

SITUATION OF SOYBEAN PRODUCTION AND RESEARCH IN CHINA

JIAN Yu Yu*

Abstract

Soybeans are distributed throughout China, but their cultivation is mainly concentrated in eight provinces. The soybean production area in China is generally divided into three cultivation regions : Northern Spring Sowing Region, Huanghe and Huaihe Valley Summer Sowing Region, Southern Multiple Cropping Region. In 1981, the total area covered approximately 8 million hectares with a total yield of 9,245 million tons.

Soybean research has been carried out for over 30 years. The objective of research focusses on increasing yield and improving the quality of soybeans. In this report, the organization of soybean research at different levels, the situation of studies on breeding, genetics, germplasm conservation, physiology, ecology, regionalization of production, cultivation techniques for achieving high yields and control methods of soybean diseases, insects and weeds are described.

Soybean, a native plant of China, has been cultivated for more than 5000 years. Soybeans are distributed throughout China, from Heihe, Huma (Heilongjiang province) to Taiwan, Hainan ; from Altay, Tachang (Xinjiang province) to Zayu, Bomi (Xizang) (Fig. 1). But, they are cultivated mainly in eight provinces : Heilongjiang, Jilin, Liaoning, Hebei Henan, Shandong, Jiangsu and Anhui. In 1981, the area under soybeans in the eight provinces accounted for 76.5% of the total area under soybeans and 80.4% of the total production in China.

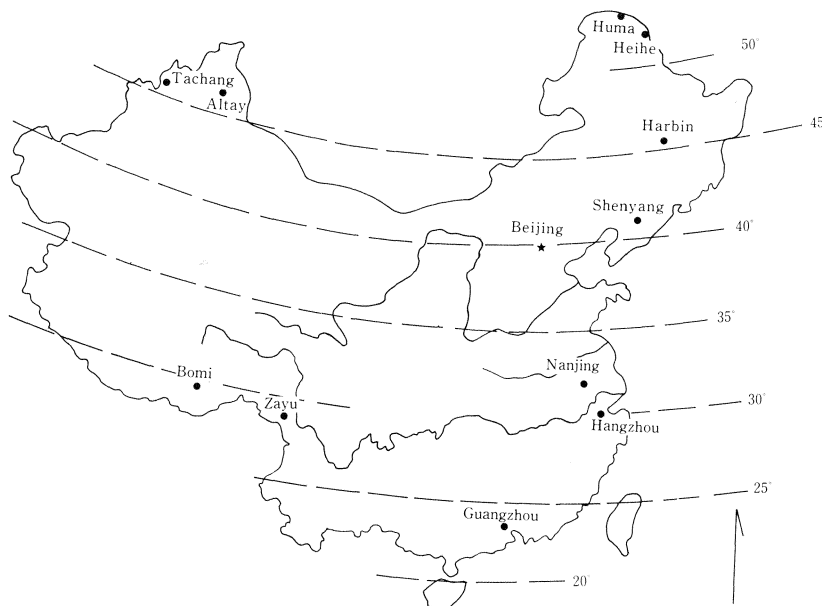


Fig. 1 Soybean production regions in China.

*Soybean Institute, Jilin Academy of Agricultural Science, Gongzhulinh, Jilin Province, China.

Depending on the annual rainfall, mean temperature during the growth season, duration of frost-free days, photoperiodic response and crop rotation system, the soybean production area in China is generally divided into three cultivation regions (Fig. 2) :

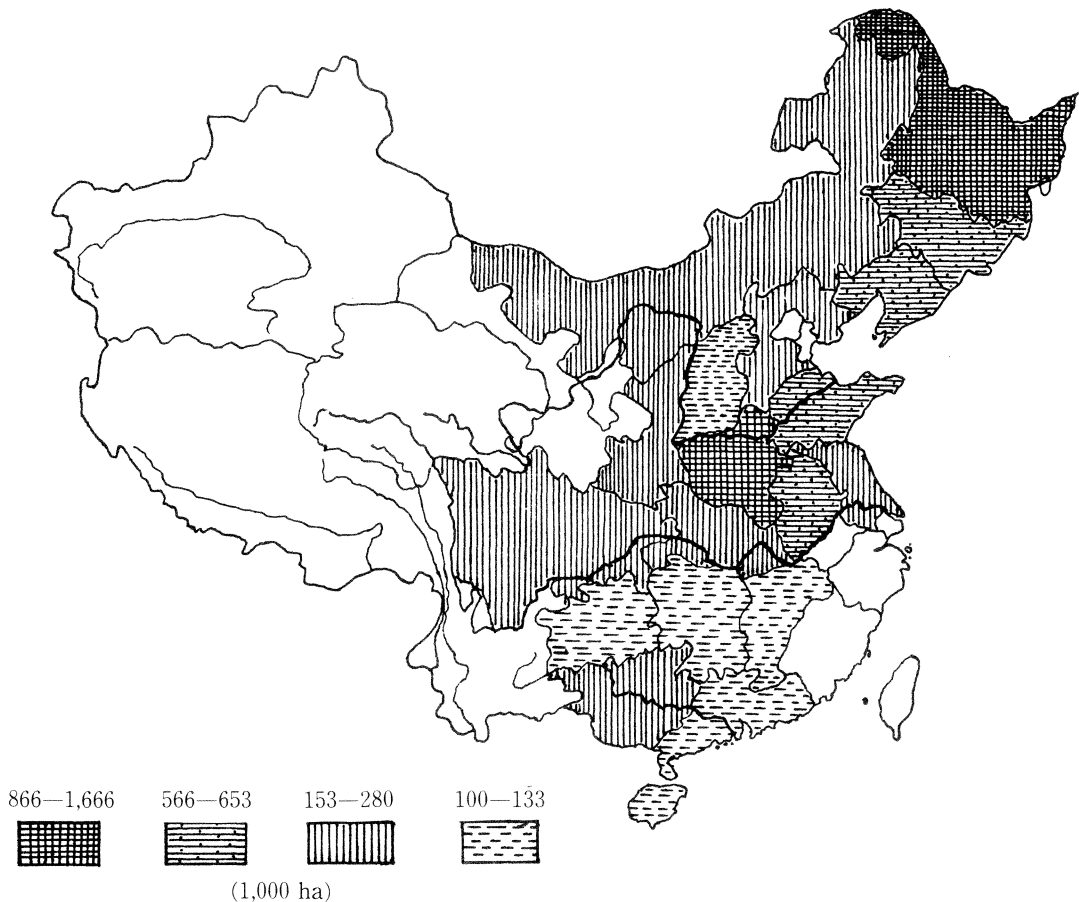


Fig. 2 Soybean distribution in China (1979).

1 Northern Spring-Sown Soybean Region

It is one of the major soybean production areas in China. This region includes the three northeastern provinces, Inner Mongolia, Ningxia, Xinjiang and the northern parts of Hebei, Shanxi, Shaanxi and Gansu provinces. It is mainly concentrated in the Songhuajiang and Liahe plains. This region has one crop a year, the soybean is sown from late April up to mid-May and harvested in September, the growing period being about 105-155 days. The main rotation system includes corn-soybean-millet or kaoliang, or soybean-spring wheat-corn. In 1977, the area of this region covered 3.060 million hectares with a total yield of 3.101 million tons accounting for 43.9% of the total soybean area and 40.5% of the total production. Most of the varieties have yellow seed, good quality with high oil content.

2 Huanghe and Huaihe Valley Summer-Sown Soybean Region

It is another major soybean production area in China. It includes Shandong, Henan and the northern parts of Jiangsu and Anhui, the central and southern parts of Hebei, Shanxi and Shaanxi provinces. The rotation system of two crops a year usually includes winter wheat-soybean. Soybeans are sown from mid-or late June and harvested in mid-or late September or early October, the growing period being 95-110 days. The area of this region covers 2.306 million hectares with a total yield of 2.750 million tons accounting for 33.1% of the total soybean area and 36% of the total production.

3 Southern Multiple Cropping Soybean Region

This region is located along the lower Yangtze and includes the southern provinces of China. The cropping system consists of two or three crops in one year, three crops in two years or five crops in three years. Soybean can be sown in spring, summer or autumn ; in Guangdong and Guangxi, soybean can be sown in winter. Spring soybeans are planted after March, or intercropped with winter wheat or barley, harvested in July or August, and followed by rice. Summer soybeans are planted in monoculture or intercropped with corn in June after winter wheat, barley or rapeseed, and harvested in October. Autumn soybeans are planted in late July after rice is harvested in October or November. The area of this region covers 1.800 million hectares with a total yield of 1.800 million tons accounting for 23% of the total soybean area and 23.4% of the total production.

Before 1949, the average annual soybean production in China was about 7-9 million tons. In 1949 the total yield of soybean dropped to 5.08 million tons. In 1957, the yield reached 9.1 million tons. In 1981, the total area under soybeans was approximately 8 million hectares with a yield of 9.325 million tons. The yield per hectare is 1.16 tons (Tables 1 and 2).

Table 1 The soybean acreage and production of the provinces in 1981

| Province | Planted area (1,000 ha) | Production (1,000 ton) |
|--------------|----------------------------|---------------------------|
| Heilongjiang | 1,800.0 | 2,015 |
| Henan | 1,194.0 | 1,540 |
| Anhui | 737.3 | 905 |
| Shandong | 719.3 | 830 |
| Jilin | 605.3 | 790 |
| Liaoning | 461.3 | 625 |
| Jiangsu | 326.7 | 480 |
| Hebei | 323.3 | 340 |
| China | 8,015.3 | 9,310 |

Table 2 The acreage and production of soybean in China

| Year | Planted area (1,000 ha) | Yield per ha (ton/ha) | Production (1,000 ton) |
|------|----------------------------|--------------------------|---------------------------|
| 1977 | 6,844 | 1.05 | 7,250 |
| 1978 | 7,143 | 1.05 | 7,565 |
| 1979 | 7,246 | 1.02 | 7,460 |
| 1980 | 7,187 | 1.09 | 7,880 |
| 1981 | 8,024 | 1.16 | 9,325 |
| 1982 | 8,414 | 1.07 | 9,030 |

Since the foundation of the People's Republic of China, soybean research work has been conducted by public institutions. The Ministry of Agriculture, Animal Husbandry and Fishery includes a Bureau of Science and Technology and a Bureau of Education. The research organizations under the Bureau of Science and Technology are : National Chinese Academy of Agricultural Science, provincial Agricultural Academies and Institutes, and district Agricultural Institutes. There are also county Agricultural Institutes, county extension services, and county seed multiplication farms. The Bureau of Education coordinates two levels of agricultural colleges and universities : regional and provincial agricultural colleges. In Heilongjiang and Jilin, the Soybean Institute has been set up under the guidance of the academy of agricultural science of the respective provinces. Soybean research laboratories were established at the Crop Breeding Institute and the Oil Crop Institute under the guidance of the National Chinese Academy of Agricultural Science, and also there are soybean research sections in Shandong, Henan, Anhui and Jiangsu provinces. Besides, there are soybean research laboratories and sections in agricultural colleges and universities, such as Nanjing Agricultural College. Now China has more than 400-500 researchers working on soybean (Fig. 3).

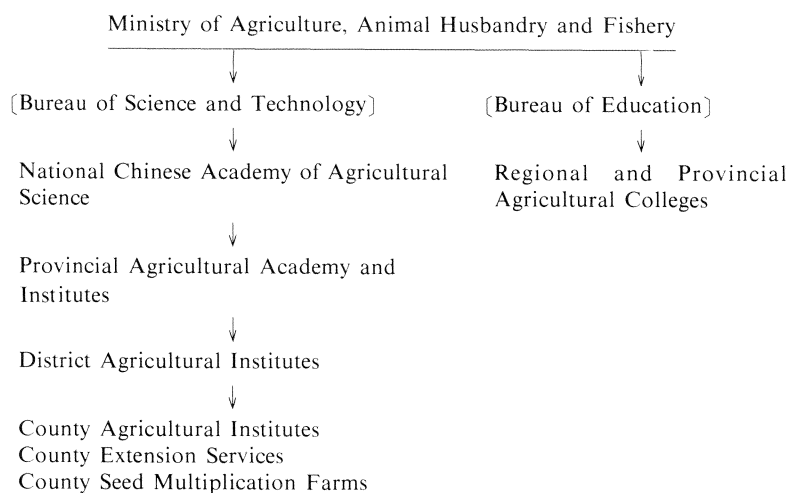


Fig. 3 The organization of research.

Soybean breeding work in China primarily involves the use of conventional techniques. Soybean is a self-pollinated crop and since inbred pure lines are used in breeding, the selection methods include pedigree, bulk population and various modifications of pure line method, such as single seed descent, early generation testing and recurrent selection which are used by different soybean breeders. Another modification of the pure line method that has been used extensively is backcrossing. The method uses good varieties with the breeding objectives of selecting lines, i.e. for high yield, good quality (high oil and protein content), wide adaptability, resistance to diseases, insects and lodging and adaptation to mechanized harvest. Since the establishment of the People's Republic of China, we have developed more than 250 new soybean cultivars which are used in production. For example : Heihe No 3, Dongnong No 4, Fengshou No 10, Heinong No 26, Hefeng No 6, Jingshanpu, Jilin No 3, Jilin No 8, Jiunong No 9, Qunxuan No 1, Tiefeng No 18, Wenfeng No 5, Qihuang No 1, Yuechin No 4, Xudou No 1, Nannong 493-1, Taixingheidou, E dou No 2, Most of those varieties cover more than 66,000 hectares or 200-300,000 hectares.

In the meantime, we have adopted some special techniques such as the induction of mutation by radiation and chemicals, induction of haploids by pollen, studies on cell modification, somatic

hybridization and genetic engineering for plant improvement, to produce the desired genetic changes in our soybean breeding research program and preliminary results have been achieved. Research on soybean genetics has been carried out in the laboratories of agricultural colleges, institutes of provincial academies, including heterosis and inbreeding depression, the quantitative inheritance of economic characters, and the theory and methods of selection.

Research work on soybean germplasm has been carried out throughout the country, and at present China has more than 8,000 *Glycine max* and almost 5,000 *Glycine soja* materials being maintained. Systematic research consists of the following aspects : geographic distribution of ecotypes, production, classification, identification of pest-resistant varieties, analysis of seed composition. The "Checklist and Catalog of Chinese Soybean Varieties" was published, in which over 6,000 varieties have been recorded, to describe in terms of a series morphological and physiological characters. At present some germplasm with high-yielding characters, strong adaptability and multiple resistance has been selected and used as parent materials in our breeding program. Cultivated, wild and semi-wild species of soybean have been collected both at home and abroad. The wild and semi-wild soybean materials have been sorted out and identified.

Furthermore, research has been done on soybean physiology, ecology and cultivation techniques to achieve high yields, i.e. studies on ideotypes and physiology of high photosynthetic rate, nutrient requirements (nitrogen, phosphorus, potassium, micro-nutrients) of soybean, photoperiodic response and regionalization of soybean production, and irrigation techniques. In the soybean-producing area of the northeastern provinces, an integrated soil cultivation system consisting of mechanized deep plowing, loosening and harrowing has been established.

A preliminary survey of the major diseases and insects of soybeans has been carried out, and research work on the pattern of outbreak of diseases and insects, as well as their control methods, has been initiated. Soybean mosaic virus is the most widespread disease on soybean in China. Six races have been identified and some highly resistant cultivars have been developed. Soybean rust is widespread in the southern region of China and resistant cultivars such as Jiu-yue-huang have been planted. Soybean pod borer is one of the important insects of soybean in the northeastern region and some insect-resistant cultivars such as Jilin No 3, Jilin No 16, Heihe No 3, have been developed by soybean breeders. The control methods of *Aphis glycines* Matsumura, *Etiella zinckenella* Treitschke, *Clanis bilineata* Walker, *Melanagromyza sojae* (Zehnter) have been studied. Research has also been conducted on the control of weeds by application of chemical at the time of cultivation.

To further develop soybean production, we shall continue to intensify our scientific research work, coordinate research and establish soybean research centers in many soybean-producing areas. We will study culture techniques and rotation systems, and develop comprehensive culture practices to achieve high yields, collect soybean germplasm extensively and systematically and identify, study and utilize these genetic resources. We will speed up selection breeding and multiplication of seeds and use of new certified soybean cultivars ; we will study the pattern of outbreaks of soybean diseases, insects and weeds, and their control methods, and carry out forecasting work. It is necessary to promote soybean science and technology in order to increase rapidly the per unit yield of soybean.

References

- 1) Na, R.H. and Zhang kan, 1982. Historical development of soybean production in China, 1 st. Sino-U.S. Soybean Symposium (to be published).
- 2) Po, M.H. and Pan, T.F., 1982. A study on the regionalization of soybean producing area in China, Soybean Science. vol. 1, No. 2, pp. 105-121. (In Chinese with English Abstract).
- 3) Jian, Y.Y., 1981. Investigative situation of Chinese soybean germplasm, National Soybean Breeders/Entomologist Workshop, Memphis, Tennessee, U.S.A.

Discussion

Sumarno (Indonesia) : 1. Have your experiments on somatic hybridization been successful ?
2. What part of the plant do you use for culture ?

Answer : 1. Somatic hybridization of soybean is in its early stage and is not particularly successful.
2. We use cell suspensions of root as well as cotyledon. Cell fusion with materials from other crops such as tobacco, pea and corn has also been attempted.

Dutt, A. K. (India) : What are the major uses of soybean in China ?

Answer : Soybean is mostly used for oil. Defatted soybean meal is used as animal feed and as fertilizer. Soybeans are also processed for food products such as tofu, soy sauce, soy milk, etc. or consumed directly as vegetables.

Trikha, R. N. (India) : 1. What is the percentage of the varieties released that are popular with the farmers ? 2. How do you procure seed ?

Answer : 1. Approximately 50%. 2. Seeds are made available through seed multiplication farms.

Galal, S. Jr. (Egypt) : Has any of the germplasm collected in China been evaluated for shade tolerance ? Indeed we are looking for such material for intercropping corn with soybean in Egypt.

Answer : We have some varieties that are shade-tolerant such as Jilin No 3. They are suitable for intercropping with corn, particularly in northeastern China. These varieties are also resistant to lodging.