

# 中国草莓

## Strawberries in China

雷家军 张运涛 赵密珍 主编

Lei Jiajun, Zhang Yuntao and Zhao Mizhen



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## 序

我1954年开始从事草莓栽培与育种研究，是我国最早的草莓科研工作者。我亲身经历了我国草莓产业从无到有并逐渐壮大的发展历程，欣喜地看到了我国在近40年里草莓栽培技术和设施条件有了很大提高，见证了我国草莓事业的飞速发展。目前，中国草莓栽培面积和产量均居世界第一位，我国成了名副其实的草莓大国，但我国还不是草莓强国，我们在草莓育种、栽培技术、育苗、机械化作业、产品质量、包装运输等方面都还落后于先进国家。

2012年2月第七届国际草莓会议即将在北京召开，这是国际草莓会议首次在中国召开，也是首次在亚洲召开，能在中国召开草莓国际会议是我毕生最大的心愿。《中国草莓》一书，正是第七届国际草莓会议即将在北京召开之际出版，由我国年轻的草莓专家雷家军教授、张运涛研究员、赵密珍研究员主编，主要用图片的形式向国内外草莓同行介绍中国草莓产业情况，很好地配合国际草莓会议在中国的召开。

该书采用大量图片，图文并茂，主要介绍了中国草莓栽培品种、栽培形式、栽培技术、流通销售、加工产品及中国原产野生草莓资源种类，还介绍了中国草莓学术会议和中国草莓文化节，都是非常难得的资料。该书图文精美，具有较高学术价值和收藏价值，值得阅读和欣赏。



邓明琴教授在草莓试验地指导工作  
Professor Deng Mingqin in strawberry field

邓明琴

中国园艺学会草莓分会 名誉理事长  
沈阳农业大学园艺学院 教授

2011年10月1日

## Preface

I started to carry out research on strawberry cultivation and breeding in 1954 and was the first strawberry researcher in China. I have seen and experienced myself the total development of the Chinese strawberry industry from the beginning to the present phase of rapid development. In the past 40 years, Chinese strawberry cultivation techniques and facility conditions have greatly been improved. The Chinese strawberry is developing rapidly now, and cultivation areas and yield rank first in the world. China has become a leading strawberry country. But there are many aspects in strawberry industry, such as breeding, cultivation techniques, nursery, mechanized operations, packaging and transportation, which are still lagging behind the developed countries.

The 7th International Symposium will be held in February 2012 in Beijing. The book, *Strawberries in China*, edited by Chinese strawberry experts, Professor Lei Jiajun, Zhang Yuntao and Zhao Mizhen, is a very valuable gift presented to this conference.

The book not only introduces Chinese strawberry cultivation, released cultivars, cultivation techniques and processing, but also highlights Chinese Strawberry Symposia and Chinese Strawberry Festivals. The wild strawberry species distributed in China are also given in detail. I think this book is worth reading and collecting for its high quality photos and academic value.

Professor **Deng Mingqin**

Honorary chairman,

Strawberry Section, Chinese Society for Horticultural Science  
College of Horticulture, Shenyang Agricultural University

October 1, 2011





## 前言

草莓浆果芳香多汁，酸甜适口，营养丰富，素有“浆果皇后”的美称，是最受人们喜爱的水果之一。草莓是果树中栽植后结果最早、周期最短的树种，特别适合设施生产。草莓已经成为我国一种重要的经济果树，全国出现了很多专业性草莓村、草莓乡、草莓镇、草莓县、草莓市。目前，中国草莓栽培面积和产量均居世界第一位，据中国园艺学会草莓分会统计，2010年中国草莓栽培面积和产量分别约为11.7万公顷和200万吨，作为中国的草莓科研工作者，我们倍感欣慰和自豪。

我国草莓有两个最突出的特点：一是草莓栽培形式多种多样。我国南北气候差异较大，加之生产力水平参差不齐，因此，露地、地膜、小拱棚、中拱棚、大棚、日光温室、玻璃温室等在草莓生产上均有应用，既不像日本以塑料大棚为绝对主体，也不像美国以露地栽培为绝对主体。二是野生资源非常丰富。我国是世界上草莓野生种类资源最丰富的国家，全世界草莓属约24个种，我国自然分布13个种，占一半以上，这些野生资源是拓宽栽培草莓遗传背景的重要基因资源，有重要的利用价值。

第七届世界草莓大会将于2012年2月在北京召开，为了让国外同行了解中国草莓的情况，我们采用中英文双语编写了《中国草莓》一书，主要展示中国草莓的栽培形式、栽培技术、栽培品种、自育品种、加工产品、包装运输及野生资源，还介绍了中国园艺学会草莓分会组织召开的历届全国性草莓学术研讨会及草莓文化节。由于本书以图片形式为主，文字量很少，因此，随手翻阅，一目了然。

本书的编写和出版，得到了第七届世界草莓大会筹办委员会和北京市昌平区政府的大力支持，同时也得到了全国草莓同行的大力协助，美国草莓专家James F. Hancock教授和新西兰小浆果专家Harvey K. Hall先生对稿件英文进行了审阅，在此一并深表谢意！由于时间和水平有限，一定存在很多不足和错误，希望大家不吝赐教，以便我们及时更正。

雷家军 张运涛 赵密珍

2011年10月1日

# Introduction

Strawberry is known as ‘The Queen of Berries’ for its delicious flavor and rich nutrient. Among all the fruits strawberry has the shortest cycle from planting to fruiting, and is especially suitable for protected production. In China, strawberries are becoming an important economic fruit crop, and many strawberry villages, strawberry towns, strawberry counties and strawberry cities have appeared in the last 30 years. In 2010 the Chinese strawberry cultivation area and production ranked first in the world, with 117,000 hm<sup>2</sup> under cultivation and 2 million tons yield, according to the statistics data of the Strawberry Section, Chinese Society for Horticultural Science.

The Chinese strawberry industry has two most prominent characteristics. The first is the diversity in modes of cultivation for production. There are open fields, production under plastic film, small plastic houses, high plastic houses, greenhouses, and substrate cultivation used in strawberry production according to the different climate conditions and productivity levels from southern to northern China. This is different from Japan and the United States, with the former’s cultivation mode mainly in plastic houses but the latter’s mainly in the open field. The second is that there is the world’s richest representation of wild species in China. Of about 24 recognized *Fragaria* species, 13 are distributed in China.

The 7th International Symposium will be held in February 2012 in Beijing. We wrote the book *Strawberries in China* in Chinese and English in order to introduce the Chinese strawberry industry. The book introduces not only Chinese strawberry cultivation, released cultivars, processing, package, transportation and wild germplasm resources, but also the Chinese Strawberry Symposia and Chinese Strawberry Festivals. We think this book will be vivid and easy to read as it is illustrated with abundant photographs.

We would like to thank the support by Changping District People’s Government. We would also like to thank our Chinese strawberry colleagues. Specially, we want to say thanks to the strawberry specialists Prof. James F. Hancock in the United States and Mr. Harvey K. Hall in New Zealand for helping us to review the manuscript. If there are any errors and shortcomings, please tell us.

**Lei Jiajun, Zhang Yuntao and Zhao Mizhen**

October 1, 2011



雷家军 教授  
沈阳农业大学园艺学院  
Professor Lei Jiajun  
College of Horticulture, Shenyang Agricultural University



张运涛 研究员  
北京市农林科学院林业果树研究所  
Professor Zhang Yuntao  
Institute of Forestry and Pomology, Beijing Academy of Agricultural  
and Forestry Sciences



赵密珍 研究员  
江苏省农业科学院园艺研究所  
Professor Zhao Mizhen  
Horticulture Institute, Jiangsu Academy of Agricultural Sciences



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# 第一章 中国草莓资源的保存

## Chapter 1

### Strawberry germplasm conservation in China

目前，中国共收集保存各类草莓种质资源约580份，其中包括品种资源300份、野生资源280份。保存方式多以田间种植为主，同时进行了离体保存。品种资源主要保存在北京市农林科学院和江苏省农业科学院两个国家草莓种质资源圃，野生资源主要保存在沈阳农业大学。全国其他一些科研单位和私人也进行了草莓资源收集和保存工作。

At present, about 580 strawberry accessions including 300 cultivars and 280 wild genotypes are conserved in China in the field, and some are also conserved *in vitro*. Strawberry cultivars are mainly conserved in two National Strawberry Germplasm Repositories established in Beijing Academy of Agricultural and Forestry Sciences and Jiangsu Academy of Agricultural Sciences. The wild strawberry germplasm is mainly conserved at Shenyang Agricultural University. Strawberry conservation is also carried out in some other public and private institutes.

#### 1.1 田间栽植保存 Conservation in the field



国家北京草莓种质资源圃（2009，张运涛）

National Strawberry Germplasm Repository in Beijing (2009, Zhang Yuntao)



国家南京草莓种质资源圃 (2009, 赵密珍)  
National Strawberry Germplasm Repository in Nanjing (2009, Zhao Mizhen)



沈阳农业大学野生草莓资源圃 (2011, 雷家军)  
Wild strawberry germplasm repository at Shenyang Agricultural University (2011, Lei Jiajun)



河北省农林科学院草莓资源圃 (2009, 杨莉)  
Strawberry resources repository at Hebei Academy of Agricultural and Forestry Sciences (2009, Yang Li)



浙江省农业科学院草莓育种大棚 (2011, 蒋桂华)  
Strawberry resources in plastic house at Zhejiang Academy of Agricultural Sciences (2011, Jiang Guihua)



辽宁省东港市草莓研究所草莓育种温室 (2011, 谷军)  
Strawberry resources in greenhouse at Donggang Strawberry Institute in Liaoning province (2011, Gu Jun)



吉林省农业科学院果树研究所四季草莓育种基地 (2009, 郑亚杰)  
Everbearing strawberry breeding germplasm at Jilin Academy of Agricultural Sciences (2009, Zheng Yajie)



吉林省蛟河草莓研究所草莓资源圃 (2010, 李怀宝)

A private strawberry repository at Jiaohe Strawberry Institute in Jilin province (2010, Li Huaibao)

## 1.2 离体保存 *Conservation in vitro*



国家南京草莓种质资源圃组培苗保存 (2011, 赵密珍)

Conservation *in vitro* at National Strawberry Germplasm Repository in Nanjing (2011, Zhao Mizhen)



## 第二章 中国的野生草莓资源

### Chapter 2

### Wild strawberry resources distributed in China

中国是世界上野生草莓资源最丰富的国家。全世界草莓属约24个种，我国自然分布13个种，包括8个二倍体种：森林草莓、黄毛草莓、五叶草莓、西藏草莓、中国草莓、绿色草莓、裂萼草莓、东北草莓和5个四倍体种：东方草莓、西南草莓、伞房草莓、纤细草莓、高原草莓。此外，近年来还发现我国东北分布有自然五倍体野生草莓（表1）。中国的天山山脉、长白山山脉、秦岭山脉、大兴安岭、青藏高原、云贵高原是天然的野生草莓基因库，蕴藏着种类和数量丰富的野生草莓，存在较多的种、变种和类型，其中许多为珍稀的优良资源（图1）。到2010年为止，沈阳农业大学从全世界收集了野生草莓20个种280份资源，其中包括原产中国的野生草莓13个种、3个变种、220份资源。

China has more wild strawberry resources than any other country in the world. Of about 24 recognized *Fragaria* species, 13 are distributed in China, including eight diploid species: *F. vesca* L., *F. nilgerrensis* Schlecht., *F. pentaphylla* Lozinsk., *F. nubicola* Lindl., *F. chinensis* Lozinsk., *F. viridis* Duch., *F. daltoniana* Gay and *F. mandschurica* Staudt, and five tetraploid species: *F. orientalis* Lozinsk., *F. moupinensis* (Franch) Card., *F. corymbosa* Lozinsk., *F. gracilis* Lozinsk. and *F. tibetica* Staudt et Dickor é. In recent years, several natural pentaploid strawberry accessions have been collected from Northeast China (Table 1). Wild strawberry populations are distributed extensively in Tianshan Mountains, Changbai Mountains, Qinling Mountains, Daxing'an Mountains, Qingzang Highland and Yungui Highland in China, where some *Fragaria* species, variations and types were discovered (Fig. 1). Up to now, more than 280 accessions of 20 *Fragaria* species, including 220 accessions native to China (13 species and three varieties) have been collected and conserved at Shenyang Agricultural University.

