March 2018. Horticultural Plant Journal, 4 (2): 83–88.

Horticultural Plant Journal

Available online at www.sciencedirect.com
The journal's homepage: http://www.journals.elsevier.com/horticultural-plant-journal

Vegetable Genetic Resources in China

WANG Haiping, LI Xixiang, and SONG Jiangping*

Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences/Beijing Research Station of Vegetable Crop Gene Resources and Germplasm Enhancement, Ministry of Agriculture, Beijing 100081, China

Received 18 September 2017; Received in revised form 25 October 2017; Accepted 26 December 2017

Available online 7 March 2018

A B S T R A C T

China is recognized as an important region for plant biodiversity based on its vast and historical collection of vegetable germplasm. The aim of this review is to describe the exploration status of vegetable genetic resources in China, including their collection, preservation, evaluation, and utilization. China has established a number of national-level vegetable genetic resources preservation units, including the National Mid-term Genebank for Vegetable Germplasm Resources, the National Germplasm Repository for Vegetatively-Propagated Vegetables, and the National Germplasm Repository for Aquatic Vegetables. In 2015, at least 36 000 accessions were collected and preserved in these units. In the past decade, 44 descriptors and data standards for different species have been published, and most accessions have been evaluated for screening the germplasms for specific important traits such as morphological characteristics, disease resistance, pest resistance, and stress tolerance. Moreover, the genetic diversity and evolution of some vegetable germplasms have been evaluated at the molecular level. Recently, more than 1 000 accessions were distributed to researchers and breeders each year by various means for vegetable research and production. However, additional wild-relative and abroad germplasms from other regions need to be collected and preserved in the units to expand genetic diversity. Furthermore, there is a need to utilize advanced techniques to better understand the background and genetic diversity of a wide range of vegetable genetic resources. This review will provide agricultural scientists' insights into the genetic diversity in China and provide information on the distribution and potential utilization of these valuable genetic resources.

Keywords: vegetable; genetic resource; preservation; evaluation; utilization

1. Introduction

Crop genetic resources have historically been a major component of biodiversity and have contributed to human survival and development (Halewood et al., 2013). With changes in climate and the environment, the challenge of increasing the food supply of the human population has become more difficult and innovations for the sustainable development of agriculture are imperative (Liu and Dong, 1998). Crop improvement enables their adaptation to biotic and environmental changes as well as the development of new foods and uses. Currently, all countries largely depend on crop genetic resources for food and sustainable agricultural development (Halewood et al., 2013; Ker et al., 2013). The exploitation, screening, and utilization of elite germplasm from genetic resources thus play important roles in the evolution of agriculture.

Great progress has been made in the collection and introduction of crop genetic resources in China. In 2015, more than 470 000 accessions of crop genetic resources were collected and conserved at the National Long-term Genebank of Crop Germplasm and various field genebanks (Wang, 2012). These resources have high diversity, which is characterized by numerous kinds of crops, multiple varieties of each crop, and abundant closely related species in the wild. However, compared with developed countries such as the United States, the crop genetic resources of China still require extensive development. In addition, only 18% of the accessions in Chinese national conservation system were collected from other countries, thus indicating a significantly low

* Corresponding author. Tel.: +86 10 82105942
E-mail address: wanghaiping@caas.cn

Peer review under responsibility of Chinese Society for Horticultural Science (CSHS) and Institute of Vegetables and Flowers (IVF), Chinese Academy of Agricultural Sciences (CAAS)

https://doi.org/10.1016/j.hpj.2018.03.003

level of genetic variation. To enrich the genetic diversity in China, there is a need to introduce new germplasms. China is not only a major grain producer but also a major food consumer. Furthermore, vegetable production is related to national economic and social stability. China is recognized as an important area of diversity for plant genetic resources, particularly for vegetables. China has historically collected and conserved vegetable germplasm, including those introduced locally and from abroad. The aim of this review was to outline the exploration status of vegetable genetic resources in China, including its collection, preservation, evaluation, and utilization.

2. Vegetable plants and production in China

China is recognized as a biodiversity region, particularly for vegetable genetic resources (Li et al., 1999). Collectively, reports have described 1 822 species, 815 genera, and 213 families of plants that could be used as vegetables in China (Li et al., 1999). There are 246 species in 50 families and 152 genera that are grown as vegetables. In addition, there are 255 species of wild edible vegetables, representing 25 families and 44 genera. Biological diversity of crop germplasm resources is a key component for the survival and sustainable development of human society. Therefore, conservation of diversity is a key factor in sustainable development. Currently, more than 290 indigenous and introduced species/varieties of vegetables, which belong to 50 botanical families, are grown in China (Li et al., 2016). At least 110 popular species are commercially distributed to major cities in China. The 15 most important plants include Chinese cabbage, radish, potato, chili pepper, cabbage, tomato, cucumber, pakchoi, eggplant, green Chinese onion, celery, garlic, Chinese chive, mustard, and spinach.

China has eight distinct types of vegetable plantation areas that support specific types of vegetables: Northeast (Heilongjiang, Jinlin, Liaoning), North China (Beijing, Tianjin, Hebei, part of Inner Mongolia), Yangtze River area (Hubei, Hunan, Shanghai, Jiangsu), South China (Guangdong, Guangxi, Hainan), Southwest (Sichuang, Guizhou, Yunnan, Chongqing), Qingzang (Qing-Hai, Xizang), Northwest (Shanxi, Gansu, Ningxia, Xinjiang), Inner Mongolia, and Xinjiang. The total area is 21 million hm^2. It yields about 0.75 billion tons, and the production value is about 200 billion dollars each year.

3. Collection history of vegetable genetic resources

3.1. *Collection*

China has a long history of collection and conservation of vegetable germplasm. Nationwide collection started in the 1950s, with the first record dated 1958. The germplasm was mainly collected by acquisition and exploitation of on-the-spot investigation (Dong, 1999). The Ministry of Agriculture conducted two waves of nationwide acquisition of germplasm from 1956 to 1957 and from 1958 to 1960, and according to a report in 1963, 17,393 accessions representing 88 species of vegetable genetic resources were collected (Dong, 1999). However, from 1966 to 1976, collection ceased and most of these samples were lost. Then, after a supplementation collection from 1979 to 1985, more than 16 186 accessions were collected and preserved in genebanks (Wang and Huang, 1999). The focus of vegetable germplasm research then moved from collection to regeneration from 2001 to 2015. Thus, approximately 2 500 accessions were collected during this period. By the end of 2015, more than 36 000 vegetable accessions had been collected and preserved in genebanks (Xiong et al., 1989; Liu and Du, 1993; Li et al., 1999; Lu and Chen, 2003).

Table 1 Nationwide exploitation of vegetable germplasm in China

Periods	Number of accessions	Collection place
1979–1980	228	31 cities and counties in Yunnan
1981–1984	655	40 counties in Tibet
1987–1990	3 506	22 counties from Shennong area
1992	100	11 counties in Daba District
1992–1994	397	7 counties in Shanxi Province
2006–2011	1 280	41 counties in Yunnan Province and part of Sichuan and Tibet
2012–2017	1 108	21 counties in Guizhou Province
Total	7 274	

3.2. *Introduction of germplasm resources from abroad*

Crop introduction from abroad is an important and historical component in establishing crop germplasm resources in China (Zheng et al., 2011; Lei et al., 2017). From 1959 to 1961, the Institute of Vegetables and Flowers, CAAS introduced about 740 plant accessions, which included broccoli, bean, carrot, and onion. From 1963 to 1965, a total of 1 113 accessions representing more than 7 species, including cabbage, Chinese cabbage, pepper, onion, carrot, bean, and onion were introduced. From 1971 to 1996, 11 410 accessions of 72 species, 48 genera, and 14 families from 40 countries were introduced (Wang et al., 1998). From 2001 to 2008, more than 500 accessions were introduced, and more than 1 000 accessions were introduced from 2011 to 2015.

3.3. *Exploitation*

Seven investigations on vegetable genetic resources have collected a total of 7 274 accessions. The first investigation was from 1979 to 1980, which collected 228 accessions representing 141 species, and 31 families were collected from 31 cities or counties in Yunnan Province. From 1981 to 1984, 655 accessions representing at least 60 species were collected from 40 counties in Tibet. From 1987 to 1990, 3 506 accessions from 159 species and 38 families were gathered from 22 counties from the Shennongjia Forest and Yangtze Three Gorges areas. In 1992, 100 pepper accessions were collected from 11 counties from Daba in Sichuan Province. From 1992 to 1994, 397 accessions representing 33 families were collected from 7 counties in Shanxi. From 2006 to 2011, 1 280 accessions representing 77 species, 59 genera, and 24 families were collected. From 2012 to 2017, 1 108 accessions comprising 92 species, 73 genera and 26 families were gathered (Table 1).

4. Conservation of vegetable genetic resources

A network has been established in China that consists of two long-term genebanks, in Beijing and in Qinghai, and there are 10 mid-term genebanks and 43 field genebanks (Lu and Cao, 2001). By 2015, more than 470 295 crop accessions were preserved in the network system of China. There are three genebanks that are related to vegetables. The three genebanks comprise more