Study on Current Situation, Existing Problems and Countermeasures of Soybean Cultivation

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Abstract As one of the world's three major food crops and an important economic and oil crop, soybean plays a crucial role in ensuring food safety. In recent years, there are many problems in soybean cultivation, production and processing. In view of this situation, this paper comprehensively expounded and decomposed the cultivation situation, existing problems, specific countermeasures and conclusions, so as to re-recognize them. This study provides reference materials for the sustainable and healthy development of the soybean industry.

Key words Soybean; Cultivation situation; Problems; Countermeasure

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As one of the three major food crops in the world, soybean is rich in lecithin, isoflavones, saponins and many physiological active substances beneficial to human body[1], and it is an important source of high-quality protein and edible oil for human beings. As an agricultural product, the contribution of soybean to rural economy and farmers' income can not be ignored, including soybean planting, processing, trade and sales, which can promote the adjustment of rural industrial structure, improve farmers' income level and quality of life, and provide an important foundation for future food security and ecological environment protection. However, in recent years, the futures price of soybeans has reached a record high in the international market, and the futures prices of soybean oil and soybean meal related to soybeans have also risen. The fluctuation of futures prices has led to violent fluctuations in the spot price of soybeans, which directly affects the entire soybean industry chain, including soybean oil, soybean meal, feed and meat processing industries[2]. Generally speaking, China's soybean industry is in an extremely unstable and unsafe state, which is not conducive to China's food security, agricultural structure adjustment and farmers' income growth, and the sustainable development of China's soybean industry brings severe challenges.

At present, the domestic soybean market is in short supply, and the demand potential is huge[3]. It is very important to maintain the steady growth of total soybean output for ensuring national food security, maintaining price stability and protecting soybean growers' vital interests. Because soybean planting area can't be expanded rapidly in a short time, the fundamental way to achieve this goal is to speed up the popularization and application of soybean production techniques and improve the level of soybean yield per unit area. The research on the present situation and existing problems of soybean cultivation at home and abroad mostly focuses on the aspects of high fertilizer consumption, application of single chemical fertilizers, insufficient organic fertilizer consumption and slow variety renewal, and the emphasis is often on several aspects. Therefore, this paper comprehensively elaborated and decomposed soybean cultivation in China from such four aspects as the current situation, existing problems, specific countermeasures, and conclusions, and conducted in-depth and systematic research on the current situation, existing problems and countermeasures of soybean cultivation in China, so as to re-recognize them. This study provides reference materials for the sustainable and healthy development of the soybean industry.

Current Situation

Planting area and yield status

From 2022 to 2024, the soybean planting area in China has remained stable at over 10 million hectares for three consecutive years. Soybean is the legume crop with the highest planting area in China. It is mainly distributed in northeastern regions such as Heilongjiang, Jilin, and Liaoning, where the planting area and yield account for more than half of the country's total.

Technological development status

With the continuous progress of soybean production technology, the application of modern agricultural techniques has improved soybean yield and quality. For example, the application of precision agriculture techniques, the improvement of irrigation facilities and the improvement of pest control techniques are all helpful to improving soybean yield and quality. In addition, remarkable achievements have been made in the improvement of soybean varieties. Through cross breeding, genetic engineering and other means, a number of excellent soybean varieties with high yield, disease resistance and strong adaptability have been cultivated. The popularization and application of these varieties have greatly improved soybean yield and risk resistance of the plant.

Policy support

China has launched a series of policies to support soybean

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production, including setting up a soybean industry fund, raising subsidy standards, and promoting the "futures + insurance" model. For example, in Yucheng City, Dezhou City, Shandong Province, a soybean industry fund of 20 million yuan was set up, and the subsidy standard was raised to 4 500 yuan/hm^2 on the basis of subsidies from the central, provincial and municipal governments. These policies and measures have effectively guaranteed farmers' income and improved the enthusiasm of soybean planting.

Existing Problems

The variety advantage is not strong

In 2018, the yield per hectare of soybeans in the United States was 1.58 times that of soybeans in China. The main reason for this phenomenon is that the advantages of soybean varieties selected in China are not strong. The soybean breeding methods in China are still mainly based on traditional cross breeding, and the breeding methods are inconsistent with the breeding needs. In addition, the problem of narrow germplasm base in soybean breeding in China is also very prominent, and many excellent germplasm genes are unused or lost. Although the speed of soybean breeding and variety renewal in China is accelerating at this stage, this aspect reflects that the economic life of soybean varieties selected is not long enough. On the other hand, it shows that the adaptability of varieties is not enough, and it is impossible to choose the same variety for a long time. Therefore, it is the focus of breeding work at this stage to find better germplasm resources, broaden breeding methods and retain excellent genetic traits. Moreover, most of the existing soybean varieties in China's main soybean producing areas are for oil and food use, and they have relatively average fat and protein contents. Moreover, there is a lack of detailed component analysis for fat and protein facing market needs, resulting in low commodity grades. For a long time, soybean production, acquisition, storage, transportation and sales are all mixed soybeans regardless of grades and varieties, and some high-oil and high-protein soybean varieties have not shown their due advantages, thus reducing the due commodity value of soybeans.

Cultivation techniques need to be further standardized

The scientific research units in the main soybean producing areas in China have successively developed standardized cultivation techniques under various ecological conditions. These comprehensive high-yielding cultivation techniques have played a significant role in increasing soybean production. However, these supporting technical achievements are only applied in a certain demonstration area, and the promotion area is not large enough, and the degree of standardization and standardization in application is not high enough. In addition, there are some new problems to be solved in soybean cultivation techniques in the production reform, such as the decrease of organic fertilizer application and the increase of chemical fertilizer application in soybean in recent years, which leads to soil hardening and soil physical and chemical properties deterioration. The problems of growers' low technical quality and poor management level also need to be solved.

Scientific research results about soybeans are not well matched with the market. For example, soybean varieties with high oil or high protein are needed in the market, but in the past, most of them focused on breeding for yield factors and neglected quality breeding. Therefore, most of the soybean varieties selected have high yield but average quality. As a result, the quality of imported soybeans exceeds that of commercial soybeans in China. Facing domestic market demand, especially soybean varieties suitable for various tofu processing are not very clear, because there is no detailed analysis on the protein components of soybean varieties with high tofu yield and good flavor according to market demand.

Excessive application of pesticides and fertilizers

Because farmers' knowledge level is limited, misunderstandings always occur in the use of pesticides and fertilizers. They often think that applying more fertilizers will lead to better growth of soybean and the yield of soybeans will be greatly improved. However, the demand of soybean plants for nutrition is limited, and excessive fertilization will not only increase unnecessary input costs, but also inhibit soybean nutrition absorption. Farmers still mainly use chemical fertilizers when growing soybean, and more than 90% of soybean fields are not applied with organic fertilizers. Most farmers still apply fertilizers blindly or empirically, regardless of the fertility and soil quality of the plots, the varieties to be planted, the cultivation methods to be applied, and the high or low content of applied fertilizers, which often leads to serious fertilizer loss and low use efficiency. Pesticides are an effective way to solve crop diseases and pests, control weeds and increase crop lodging resistance in contemporary agriculture. Therefore, farmers have misunderstandings in the application of pesticides.

Prevention and control of soybean pests and diseases is not in place

Soybean-planting fields will be damaged by diseases, weeds and pests to varying degrees all the year round. Diseases are more serious than pests in rainy years, and pests are more serious than diseases in dry years[4]. Soybean diseases spread widely and at the fastest speed, and have a serious impact on soybean yield. In 2024, soybean diseases in the whole country showed a moderate occurrence trend, and the occurrence area was estimated to be 8.7×10^6 hm^2, which was heavier than the previous year. The main diseases include soybean root rot, soybean downy mildew, soybean moths, beet armyworms, soybean rust, virus disease, stalk break, leaf spot disease, and *Heterodera glycines* Ichinohe. Among them, soybean root rot occurs mainly in Heilongjiang, and moderately in Inner Mongolia, Sichuan and Anhui. Soybean downy mildew occurs moderately in Sichuan and Hunan. Soybean moths occur locally in northeast spring soybean area. Beet armyworms occur in Huang – Huai – Hai soybean-corn compound planting area. Viral diseases, rust and leaf spot occur in Guizhou, Sichuan and other places. In addition, disaster weather enlivens insects and aggravates the occurrence of diseases. Moreover, soybean root rot also occurs from time to time. Although the effect of diseased plants on soybean yield is not obvious, the incidence rate

is on the rise.

The soybean deep processing industry is not strong

Large-scale processing enterprises supporting soybean production areas have not yet been established. Although some small-scale bean product enterprises are engaged in the processing of bean products, they only stay in the rough processing of primary products, such as tofu, dried tofu, dried beancurd sticks, and lobster sauce, and the research and development and production technology of fine processing products lag behind other major soybean producing provinces, such as soybean milk, soybean oil, isoflavones, soybean phospholipids, and concentrated protein. The low processing level restricts the promotion of added value of products, which leads to the condition that a large number of protein feed needed by animal husbandry and vegetable oil needed by human life are transported from outside, which further restricts the development of soybean industry in China.

Countermeasures

Strengthening the upgrading of varieties and using high-quality varieties

Variety selection should be adapted to local conditions, and high-quality varieties with suitable maturity, high yield and strong stress resistance should be selected. Farmers cannot plant unapproved varieties with a fluke mentality. Spring sowing varieties are mainly fresh-food varieties, and there are no strict requirements for planting varieties. Some northeast varieties are also planted for seasonal sales[5-6]. In soybean production, agricultural management departments should advocate regional planting which is conducive to the large-scale production of high-oil, high-protein and high-quality special varieties, so as to achieve unified planting, unified harvesting and centralized management and finally high quality and good price.

Strengthening the innovation of cultivation techniques to help improve soybean yield

Specific problems, specific analysis, targeted elimination of relative technical measures based on the climate and environmental conditions of different regions and adoption of effective methods will yield twice the result with half the effort. For example, in some areas, the large area of soybean continuous cropping has become the key to hinder the improvement of soybean yield. Therefore, technical measures such as adopting reasonable rotation, choosing varieties resistant to *H. glycines* Ichinohe, increasing the application of organic fertilizer, applying drugs and fertilizers or dressing seeds with seed coating agents that can effectively prevent and control continuous cropping can be taken to solve the problem, which will inevitably greatly increase local soybean yield. In some areas, there is little rainfall and no irrigation conditions, and soybean is planted in dry land, so water is the key hindering soybean production. Therefore, technical measures such as increasing the application of organic fertilizer, doing a good job in farming, increasing fertilizer and water storage capacities and selecting drought-resistant varieties can be taken to solve the problem, so as to achieve stable and high yield of soybean planted locally. In other areas, the soil moisture content is high, and the ground is cold, so the low temperature and humidity become the key factors hindering the increase of soybean yield. For these areas, it is necessary to adopt high ridge cultivation to obtain good effects of warming, waterlogging prevention and yield increasing[7]. In addition, new soybean cultivation modes are all effective cultivation methods that have been verified by experts and scholars, so the yield and quality of soybeans will be greatly improved in application. In order to make soybean cultivation develop better, it is necessary to popularize new cultivation modes. Therefore, relevant departments should do a good job in promoting awareness among farmers and provide them with corresponding machinery and funds as much as possible to promote the development of the soybean industry.

Strengthening scientific research to promote the development of soybean industry

We must mobilize the enthusiasm of all members of the soybean scientific research community, make great efforts, and deepen research at all levels, so as to create high-tech achievements. The research should focus on the innovation and utilization of excellent soybean resources, the inheritance and improvement of soybean with high quality and high yield, the comprehensive cultivation techniques of soybean with high quality and high yield, and the deep processing and utilization of soybean. Through efforts, in the near future, we must create and develop soybean varieties with high protein content, soybean varieties with fat content exceeding 18%, hybrid soybean varieties with yield increase of more than 20% that can be promoted and applied in production, and varieties that are particularly resistant to insects and drought.

Increasing the application of organic fertilizers and reducing the application of pesticides

In soybean cultivation, organic fertilizers should be used as much as possible to reduce soil hardening and caking caused by a large amount of chemical fertilizers. Large machinery should be used as much as possible in the process of farmland cultivation to reduce the crushing of land by agricultural machinery, and the plowing depth should reach the standard. Rational use of organic fertilizers can increase soil nutrition, improve organic matter in soil and balance soil pH[8]. Fertilization of crops needs to be targeted, so before fertilization, it is necessary to test the planting soil, analyze favorable and unfavorable factors of soybean yield and quality in the soil, and then carry out targeted fertilization according to the needs of soybean for nutrition in the soil, so as to ensure the nutritional supply of soybeans and improve soybean yield and quality. In addition, pesticides with high toxicity and long residue time cannot be used to prevent them from affecting soybean quality or causing pesticide residues which affect people's health.

Adhering to prevention first and comprehensive control of diseases, pests and weeds, and serving socialization

According to the occurrence of pests and diseases, we should

follow the plant protection policy of giving priority to prevention and combining prevention with control to prevent and control soybean pests and diseases[9]. First of all, we should choose disease-resistant varieties. Planting soybean varieties with strong disease resistance is one of the most effective ways to control diseases. Resistant varieties can reduce the occurrence of diseases and improve the stress resistance of crops. Secondly, reasonable rotation should be carried out to avoid continuous cropping and reduce the occurrence of pests and diseases. Crop rotation can destroy the life cycle of pests and diseases and reduce the accumulation and spread of pests and diseases. Thirdly, seed treatment is carried out, that is, the seeds are disinfected before sowing, and seed treatment agents containing components such as metalaxyl-M · fludioxonil and pyraclostrobin can be used to prevent and control root diseases and underground pests. Meanwhile, field management should be strengthened, and measures such as rationally applying fertilizer, increasing the application of organic fertilizer or farmyard manure and improving the soil environment can be taken. The disease resistance of plants should be improved, and diseased plants should be promptly removed to reduce the accumulation of pathogens. Chemical prevention and control should be prepared well, and chemicals can be applied appropriately to prevent and control diseases at the early stage. For example, yellow leaf disease can be sprayed with micro element fertilizers such as zinc, iron and bactericides. *Cercospora kikuchii* disease can be controlled with 800 times dilution of carbendazim wettable powder. Downy mildew can be controlled with metalaxyl 800 times dilution. Fungicides such as triadimefon and difenoconazole can be used for soybean rust. Aphids can be controlled using natural enemies such as syrphidae and *Aphidius colemani*. Physical methods such as yellow boards and lamp lures are adopted to monitor and trap and kill adult pests.

Strengthening soybean deep processing capacity and developing deep processing industry

Deep processing of soybeans is closely related to soybean production. Only by creating good economic benefits through deep processing of soybeans can large-scale production of soybeans be promoted, which is the most ideal effect of market regulation[10]. Efforts should be made to improve the modernization and standardization of traditional bean product production techniques and extend the shelf life of traditional bean products. We should research and develop new soybean raw material ingredient production and new products including soybean functional food and health food, explore new soybean processing techniques, and fully tap the potential nutritional value and added value of soybeans, so as to broaden the industrial chain and improve the added value of products[11]. Meanwhile, it is necessary to deeply explore the nutritional value and medicinal value of soybeans, actively introduce soybean refining and deep processing enterprises, and promote the rational development and application of soybean flavonoids, protein and fat. We should also jointly promote the development of China's soybean industry, and achieve coordinated development before, during and after production, thereby improving the production efficiency of soybean processing industry and reducing production costs. Finally, the soybean industrial chain will be continuously improved and optimized.

Conclusions

Soybeans are one of the main agricultural products in China, but there are a series of problems in the process of soybean industry development. Specifically, the variety advantage is not strong, and the cultivation techniques need to be further standardized. The scientific research results are not well matched with the market. There are also problems such as excessive application of pesticides and fertilizers, inadequate prevention and control of soybean pests and diseases and weak soybean deep processing industry. These problems have led to the expansion of soybean planting area in China, the continuous improvement of soybean yield, the enhancement of soybean farmers' enthusiasm for planting and the healthy and sustainable development of soybean industry. Such situation has also brought many adverse effects, and then causes a certain impact on China's agricultural output and economic development. In order to accelerate the development of soybean industry at this stage, it is necessary to strengthen the upgrading of varieties and use high-quality varieties. The innovation of cultivation techniques should be strengthened to help increase soybean yield. Scientific research should be strengthened to boost the development of soybean industry. We should increase the application of organic fertilizers and reduce the application of pesticides. We should adhere to prevention first and comprehensive control of diseases, pests and weeds, and serve socialization. It is necessary to strengthen the deep processing capacity of soybeans, develop the deep processing industry, and then improve the overall level and quality of the industry. The level of soybean planting and production machinery should be improved to increase the total and per unit yield of soybean production. It is anticipated to promote the development of follow-up industries and enhance the overall important position, so as to improve China's grain output and quality and promote China's economic development.

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Through standardized breeding, the survival rate and production efficiency of sheep in Lubei region can be effectively improved, and the breeding cost can be reduced, thus improving breeding efficiency.

Enhancing breed improvement and breeding

Combined with market demand and resource advantages, we should strengthen the breeding and popularization of excellent breeds to improve the growth performance and meat quality of sheep in Lubei region. Meanwhile, we should also pay attention to the introduction and cultivation of breeding sheep. New breeds that meet the market demand can be bred by introducing excellent breeding sheep at home and abroad and crossbreeding and improving them, providing strong support for industrial development.

Deepening the integration of upstream and downstream enterprises in the industrial chain

The cooperation and integration between the upstream and downstream enterprises in the industrial chain should be strengthened to form a close industrial chain. The upstream enterprises should provide high-quality breeding sheep and feed, and the midstream enterprises should strengthen breeding management and technical services, and the downstream enterprises should expand sales channels and increase the added value of products. Through the integration of the industrial chain, a virtuous circle of resource sharing and complementary advantages can be formed, and the Wadi sheep industry in Lubei region can be promoted to a higher level.

Strengthening policy support and supervision

The government should continue to increase its support for the industry by providing financial, technical and market support. Meanwhile, we should strengthen supervision, establish a sound supervision system, and strengthen supervision over breeding, processing and sales to ensure the quality and safety of products. Through the joint efforts of policy support and supervision, the healthy, stable and high-quality development of Wadi sheep industry in Lubei region can be promoted and ensured.

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