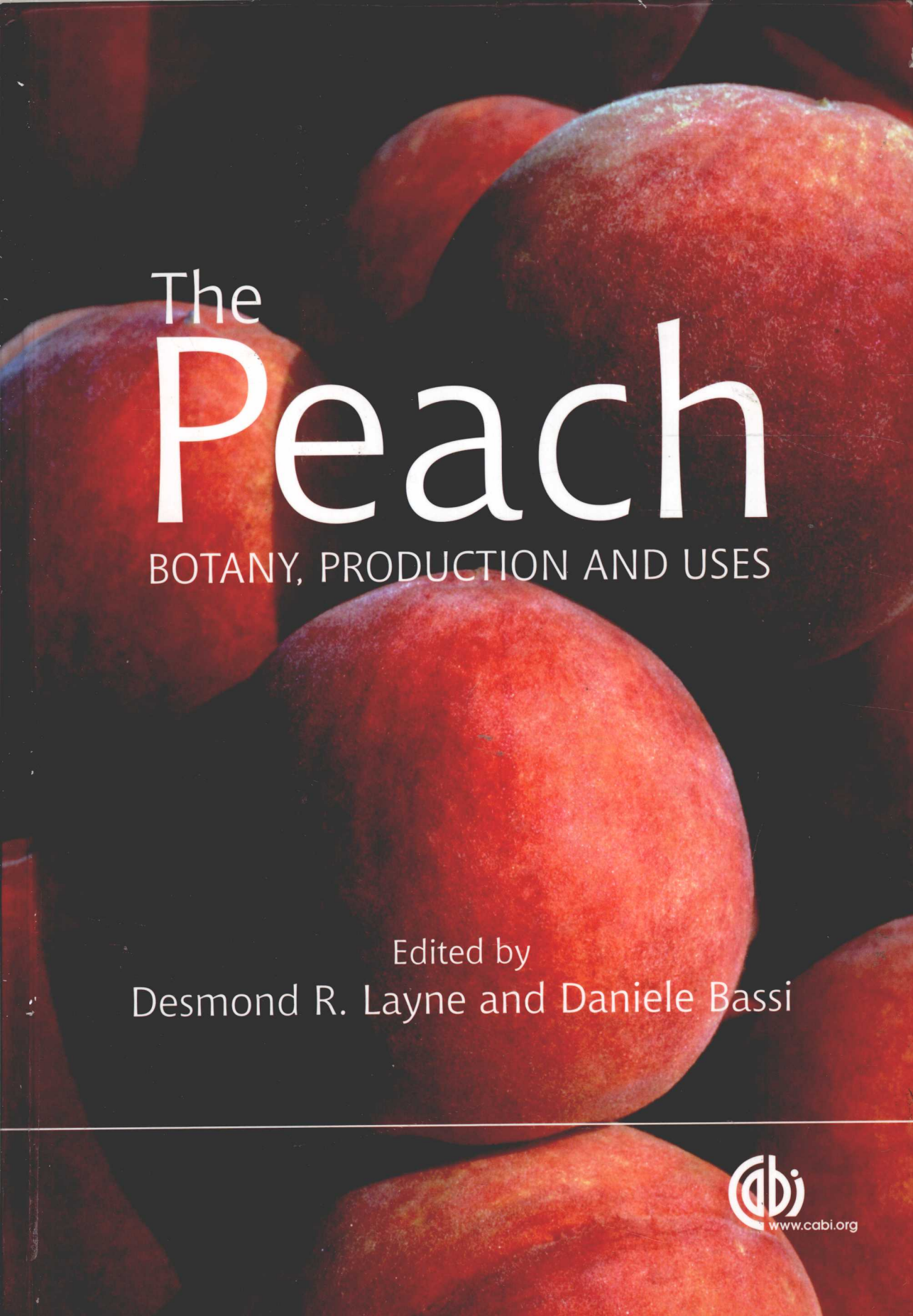

The Peach

BOTANY, PRODUCTION AND USES

Edited by
Desmond R. Layne and Daniele Bassi

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The Peach

Botany, Production and Uses

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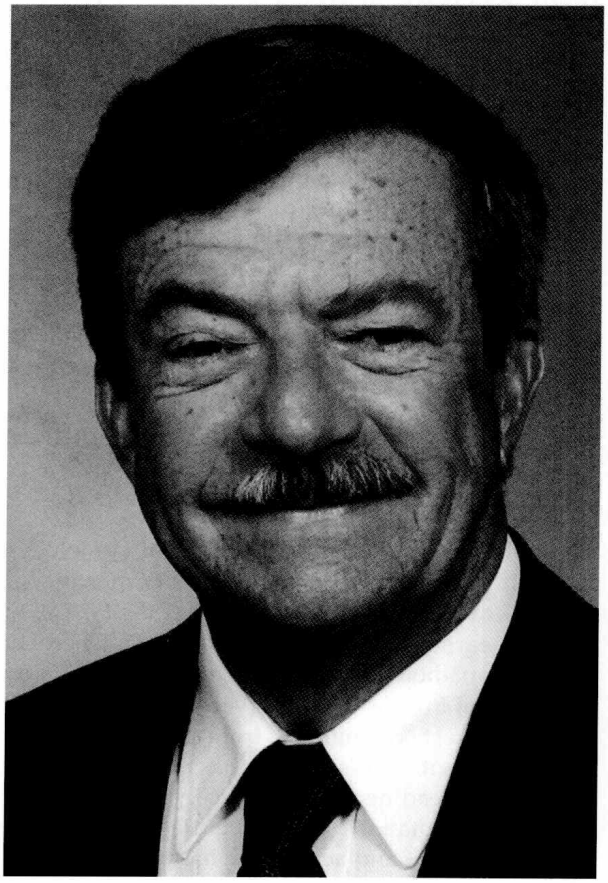
The Peach

Botany, Production and Uses

Dedication

Richard E.C. Layne



Richard E.C. Layne served as Research Scientist (1963–1996) and directed the fruit breeding programme (1969–1996) at the Agriculture and Agri-Food Canada Research Centre at Harrow, Ontario. While at Harrow, his scientific research, new cultivar development and outreach efforts significantly impacted the Canadian tree fruit industry and many other temperate, fruit-growing regions around the world. After growing up on the tropical island of St Vincent, West Indies, he attended McGill University, where he earned his BSc degree in Agronomy. Next, he earned MS and PhD degrees in Agronomy from the University, of Wisconsin. His first research experience with fruit crops occurred when he began his new job with Agriculture Canada at Harrow in 1963.

During his tenure at Harrow he was responsible for the introduction of 36 new fruit cultivars, ornamentals and rootstocks. Specifically, these included 15 peaches (ten cultivars, three ornamentals and two rootstocks), 13 apricots (12 cultivars and one rootstock), four nectarines and four pear cultivars. In addition to Ontario, these cultivars play significant roles in the fruit crop industries of Michigan, New York, Pennsylvania, New Jersey and various European countries. This

is due, in part, to their improved bud and wood cold hardiness, superior disease resistance, attractive colour, good eating quality and consistency of production.

In Ontario, his peach cultivars span the entire ripening season. Those that are currently most widely planted include 'Harrow Diamond', 'Harrow Beauty', 'Harson', 'Harrow Dawn', 'Harrow Fair' and 'Harblaze' (nectarine). His apricots also span the ripening season in Ontario, with 'Harcot' and 'Harogem' being those cultivars most widely planted. 'Haroblush', 'Harojoy', 'Harostar', 'Hargrand' and 'Harval' are becoming more widely planted now. His 'Harlayne' apricot with natural resistance to *Plum pox virus* has become a donor of this resistance trait in conventional breeding programmes around the world. 'Harrow Delight', 'Harrow Sweet' and 'AC Harrow Delicious' pears all offer improved tolerance to fireblight.

In addition to his cultivar development work, his pioneering work on cold hardiness physiology and applied work on scion/rootstock relationships, peach orchard management and integrated production systems including irrigation have added significantly to the pomological scientific literature. This includes more than 130 publications and six book chapters.

He has received numerous research awards and served in important leadership roles during his career. These include the Wilder Silver Medal (1996) awarded by the American Pomological Society (APS) and Outstanding Researcher (1993) by the American Society for Horticultural Science (ASHS). In 1992 he was elected a Fellow of ASHS. He received the Carroll R. Miller award from ASHS in 1977, 1978, 1982 and 1985 for 'excellence in research dealing with the improved production and utilization of peaches'. He received the Paul Howard Shepard Award for the best paper published by the APS in 1967 and 1982. He was President (1991/2) of the APS and he was also President of the Canadian Society for Horticultural Science (1976/7). He has been an international consultant to the USA, Brazil and China, and participated in an exchange fellowship with INRA, France.

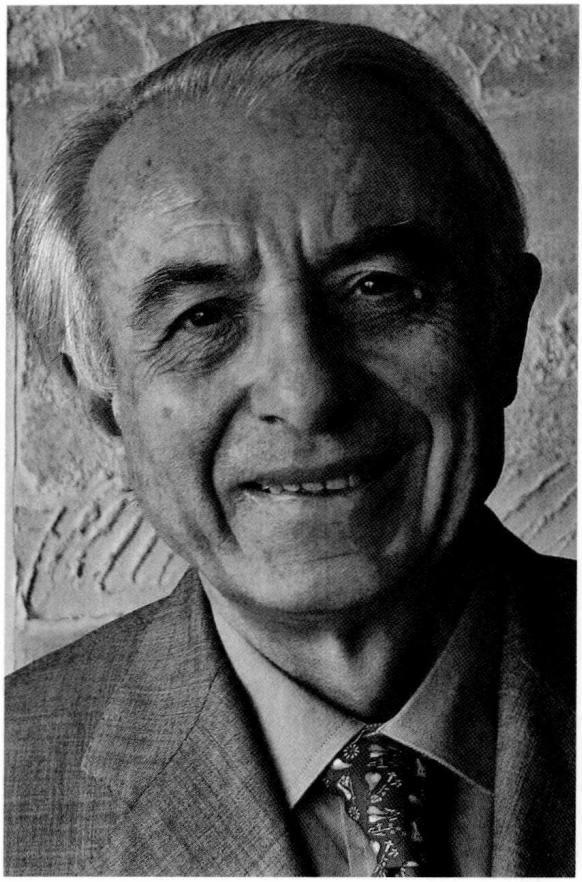
As a young boy, I fondly remember going with my dad to his research orchards and seeing and tasting the results of his labours. I had the privilege of learning much about other cultures and the importance of scientific collaboration and exchange while sitting at the dinner table at our home as we hosted scientists visiting my dad from around the world. While in college assisting him in his breeding and orchard management programmes at Harrow, I developed a passion for pomological research and extension that has been the focus of my career. My dad has been and continues to be a great friend, mentor and inspiration; and I fondly dedicate this book to him.

Desmond R. Layne

Silviero Sansavini

Silviero Sansavini has been Professor of Pomology at the University of Bologna, Italy, since 1974. After growing up on a small fruit farm in the heart of one of the major fruit-growing areas in northern Italy (the Romagna part of the Po Valley), he attended the University of Bologna, where he earned a degree in Agricultural Science. His early career involved a stint as an extension phytopathologist, before being hired at the same university, where he went through the ranks to Full Professor, and served as Chairman of the Department of Fruit and Woody Plant Sciences almost continuously from 1977 to the end of 2007.

A 'man with a mission', he has promoted the art and science of fruit growing throughout his career by leading many nationally funded research projects and participating in many collaborative international ones, including several funded by the EU. As a natural consequence of this commitment and activity, he has been convener and/or organizer of well over 100 scientific meetings or extension events at the international and national levels. He was elected Chairman of the International Society for Horticultural Science in 1994 and in his 4-year tenure he organized a signal event for horticulture: The World Congress on Horticultural Research (Rome, 1998), the first joint venture carried out by the International Society for Horticultural Science and the American Society for Horticultural Science (ASHS), which marked the first



time that horticulturists from all over the globe had convened to discuss political and economic aspects related to worldwide horticultural research.

He has received many awards recognizing his dedication to horticulture: from the National Canners Association Award (assigned by the ASHS for his work on 'ripening of nectarines and canning peaches') to the Wilder Medal 2000 awarded by the American Pomological Society, the Gold Veitch Memorial Medal from the Royal Horticultural Society (London, UK) and an Honorary Degree in Horticultural Sciences from the University of Budapest, Hungary. At the national level, he has been recognized by the Italian Ministry of Higher Education. He was named ASHS Fellow in 1995.

His editorial activity is tireless. He has been Editor since 1986 of the monthly Italian journal *Rivista di Frutticoltura*, and is an editorial board member of the following journals: *Tree Fruit Production* (Binghamton, New York, USA), *Fruits* (CIRAD, Montpellier, France), *L'Arboriculture Fruitière* and the *International Journal of Agronomy, Agricultural Ecosystem and Plant Genetics* (INRA, Montfavet, France). Throughout his career he has edited the proceedings of innumerable symposia and meetings at the international and national levels.

He is also Member of several academies: the Italian National Academy of Agriculture, the Italian Academy of Science, a Corresponding Member of the Academie d'Agriculture of France, the Italian Academy of Grape and Wine and the prestigious Academy of 'Georgofili' (Florence, Italy).

He is author, co-author or editor of more than 500 papers, proceedings and books on biological, physiological and genetic aspects of pome and stone fruits. His in-depth command of very diverse facets of horticultural research is witness to his passionate commitment to horticulture as a whole, his scientific curiosity and his hard-working and demanding attitude, which are the unique traits that have attracted hundreds of students from Italy and abroad to work with him. His students, many of whom have followed his path in research, value the privilege of working with one of the most dedicated, open-minded and challenging personalities of the international fruit science community.

Daniele Bassi
Luca Corelli-Grappadelli

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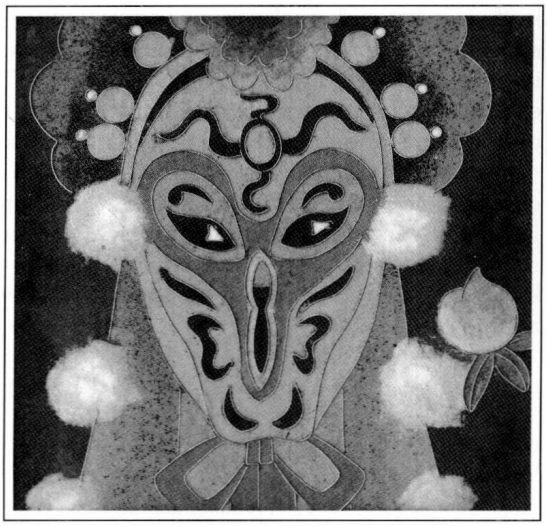
Preface

Before the 19th century, many non-Asians believed that the peach originated from Persia (modern-day Iran). Peach probably came to Persia from China along the silk trading routes in the 2nd or 3rd century BC. The Persian origin hypothesis was due, in part, to the fact that peaches were brought from Persia to Europe by the Roman army in the 1st century BC. Alphonse De Candolle in his *'Origin of Cultivated Plants'* (1885, Appleton and Co., New York, pp. 221–229) contended that peach originated in China. In his tome, *'The Peaches of New York'* (1917, J.B. Lyon Co., Albany), U.P. Hedrick made the same assertion. In fact, Chinese literature refers to peach more than 1000 years before it first appeared in any European writings. There is documented evidence of peach cultivation in China for more than 3000 years ago.

The peach is a symbol of immortality in Taoist mythology. The Queen Mother (goddess) of the West (Xi Wang Mu) had a jade palace that was surrounded by a beautiful garden containing the peach trees of immortality. In the classic Chinese novel, *'The Journey to the West'* (Wu, Ch'eng-en ~1590 AD, translated by Anthony C. Yu), Sun Wukong, or the Monkey King (picture inset), attained immortality as a result of a memorable visit to this garden:

> 'I have been authorized by the Jade Emperor,' said the Monkey King, 'to look after the Garden of Immortal Peaches.' The local spirit hurriedly saluted him and led him inside. The Monkey King then asked the local spirit, 'How many trees are there?' 'There are three thousand six hundred,' said the local spirit. 'In the front are one thousand two hundred trees with little flowers and small fruits. These ripen once every three thousand years, and after one taste of them a man will become immortal with healthy limbs and a lightweight body. In the middle are one thousand two hundred trees of layered flowers and sweet fruits. They ripen once every six thousand years. If a man eats them, he will ascend to Heaven with the mist and never grow old.



> At the back are one thousand two hundred trees with fruits of purple veins and pale yellow pits. These ripen once every nine thousand years and, if eaten, will make a man's age equal to that of Heaven and Earth, the sun and the moon.' Highly pleased by these words, the Monkey King made thorough inspection of the trees and a list of the arbors and pavilions before returning to his residence. One day he saw that more than half of the peaches on the branches of the older trees had ripened, and he wanted very much to eat one and sample its novel taste. Closely followed, however, by the local spirit of the garden, the stewards, and the divine attendants, he found it inconvenient to do so. He therefore devised a plan on the spur of the moment and said to them, 'Why don't you all wait for me outside and let me rest a while in this arbor?' The various immortals withdrew accordingly. The Monkey King then took off his cap and robe and climbed up onto a big tree. He selected the large peaches that were thoroughly ripened and plucking many of them, ate to his heart's content right on the branches.

Peach is revered as a delicious and healthy summer fruit in most temperate regions of the world. It is highly perishable but, depending on market demands and fruit availability, it can be a very profitable fruit crop for the careful farmer. Today it is a major fruit crop of commerce in China, Italy, Spain, the USA, and Greece, the top five producing countries, respectively. Currently, there are nearly 1.5 million ha of peaches in production worldwide with the vast majority planted in China (approx. 46%).

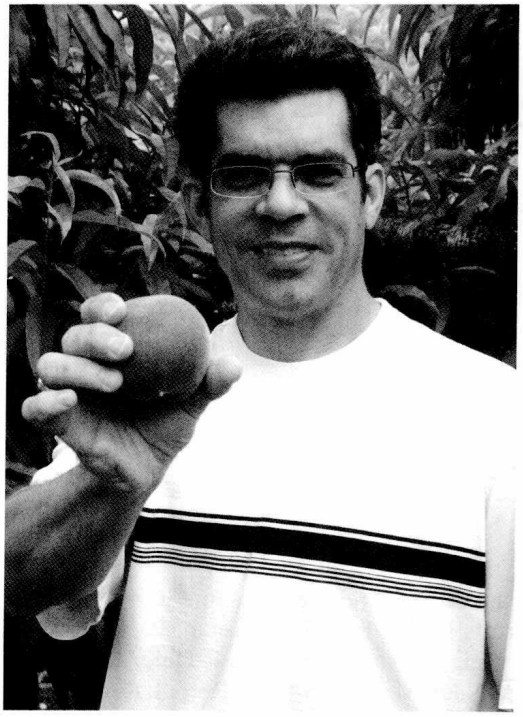
Tremendous diversity exists within the cultivated peach germplasm for tree size, growth habit, flower size and colour, chill hour requirement, fruit size, shape, flesh texture, flesh colour, flesh acidity, stone adherence to flesh, etc. As a result, many hundreds of cultivars of peaches are grown successfully from climatic and geographic regions as diverse as southern Canada to the highlands of Thailand.

Because of the small genome size (about twice that of *Arabidopsis*), peach has been selected as a model species for studying genomics in the *Rosaceae*. An extensive physical map/genetic map has been developed and vast genetic information is available through an online database. Marker-assisted selection in conjunction with conventional breeding techniques will undoubtedly lead to new cultivars with enhanced pest resistance, nutritional value and other novel traits. Until a reliable transformation and regeneration protocol can be developed, however, some of the novel genetic advances that have occurred in other fruits and crop plants remain to be fully realized.

Management of light interception, careful pruning and training, orchard floor, soil fertility, water availability and crop load are just a few of the many complexities of producing peaches profitably. Combining these factors with the reality that peach is subject to many difficult to manage pests makes it even more of a challenge. Breeding for pest resistance has resulted in some improvements in tolerance to a few diseases and insects, but if trees are left unattended in most locations, they will die prematurely. Thus, careful rootstock and cultivar selection, combined with proper site selection and pest management (monitoring, forecasting, thresholds, cultural and physical controls, biological and chemical control), are vital for success.

This comprehensive treatise by 49 research scientists from eight countries summarizes the current state of knowledge in topics ranging from botany and taxonomy to breeding and genetics of cultivars and rootstocks, propagation, physiology and planting systems, crop and pest management and postharvest physiology. The goal was to provide research scientists, extension personnel, students, professional fruit growers and others with a vital resource on peach and its culture.

Desmond R. Layne
Daniele Bassi



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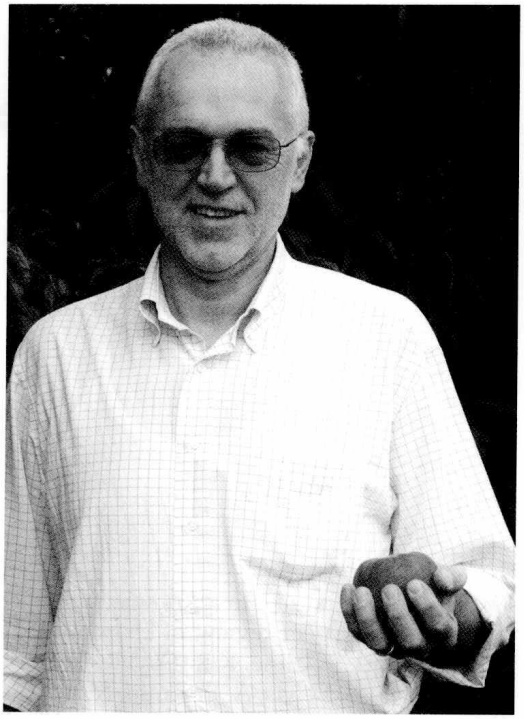

Daniele Bassi

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1 Botany and Taxonomy

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1.1 Introduction: Origin and Dissemination of Peach

The botanical name of peach (*Prunus persica* (L.) Batsch) refers to the putative country of origin, Persia (actual Iran), and Linné (1758) first named the species based on this opinion (*Amygdalus persica*). Only in the 19th century was the Far East geographical origin (western China) finally acknowledged (De Candolle, 1883; Hedrick, 1917; Vavilov, 1951); written records and archaeological evidence date peach domestication at least as far back as 3000 BC (Li, 1984).

Faust and Timon (1995) gave a detailed account of the possible genetic and geographic origin and dissemination of the peach and related species. Taking into consideration the long history of cultivation of this species and its growing role in several countries over the centuries, many scholars have attempted the classification of the species

 The Peach: Botany, Production and Uses (eds D.R. Layne and D. Bassi)