The Green Development of Special Agricultural Product Chili in China

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There are about 140 countries in the world growing chilies. Chilies are divided into dry chilies and green chilies. In 2020, the global planting area of dry chilies reached 1,615,140 hectares, with the production of 4,157,205 tons, and the planting area of green chilies reached 2,069,990 hectares, with the production of 36,136,996 tons. The global planting area and production of chilies showed an overall increased trend.

The production of green and dry chilies in Asia has always ranked first in the world. The production of green chilies of China has always ranked first in the world and has absolute advantages. The production of dry chilies of China ranks among the top ten in the world.
After more than 400 years of development, chili has become the most important condiment in the diet of Chinese people. In recent years, the planting area and production of chili in China are on the rise. In 2020, the planting area of dry chilies in China reached 46,048 hectares, the production reached 307,593 tons, and the planting area of green chilies in China reached 737,539 hectares, the production reached 16,680,927 tons, and the annual output value reached 250 billion yuan. China is the largest producer and consumer of chili in the world.

The chili industry chain of China covers seed research and development, seed sales, large-scale planting, primary processing, deep processing. It has become the largest vegetable industry in China. As the largest vegetable crop in China, chili plays an important role in increasing income of farmers and in agricultural industry development.
Comparative Advantages

- In China, chili has been transformed from regional production and consumption to national consumption. Chilis are planted in Guizhou, Henan, Shandong, Yunnan, Sichuan, Hunan, Jiangxi, Hebei, Xinjiang, Inner Mongolia with large-scale. Characteristic producing region of chili is Zunyi, Zhecheng, Jize, Shawan and Qiubei.

- In terms of varieties breeding of chili, famous brands such as Zhongjiao, Xingshu, Bola, Xiangyan, Jingyan, Sujiao, Shenjiao, Zunjiao, Yanjiao and Shila have been developed with high resistance and reducing the use of pesticide.

- A large number of hybrid varieties of chili have been bred based on heterosis. There are 4897 chili varieties registered in China. At present, more than 80% of commercial chili are F1 hybrids.
Comparative Advantages

- The cultivation techniques of chili in early spring and in late autumn in the south, in greenhouse in the north, at high altitude, and in tropical winter season have been developed. While the production of chili has increased and the use of fertilizer has reduced significantly, we have achieved balanced supply all the year.

- The chili industry chain of China has covered breeding, primary processing, deep processing. The extraction techniques and output of capsaicin and capsanthin are at the global leading level. For example, Guizhou Laoganma chili sauce is exported to 72 countries and regions in the world, and the capsaicin and capsanthin products extracted by Hebei Chenguang Biotechnology Co., Ltd. account for more than 80% of the international market. Xinjiang Longping High-tech Hong’an Natural Pigment Co., Ltd. has built a 1000 tons production line of red pigment. In the future, Xinjiang will be a key region of chili processing industry in China.
Demands

- With the rapid spread of chili planting areas, more people start to like spicy food. At present in China, exceeding 40%, an equivalent to more than 500 million people. With the change of people's eating habits, more people will like spicy food. In recent years, hot pot and Sichuan cuisine characterized by spicy food becomes more popular.

- In recent years, with the rapid growth of domestic and international market demand for chili processing products, the processing industry of China has developed rapidly, driving the market demand for special chili varieties. Capsanthin and capsaicin products' international trade await expanding. The market demand for chili intensive processing products has maintained a rapid growth.
Challenges

- Lack good varieties for processing. At present, most of the leading varieties for processing chili in China are local varieties, such as Yiduhong, Tiepi and Qiubei chili. The varieties are seriously degraded, with low yield and poor disease resistance, resulting in low economic benefits.
- The incidence of TMV and CMV is high, which seriously affects the yield of chili, and there is a lack of disease resistant varieties.
- The traditional breeding needs a long time to harvest with low efficiency
- Chili flower is small, and the production cost of hybrid seeds is high, which affects the promotion of hybrid seeds.
**Challenges**

- The chili planting is mainly scattered and not standardized, the level of mechanization is low, and the production cost is high.

- The number of chili processing enterprises is large, but the scale is small, the research and development ability is poor, and the market competitiveness is not strong.

- The drying technology of chili is backward. The proportion of discoloration and rot in the natural drying process is as high as 50%, and even as high as 80% in some areas, which has a serious impact on the production and processing of dried chili.
Strategy

- Strengthen the breeding and promotion of processing chili varieties, fill the market gap, and improve the product structure.
- breed multi resistant chili varieties with the identification of resistant germplasm and molecular marker assisted selection.
- breed new chili varieties with cell engineering and space breeding technology.
- Conduct the purification and rejuvenation of local chili varieties and improve the market competitiveness.
Strategy

- Carry out research on the utilization of chili male sterility, reduce seed production cost and improve the purity of hybrid seeds.
- Research and develop chili intercropping planting to improve production efficiency.
- Accelerate the mechanization of chili production and reduce labor costs.
**Key Technologies**

- Molecular marker assisted selection has been applied in improving chili resistance to virus and root knot nematode.
- Anther culture technology has been applied in creating haploid and purifying inbred lines.
- Space mutation technology has been applied in creating new chili germplasm and breeding new varieties.
- New drying technology has been applied in chili processing.
The distribution of pathogenic bacteria and dominant physiological races have been thoroughly studied. At present, 185 germplasm resistant to TMV and 152 germplasm resistant to CMV have been identified.

A series of chili stable male sterile lines with excellent comprehensive characters were bred by means of distant hybridization and backcross. Such as 2298A, 1110A, etc.

Chili and corn intercropping mode: it is applied in Shanxi, Liaoning and Hubei, with six rows of chili and one row of corn.

Chili and garlic interplanting mode: it is a relatively mature and efficient cultivation mode in Shandong Province. Garlic is sown in October, harvested at the end of May the next year, and chili is planted at the end of April and harvested at the end of September.
A series of new chili varieties, such as Lafeng No.3, were bred by using sterile line, maintainer line and restorer line.

Molecular marker assisted selection has been applied in increasing resistance to virus and root knot nematode. At present, Zhongjiao 105, Zhongjiao 106, Zhongjiao 115, etc. have been bred. The resistant varieties have played important roles in ensuring chili production, reducing pesticide consumption, and improving product quality. At present, the main varieties are generally resistant to 2 to 3 kinds of diseases.
A new chili variety Haifeng 16 was bred with anther culture technology. It has the characteristics of strong storage and transportation tolerance, vigorous plant growth, and strong continuous fruit setting ability.

Excellent chili inbred lines were created through space mutation, and a series of new varieties were bred, such as Hangjiao No.3, Hangjiao No.10, and Hangjiao No.25, which are characterized by high yield and high spiciness.
The purification and rejuvenation of 85% local chili varieties have been completed, and the dry chili variety of Jingla No. 2 have also been bred by using sterile line, maintainer line and restorer line.

The processing chili variety of Yanjiao 425 has been bred, which has high yield, high quality, high resistance, high spiciness, and is easy to harvest. It is not only suitable for drying, but also for processing.
**Effectiveness**

- Chili and corn intercropping could effectively reduce the occurrence of sunburn and aphids, improve the yield of chili and harvest corn at the same time.
- Intercrop chili and garlic: chili ripens early and has high yield, reducing the occurrence of diseases and pests.
- The mechanization of chili drying has developed rapidly. New methods such as microwave drying and air source heat pump drying have been developed, greatly reducing the rot rate.
- The use of color sorter, automatic transplanter, and harvester has gradually increased, improving work efficiency, and significantly reducing labor costs.
Experience and Lesson

• The new chili varieties have made great progress in terms of yield and disease resistance, and the varieties basically meet the production demand, but there is still a gap between processing chili varieties and the market demand. In addition, the homogenization of chili varieties is prominent. In recent years, the chili varieties suitable for protected cultivation is insufficient.

• In China, chili breeding focuses on systematic breeding and hybridization. Although it is helpful to improve the efficiency of breeding, but it is difficult to solve complex genetic problems. Molecular breeding of chili is limited by high cost and complex operation, so it is rarely used in breeding practice.
Experience and Lesson

• In recent years, China has made great progress in green chili breeding and field management, but compared with developed countries, there is still a big gap in chili planting level, and the yield needs to be further improved.

• Although Xinjiang and Inner Mongolia have developed into the largest production region of processing chili in China, the planting area of traditional chili region has declined due to the increase of labor costs.

• Although the chili has the longest industrial chain and the largest number of processing enterprises in China, the chili industry of China still has problems such as weak driving capacity of leading enterprises, more primary processing enterprises, fewer deep processing enterprises, and weak market competitiveness.
Suggestions

Strengthen the breeding and promotion of new varieties, and scientific and technological investment
Scientific research institutions and leading enterprises should jointly carry out the breeding and promotion of new varieties, improve the ability innovation, and speed up the renewal of varieties. Focus on the chili breeding of high-quality, suitable for mechanized cultivation, accelerate the research and development of special varieties, such as high capsaicin and capsanthin content, strengthen the effective connection with market demand, and further improve the coverage of well varieties.

Innovate the cultivation mode and technique
Integrate new varieties and technologies, promote the simplification of advanced technologies, promote the intercropping technology between chili and other crops, promote key technologies such as integration of water and fertilizer, conduct green control of pest and disease and improve the yield and product quality.
Suggestions

Strengthen the demonstration of mechanization in superior production areas
Increase the research and development of chili production machinery, achieve standard planting, mechanical harvesting and reduce costs. Through the research, development, and demonstration of mechanized production technology, it will promote mechanization, and improve the efficiency of large-scale production.

Develop the intensive processing and enhance the overall strength of the enterprise
Integrate existing resources, increase scientific and technological investment, develop new products, improve the added value, innovate and promote the deep processing technology, increase the product value and industrial extension value, adjust the product structure, increase the research and development of functional food and make new breakthroughs.
Thank you