Chapter 25

Diversity of Land Races and Wild Relatives of the Soybean in China

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The soybean, *Glycine max* (L.) Merr originated in China. Its wild ancestors *G. soja Sieb.* and *G. soja* are distributed throughout China and the adjacent areas of Russia, Korea, and Japan. They grow in fields and hedgerows and along roadsides and river banks. The statistics of the Chinese Ministry of Agriculture show that soybeans are grown over an area of 9.3 million hectares, with a production in 1993 of one million metric tonnes. So far, China has collected more than 17,000 accessions of *G. max*, more than 5,200 accessions of *G. soja*, and two perennial species, *G. tabacinal (Labill.)* Benth and G. tomentella Hayata.

Diversity of *Glycine soja*

G. soja is distributed from Guangdong province (about 24°N) in the south to the Heilongjiang river (52°55'N) in the north. There are many populations, and each of them covers a wide area. Different types of *G. soja* have evolved in different environments. A wild soybean collection has been organized on a national scale since 1979. A lot of new wild types, with wild white flowers, very narrow leaves, and different seed coat colours have been found. A total of 5,200 samples has been characterised on the basis of plant morphological traits. A further 1,000 wild soybean types have also been recorded recently.

The protein content of 5,147 wild soybean germplasm samples was analysed. The mean content of protein was 45.49 per cent for typical wild soybeans and 44.6 per cent for semi-wild types. There was a significant positive correlation between protein content and longitude in typical wild soybean samples ($r = 0.85^{***}$). High protein wild soybeans occurred in the central area and parts of

the northeast and Yangtze River regions. Low protein content soybeans occurred in the Yellow River region and the southern part of China, especially in the Ningxia and Tibetan plateau regions. The protein content of wild soybean was higher than that of cultivated soybeans. There were 349 accessions of Chinese wild soybeans with a protein content of more than 50 per cent, one of them was as high as 55.37 per cent.

The mean oil content of wild soybean accessions was 8.38 per cent, the highest content 13.9 per cent, and the lowest 4.8 per cent. The oil content of wild soybeans was related to hilum colour, seed coat colour, bloom on the seed coat, 100-seed weight, leaf shape, and plant height. The mean oil content of wild soybeans was lower than that of cultivated soybeans.

The wild soybean, *Glycine soja*, is believed to be the progenitor of the cultivated soybean, *G. max*. These two species produce fertile offspring upon hybridisation. Evaluating genetic variation in *Glycine soja* will not only help facilitate its use in breeding programmes, but also provide information about conservation needs and strategies.

The Diversity of *Glycine max*

Tens of thousands of soybean varieties were reported. This high number is the result of the large territory, diverse terrain and climate, and long history of cultivation and natural and human induced selection. Different cultivars fit different environments and culture system, and can meet the different needs of people.

A total of 23,000 soybean land race cultivars were collected during surveys made in 1956, 1979, and 1990 and listed in the Chinese Soybean Varieties Resources' catalogue. These soybean land races belong to the erect types (62.6%), semi-erect types (23.81%), and twining and semi-twining types.

The majority of the accessions (60.1%) have a yellow seed coat. The other seed coat colours are black, 8.2 per cent; green, 15.0 per cent; and bicolour, 2.76 per cent. Most Chinese soybeans have small (33%) or medium (43%) sized seeds. Eighteen per cent have large seeds, 3.8 per cent very large seeds, and 1.28 per cent extremely large seeds. The protein content of 49 per cent of Chinese soyabean germplasm ranged from 40 to 48 per cent.

The oil content of most varieties was below 20 per cent; 1,394 lines had an oil content of between 20 and 22 per cent and 113 lines had an oil content between 22 and 28 per cent. Only 38 varieties had more than 23 per cent oil, and these were concentrated in the northeast and north, spring planting soybean areas. The highest oil content found was 24.2 per cent for 'Wu Zhai Huang Dou'.

Box 25.1

Research and Conservation Efforts on Crop Genetic Resources: A Comparison between the Plains and Mountains of China

Gene banks are the most important strategy employed in China to address the conservation of plant Genetic Diversity, Dr. Xu said. They are based on collections of genetic material from centres of crop origin and elsewhere that are stored under controlled conditions and periodically regenerated. China has invested a lot of resources in developing facilities for *ex situ* conservation. To date a total of 20 modern gene banks has been established throughout the country. The Institute of Crop Germplasm Resources, Chinese Academy of Agricultural Sciences, is responsible for the long-term preservation of all crop germplasm resources. Currently a total of 360,000 accessions have been preserved and 80% of them are land races. Seeds of the following crops are preserved (listed in order of priority): rice, wheat, soybean, vegetables, millet, food legumes, oil crops, barley, sorghum, maize, cotton, sugarbeet, bast fibre crops, forage grass, tobacco, buckwheat, amaranths, watermelon, muskmelon, and green manure.

The gene banks cannot conserve all types of on-farm species. China has institutionalised a method for conserving live plants in the field as 'field nurseries' for germplasm resources. Dr. Xu said there is a total of 25 field nurseries that maintains 20,000 accessions of germplasm for perennial and crop species such as tea, fruit trees, wild grapes, mulberry, rubber, and sugarcane.

In recent years more emphasis has been given to the collection of germplasm from mountain regions of China such as Yunnan province, the Tibetan autonomous region, the Shennong mountain chain, Henan province, the Daba mountain chain, and the South Guizhou and West Guangxi regions. The proportion of germplasm diversity conserved from the mountains is relatively very small.

In China, there is more experience of *ex situ* conservation than of *in situ* conservation. There has been only poor institutional support for *ex situ* conservation of agrobiodiversity in mountain agroecosystems, however, as a result of inadequate funding, expertise, and facilities.

(Source: Liu Xu 1996)

Thirty-eight varieties had a linoleic acid content above 60 per cent of the total oil. The highest linoleic acid content reported was 63.4 per cent for 'Long Yao Hei Dou'.

A total of 874 of the soybean land races was resistant to drought, all of them were from the northwest of China where there is less rainfall. Varieties with both sprouting and plant resistance to drought came from Shandong, Henan, Hebei, Shanxi, and Shannxi.

Use of Soybeans

About 400 cultivars have been developed by breeding programmes using elite local varieties and pure-line cultivars as one of the parents. Pedigree analysis

shows that the genetic base of Chinese soybean cultivars is tending to become narrower.

Introduced soybean germplasm enriches the Genetic Diversity of Chinese soybean germplasm, and has a great effect on breeding, especially on high yield, disease resistance, and high quality characteristics. The cultivar 'Hefen 27' is a good example. It is highly resistant to frog eye leafspot, a characteristic developed by using 'Rampage', an American cultivar, as one of the parents. 'Liaodou No. 3' and 'Heihe No. 5' cultivars, which have high yields, were derived from 'Amsoy'.

In China, soybean is processed mainly for edible oil and meal (feed purposes) by using different extraction processes. Improvement in yields through improved soybean cultivars has been slow over the past 40 years. Recently, soybean pests and diseases have become an important factor in soybean production, the soybean cyst nematode in particular has become a widespread problem. A critical problem for the breeder is how to use the large number of germplasm lines effectively and find sources for further improvement. Special attention needs to be focussed on the following aspects.

- Collection and evaluation of germplasm of soybean varieties in remote areas
- Collection and evaluation of wild soybean accessions, and studies of the population biology and ecology of natural populations
- Analysis of the Genetic Diversity of soybeans to select cultivars for diverse agroclimates in the mountains
- Conserving the Genetic Diversity of soybean germplasm, especially *in situ* conservation of cultivated soybeans and natural populations of wild soybeans.

Reference

Liu Xu, 1996. 'Research and Conservation Efforts on Crop Genetic Resources: A Comparison between Plains and Mountains of China'. Paper Presented in the ICIMOD Expert Meeting on Agricultural Biodiversity in the Hindu Kush-Himalayan Region; Status and Management Issues in China, Chengdu, June 11-12.