

Overview of Garlic Planting Situation and Planting Technology at Home and Abroad

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Abstract

Garlic (*Allium sativum* L.) is a perennial herb belonging to Liliaceae family, *Allium* genus. It has both nutritional and medicinal value and has a wide range of applications. In recent years, the planting area and output of garlic at home and abroad have increased steadily. China is the world's largest producer and major exporter of garlic, and its planting scale and output occupy a leading position in the world. In this paper, the environmental requirements of garlic planting, planting technology, common types of diseases and insect pests and their control technology, policies and support measures, future development trend, challenges and countermeasures in the planting process were summarized. This review is expected to provide theoretical basis for garlic planting and promote the development of garlic planting industry.

Keywords

Garlic; Planting Situation; Planting Technology; Overview.

1. Overview of Garlic Planting Situation at Home and Abroad

1.1. Trends of Garlic Planting Area and Yield at Home and Abroad

Garlic (*Allium sativum* L.) is a perennial herb of Liliaceae family, *Allium* genus. It is native to western Asia or Europe. During the Western Han Dynasty, Zhang Qian brought it back from the Western regions. Garlic has a long history of cultivation in the world and is widely cultivated in north and south China. The spicy taste of garlic can remove fishiness and greasy, wake up the taste buds. During the cooking process, garlic can also produce a variety of flavor substances such as sulfur-containing compounds, adding a rich taste level to dishes. Garlic is also a widely used medicinal materials, with food accumulation and stagnation, sterilization and insect control.

Over the past decade, the global garlic planting area and production have grown steadily, with China, as the largest producer, increasing its planting area from 756,600 hectares in 2007 to 831,800 hectares in 2021, an increase of about 9.95%, and production from 16,064,700 tons to 20.51,400 tons, an increase of 27.7%. China's garlic planting covers 30 provinces, forming a number of main producing areas, such as Hebei Single garlic, Jiangsu purple garlic, etc. The planting scale and output of these regions are on the rise [1].

However, in 2014, the planting area and production of garlic in China have fluctuated to varying degrees, especially in Jinxiang area of Shandong Province, due to the impact of bad weather, the yield per unit area has decreased. In addition, the small size of garlic scale in some areas has also affected the supply of the market.

From a global perspective, from 2014 to 2020, the global garlic planting area and production have shown an increasing trend. China's garlic production accounts for about 76% of the world's total, showing its dominance in the global garlic market. This status is not only reflected

in the yield, but also in the continuous expansion of the planting area and the continuous progress of technology.

Overall, the changing trend of China's garlic planting area and output not only reflects the domestic agricultural development dynamics, but also affects the global garlic market pattern to a certain extent. With the progress of planting technology and changes in market demand, there may be new changes in the planting area and output of garlic in China in the future, which is worth continuous attention.

1.2. Overview of the Main Garlic Growing Countries and Regions

China is the world's largest producer and major exporter of garlic, and its planting scale and output occupy a leading position in the world [2]. According to the Food and Agriculture Organization of the United Nations, China's exports account for a very high proportion of the world's total exports, such as 84.53% in 2011. The main growing area is concentrated in Jinxiang County in Shandong Province, which is not only the largest garlic producing county in China, but also the main source of farmers' income. Jinxiang County and its surrounding areas such as Chengwu and Juye constitute the largest garlic producing areas in China, with an area of more than 700,000 hectares. With its high quality, large size and long storage period, Chinese garlic has a competitive advantage in the international market, and the characteristics of early listing make Chinese garlic occupy a leading position in global trade. However, China's garlic farming industry also faces challenges such as low mechanization level, disordered export competition, deep-processed products and insufficient brand building. In addition to China, the United States, India, South Korea and other countries are also actively developing the garlic industry, and the rapid growth of the United States is particularly noteworthy.

In addition, China's garlic export markets are widely distributed, including Indonesia, the Netherlands, Malaysia, Japan and other countries and regions. The increase in export volume and the expansion of the market are important achievements of the Chinese garlic industry. However, due to the fierce export competition and other factors, China's garlic exports are also facing challenges such as falling prices, anti-dumping duties and quota restrictions.

Overall, China's garlic industry occupies an important position both at home and abroad, and although it faces challenges, its huge planting scale, product quality and early market advantages still make it a central role in the global garlic market.

2. Environment Requirements for Garlic Planting

Garlic is an important cash crop, the key to its success is: fertile, loose, well-drained soil environment, pH between 6.0 and 7.5, as well as suitable temperature and water management [3]. Garlic soil requirements include good ventilation and water retention, as well as rich organic matter and major nutrients such as N, P, K. In addition, garlic's roots have poor absorption capacity, so alkaline soil needs to be avoided to safeguard its healthy growth and improve yield. Suitable climatic conditions and reasonable water management are also important factors to ensure high quality garlic output. A sunny environment facilitates photosynthesis and nutrient accumulation, which is essential for bulb formation.

In summary, garlic growth requires specific soil conditions, climatic conditions, and water management. Only when these conditions are fully met can the cultivation of garlic be successful, resulting in a high yield and quality product. Therefore, understanding and mastering these growing conditions is crucial to the success of garlic cultivation.

The influence of climatic conditions on garlic growth is complex and critical. The proper temperature range (12-24 °C) and proper precipitation are essential for the healthy growth of garlic. The examples of Lanling County and Chengxian County show that geographical location and specific climatic conditions affect garlic planting methods and growth cycles. Garlic in

Lanling County is usually planted in late autumn, and high temperature and dry weather may affect the seedling emergence rate, while spring drought may affect bolting and garlic clove swelling [4]. In Chengxian county, the ground temperature was increased by mulching film to prevent the influence of late frost on flower buds and bolting. In addition, the storage temperature and humidity of garlic seeds will also affect the secondary growth. Therefore, understanding the effects of climate on garlic growth is crucial to improving garlic production and quality.

3. Research Progress of Garlic Planting Technology

Garlic planting in China adopts a diversified model, combining local climate and soil conditions, to optimize land use and improve economic benefits [5]. Crop rotation and intercropping are common planting patterns that help with pest control and soil fertility recovery. In northern China, crop rotation is common with wheat and corn, while in Yunnan, crop intercropping is common with corn and rice. Soil preparation, application of base fertilizer, seed selection and treatment, sowing density control and field management are the key technical measures to ensure good growth and high yield of garlic. When harvesting, garlic growth and market demand should be considered to ensure product quality. On the whole, garlic farming is an integrated scientific activity that requires precise management and technical application to achieve sustainable development.

The key of garlic cultivation is to select high quality, high yield and disease resistance varieties. Suitable land and fertile previous crops are the foundation. High quality garlic planting can improve the yield and quality, and the improvement of varieties is also an effective way to increase the yield. Overall consideration, garlic planting should pay attention to variety selection, land selection and avoid continuous cropping to ensure product quality and meet market demand.

4. Prevention and Control Technology of Common Disease and Insect Pest in Garlic Planting

4.1. Types of Disease and Insect Pest in Garlic Planting and Their Control Strategies

As an important cash crop, garlic has a wide range of planting areas at home and abroad. However, garlic is vulnerable to various pests and diseases during the growth process, which not only affects the yield and quality of garlic, but also may increase the cost of planting. Therefore, understanding the main types of pests and diseases and corresponding control strategies is an important task for garlic growers.

The diseases of garlic mainly include leaf blight, white rot, rust and soft rot. The control strategies of leaf blight mainly include selection of disease-resistant varieties, strengthening field management, applying enough organic fertilizer and implementing crop rotation. In terms of chemical control, carbendazim wettable powder can be used to mix or dip seeds before sowing, and chlorothalonil wettable powder can be used for spray treatment when the rate of diseased leaves reaches a certain degree.

The prevention and control of white rot should be through strengthening field management, crop rotation and timely removal of disease residues. Chemically, carbendazim can be used for spray treatment in the early stages of the disease.

The control strategy of rust disease is similar to that of white rot, with agricultural measures such as strengthening management and crop rotation to reduce the probability of occurrence, and chemical control is sprayed with powdered rust rather than wet powder at the early stage of the disease.

Soft rot prevention and control measures also include strengthening field management, reducing humidity and rotating crops. In terms of chemical control, appropriate fungicides can be selected for spraying according to the actual situation.

In addition to diseases, garlic can also suffer from pests, such as garlic maggots, mole crickets, and onion thrips. For these pests, integrated control strategies are usually adopted, including agricultural control, physical control, biological control and chemical control. For example, infestations can be lured by sprinkling plant ash and covering the roots with a mixture of sawdust and trichlorophon plus brown sugar, white vinegar, and water. Chemical control requires strict adherence to pesticide use standards, and the use of pesticides should be stopped about 15 days before harvest.

To sum up, garlic pest control needs to consider a variety of factors and adopt reasonable control strategies. Through scientific management and correct use of control means, diseases and pests can be effectively controlled to ensure the yield and quality of garlic.

4.2. Biological and Chemical Control Technology of Disease and Insect Pest in Garlic Planting

In the planting process of garlic, in order to control various diseases and pests, it is usually necessary to use a combination of biological control and chemical control technology. Biological control refers to the use of natural predators, parasites or pathogens to control pest populations, which is environmentally friendly and long-lasting, but the effect is relatively slow and may take a long time to see significant results. Chemical control is to use chemical pesticides to rapidly reduce the number of pests and diseases. This method has a fast effect and low cost, but it may cause certain impact on the environment and human health [6].

In terms of chemical control, references provide the use of a variety of agents. For example, for garlic rust, 15% powder rust can be used as a wet powder 1000-1500 times the liquid, combined with 70% mancozeb wettable powder 1000 times the liquid for control. For leaf spot, gray mold, etc., 75% chlorothalonil wettable powder 800 times liquid or 64% virulent alum wettable powder 500 times liquid can be used for prevention and control. In addition, it is also necessary to pay attention to the timing and frequency of drug use, as well as the prevention and treatment of other diseases.

In terms of biological control, the control of garlic root maggots is a typical example. The larvae of these pests can seriously affect the yield and quality of garlic, so timely measures need to be taken. In the early stages, the roots can be sprayed with either 70% phoxiion solution or 25% Mala phoxiion solution, which are chemicals that effectively kill root maggots.

In practice, chemical control and biological control often need to be flexibly matched according to the actual situation. For example, while using chemical agents, some natural enemies can also be appropriately introduced to help control the population of pests. At the same time, it is also necessary to pay attention to the safe use of agents to avoid unnecessary pollution to the environment.

Combining biological and chemical control strategies is an integrated approach to garlic pest management, designed to ensure yield and quality while reducing environmental impact. This strategy requires accurate diagnosis of pests and diseases, correct selection and use of chemicals, and adjustment of control methods according to the actual situation to achieve optimal results.

5. Policy and Support Measures for Garlic Planting

5.1. Policy and Support Measures at Home and Abroad

China's leading position in the field of garlic cultivation benefits from the state's attention and support for agricultural development. In order to ensure the sustainable development of the

garlic industry, the Chinese government has formulated a series of policy measures to promote the scientific, large-scale and modern cultivation of garlic.

First of all, the government optimizes the garlic planting structure through scientific planning and guidance. In July and August of every summer, the rural agricultural technology stations in various places will collect and publish the planting plan of the year, including planting area, varieties and time, etc. These data are then summarized by the county agricultural Bureau and compared with the data of previous years, so as to facilitate farmers to arrange their planting plan scientifically, avoid blindly following the trend and ensure the stability of farmers' income [7].

Secondly, the government encourages the cultivation and research and development of garlic through financial support and subsidy policies. For example, for scientific research projects and technological innovation that have made breakthroughs in the field of garlic planting, the government will give certain financial support to promote the progress of garlic planting technology and the upgrading of the industry.

Third, in order to ensure the sales and market stability of garlic, the government has also formulated relevant market control measures. For example, the establishment and improvement of the garlic collection and storage system, through the government reserve to regulate market supply and demand, to ensure the stability of prices, so as to protect the interests of farmers from the impact of market fluctuations.

Finally, the government is actively promoting the internationalization of the garlic industry. Through the introduction of a series of export policies and preferential measures to support the export trade of garlic, improve the competitiveness of China's garlic in the international market. For example, for export enterprises, the government provides export tax rebates, credit support and other policies to reduce their operating costs and enhance their export competitiveness [8].

To sum up, the Chinese government has adopted a series of policy measures to not only ensure the stable development of domestic garlic planting, but also promote the internationalization of the garlic industry and provide strong policy support for China's garlic planting industry.

5.2. The Effect of Policy on Garlic Planting

According to FAO data, China is the world's garlic production leader, planting area and output ranked first in the world, the market share of more than 60%. This position is due to the country's high attention and policy support for garlic cultivation. Policy promotion mainly includes: first, the introduction of preferential policies to promote large-scale planting of garlic, improve the level of agricultural mechanization, reduce labor intensity, and improve production efficiency; The second is to strengthen export trade management, regulate the market, combat smuggling, establish industry associations to regulate competition, and protect product pricing and enterprise rights and interests.

Third, the government has also increased investment in research and development of garlic deep-processed products to improve the added value of products. Through scientific and technological innovation and technological transformation, it not only enriches the deep-processing methods of garlic, but also promotes the development of high value-added products, such as allicin, garlic oil, etc., which opens up new growth points for the deep-processing and comprehensive utilization of garlic.

Finally, in order to enhance the international competitiveness of Chinese garlic, the government encourages and supports enterprises to establish their own brands and enhance brand influence. Through these measures, China's garlic products not only occupy an advantage in quantity, but also have been significantly improved in quality and brand.

In general, the positive role of the policy has largely promoted the modernization process of China's garlic planting industry, not only to ensure the needs of domestic consumers, but also to enhance China's competitiveness in the global market.

6. The Future Development Trend of Garlic Planting

In the world, garlic as an important cash crop, the development of its planting technology is constantly improving. In China, the key of garlic mechanized planting technology is to solve the problem of single seed row and garlic tip up control, which is not only the difficulty of mechanical design, but also the focus of improving planting efficiency. In recent years, the self-propelled five-step garlic planter jointly developed by the Chinese Academy of Agricultural Mechanization Sciences and other units has realized the automatic feeding and directional control of the garlic clove falling process during planting through the rotating spoon seed row and the spiral tube orientation device, which marks a great progress in domestic garlic planting technology.

Foreign garlic planters, such as equipment in the United States, Italy, and South Korea, are mainly characterized by spreading after ditching, which is suitable for large-scale mechanized planting. Although single-grain seeding can be realized basically, there are limitations in the control of garlic tip up. The breakthrough of this technical bottleneck will greatly improve the precision and efficiency of garlic planting [9].

In terms of agronomic traits and yield, the appropriate ecological environment and cultivation technology of garlic are the key points. Garlic is suitable for cold and cool climate areas at higher altitudes, mainly in the open field without film cultivation. Proper light, temperature, moisture, gas conditions and the proper application of fertilizer are all key factors to ensure the normal growth of garlic. For example, appropriate planting density, reasonable fertilization strategies, especially the reasonable proportion of nitrogen and potassium fertilizers, can effectively improve the agronomic traits and yield of garlic.

In terms of cultivation mode, the popularization and application of mulch mulch, double mulch mulch and mulch corn interplanting have greatly improved the yield and economic benefit of garlic. Through scientific time planning and technical application, the technology of double film cover planting in autumn sowing not only solves the problems of late ripening, low yield and inferior quality, but also significantly improves the yield and economic benefits.

From the planting situation at home and abroad, the development trend of garlic planting technology is obvious. On the one hand, the development and application of mechanization and intelligent equipment will become the mainstream, improving the precision and efficiency of planting; On the other hand, scientific agronomic management and efficient cultivation patterns will be the key to improving yield and quality. With the continuous progress of science and technology and the increase of market demand, the development of garlic planting technology will be more diversified and intelligent to meet the needs of efficient, environmentally friendly and sustainable agricultural development.

China's garlic farming industry occupies an extremely important position in the global market. According to relevant data, China's garlic planting area and output rank first in the world, and the continuous growth of planting area and output also shows its expanding market potential [10]. In 2020, China's garlic planting area reached 843,000 hectares, and the output was as high as 24.028 million tons, showing China's leadership in the global garlic market.

In the international market, although China's garlic exports only account for about 9% of domestic production, this figure still reflects the competitiveness of China's garlic in the global market. With the continuous growth of domestic consumption, it is expected that the proportion of Chinese garlic exports is expected to further increase in the future.

In the domestic market, China's garlic growing areas are mainly concentrated in Shandong, Henan and Jiangsu, and these three provinces account for more than 50% of the country's planting area. The garlic industry in these areas has formed a complete industrial chain, including the storage, processing and export of garlic, forming an industrial cluster, which is of great significance for improving the overall competitiveness and market share.

Looking forward to the future, with the increase in consumer demand for healthy food, garlic as a food with rich nutritional value, its application in the food field will be further expanded. In addition, with the progress of planting technology and the expansion of market demand, the quality and output of Chinese garlic are expected to further improve, which will help the competitiveness of Chinese garlic in the global market.

To sum up, China's garlic planting industry has obvious competitive advantages in the global market, and the future market prospects are broad. With the advancement of technology and the growth of market demand, China's garlic planting area and production are expected to continue to grow, thus further strengthening its position in the global market.

7. Challenges and Countermeasures in Garlic Planting

China's garlic farming industry is subject to multiple challenges, most of the domestic small-scale farmers, easy to cause production and sales disjointed, "rush" to follow the trend of planting increased risk. The degree of industrial organization is low, most enterprises are small in scale, low in efficiency, and lack of market competitiveness. Enterprises are at a disadvantage in the face of international trade protection barriers. The problem of information asymmetry is intensified, traders use their advantages to operate the market, and hot capital intervenes to push up prices, damaging the interests of farmers and increasing the business risks of enterprises. The lack of authoritative and scientific industrial information service platform aggravates the asymmetry of industrial information. Finally, the over-concentration of export markets is also a problem that cannot be ignored. China's garlic exports are mainly concentrated in Indonesia, Malaysia, India, the Middle East, Japan and other countries. Such over-concentrated export markets make China's garlic industry more susceptible to the impact of international trade policies [11]. Once the policies of these exporting countries change, or the market demand changes, it may have a significant impact on China's garlic exports. To sum up, when China's garlic planting industry faces multiple challenges in domestic and foreign markets, it needs to strengthen the degree of industrial organization, improve the competitiveness of enterprises, solve the problem of information asymmetry, and optimize the export market structure to achieve the healthy and sustainable development of the garlic industry.

First of all, it is recommended to establish a national garlic information platform to ensure the timeliness and accuracy of information, reduce market information asymmetry, and stabilize garlic prices. The platform can provide key information such as planting area, yield and market demand, providing decision-making basis for market participants and helping to avoid risks. Secondly, the main production base of garlic should reasonably arrange the planting area to avoid blindly following the trend and prevent price fluctuations [12]. At the same time, the technical station needs to strengthen the research of planting technology, improve the yield per unit area, and meet the market demand. Finally, the government needs to strengthen macro-control and market supervision to protect the interests of farmers and consumers.

Acknowledgments

This study was supported by Jiangsu Innovation and entrepreneurship project of college students No. 202411049040Z.

References

- [1] Hou J H, Liu Chunlei. Garlic resource deep processing and industrialization of research progress in China [J]. Journal of biological resources, 2020, 01: 36-42.
- [2] Liu P Z. Survey and analysis report on garlic market and industry in China [J]. Agricultural Products Market, 2021, 11: 55-56.
- [3] Hu B Y. Autumn sowing garlic high-yield cultivation technology [J]. Journal of hebei agricultural machinery, 2024, 10 : 130-132.
- [4] Wu X C, Chen J X, Yan X, et al. Analysis of climatic conditions and planting regionalization of garlic growth stage [J]. Modern Agricultural Science and Technology, 2019, 10: 83-84+86.
- [5] Fang Y J, Li Y M, Feng X B, et al. High yield cultivation techniques of Laiwu garlic [J]. Special Economic Flora and Fauna, 2019, 27(05): 104-106.
- [6] Yang H F. Garlic cultivation management and key points for prevention and control of plant diseases and insect pests of green technology analysis [J]. Seeds of science and technology, 2024 (12): 99-101.
- [7] Zhou H T, Guo Z. Economic man theory analysis of garlic farming behavior in Zhongmou County, Henan Province [J]. Rural Economics and Science and Technology, 2014, 25(10): 108-110.
- [8] Yang B B, Zong Y X, Zhao B H. Study on the development path of garlic export trade between China and countries along the "Belt and Road" [J]. Northern Horticulture, 2019, 09: 164-169.
- [9] Li R C, Sun X, Song C T, et al. Overview and Research of WZ-4 type garlic Planting Machinery [J]. Agricultural Equipment and Vehicle Engineering, 2013, 51(05): 15-17+22.
- [10] Li P L. The China producing garlic varieties cultivated adaptability evaluation [D]. Northwest agriculture and forestry university of science and technology, 2019.
- [11] Liu L, Zhang Y, Feng J H, et al. Suggestions on promoting sustainable development of garlic industry in China [J]. China Fruit and Vegetable Science, 2008, 04: 42-43.
- [12] Zhu S M, Liu X H. Long-term development of garlic industry in China from the perspective of supply and demand [J]. Rural Economy and Science and Technology, 2013, 24(03): 31-34.