Current Status and Development Strategies of Tomato Seed Industry in Lintong District, Xi'an City

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Abstract This paper investigates and analyzes the general situation of the tomato seed production industry in Lintong District, Xi'an City. Development strategies and suggestions are proposed to address existing problems. These include strengthening technological innovation and variety R&D, promoting industrial standardization and intelligent upgrading, enhancing brand building and market expansion, improving policy support and industrial chain coordination, strengthening intellectual property protection and talent cultivation, and expanding sales channels to promote industrial transformation and upgrading.

Key words Lintong, Tomato, Seed industry, Current status, Suggestions

0 Introduction

Tomato is highly nutritious, has a large cultivation area, and offers good economic benefits, making it one of the most important vegetables in China and worldwide. Starting in 1985, Shaanxi Province gradually established the Xi'an Lintong Tomato Breeding Base, which became the province's tomato breeding center. It radiated outwards, driving the development of tomato hybrid seed production bases in surrounding districts and counties like Gaoling and Yanliang. This led to the emergence of nationally renowned tomato seed production leading enterprises under brands such as Jinpeng, Xiyou, Qinhuang, Heimao, and Yangguang. Lintong District has been designated as a national-level tomato seed production base and is famously known as "China's Hometown of Tomato Seed Production". Currently, there are 15 large tomato seed production enterprises in Lintong District. They have bred over 50 high-quality tomato varieties under brands like Jinpeng and Qinhuang. The annual tomato seed production output is 30 000 kg, accounting for over 40% of the national market share, with an output value approaching 100 million yuan.

As one of China's major tomato breeding and seed production bases, Lintong District has played a significant role in promoting the development of the tomato seed industry in Shaanxi. To comprehensively advance rural revitalization, promote farmers' income growth, further understand the current status of the tomato industry in Lintong District, drive the high-quality development of Shaanxi's tomato industry, and accelerate the pace of agricultural technological innovation, this investigation into Lintong's tomato industry was conducted.

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1 Research content and plan

1.1 Research content The basic situation of various tomato seed companies in Lintong District, including planting scale, methods, tomato varieties, and existing problems, such as those related to varieties, technology and management.

1.2 Implementation plan After a 7-day investigation, 15 tomato seed companies in Lintong District were visited. These are: Xi'an Changfengyuan Seed Co., Ltd., Xi'an Qinshu Agriculture Co., Ltd., Xi'an Shiyang Seedling Co., Ltd., Xi'an Tomato Research Institute, Xi'an Jinpeng Seedling Co., Ltd., Xi'an Shengmei Seedling Co., Ltd., Shaanxi Dongsheng Seed Co., Ltd., Xi'an Beidou Seedling Co., Ltd., Xi'an Jinsheng Seed Co., Ltd., Nianfeng Tomato Seedling Breeding Co., Ltd., Xi'an Qunxing Seed Co., Ltd., Xi'an Shijia Seed Co., Ltd., Xi'an Jiaxin Seed Co., Ltd., Changfeng Vegetable Research Institute of Lintong District, Xi'an Zhongnong Fengnong Co., Ltd. The basic situation of each seed company was understood, and the existing problems were summarized and categorized to provide a basis for proposing effective solutions.

2 Results and analysis

2.1 Company establishment duration There are significant differences in the establishment duration among different companies, spanning from 2000 to 2022. Most companies have a relatively long establishment history, indicating that these enterprises possess considerable experience in the tomato industry. Some larger-scale companies, such as Xi'an Tomato Research Institute, Jinpeng Seedling Co., Ltd., and Xi'an Qunxing Seed Co., Ltd., were established as early as 2000 and 2001, indicating a relatively long establishment duration. Their stable position in the market and rich industry experience are likely related to their accumulation and development journey within the tomato industry. Xi'an Shiyang Seedling Co., Ltd. and Xi'an Zhongnong Fengnong Co., Ltd. are enterprises that have newly entered the market in

recent years. With shorter establishment duration, they lag behind companies with longer histories in terms of market recognition, technological accumulation, and resource accumulation.

2.2 Breeding area With the continuous improvement of tomato seed production technology, the base area has gradually stabilized, and companies are showing positive trends in investment and innovation in breeding. The total breeding area exceeds the total propagation area, reflecting the strong demand for breeding innovation in the tomato industry. Among them, five companies have a relatively large scale, with an area exceeding 13.33 ha: Xi'an Tomato Research Institute, Jinpeng Seedling Co., Ltd., Xi'an Qunxing Seed Industry Co., Ltd., Xi'an Qinsu Agriculture Co., Ltd., and Xi'an Zhongnong Fengnong Co., Ltd. The breeding area of most companies ranges from 6.67 to 13.33 ha, which is considered a medium scale; Xi'an Jiaxin Seed Industry Co., Ltd. and Xi'an Lintong Changfeng Vegetable Research Institute have breeding area less than 6.67 ha, making them relatively small-scale enterprises. Comprehensive analysis shows that the tomato industry is actively engaged in breeding innovation and scale expansion, with enterprises of different sizes having their own advantages and challenges. Expanding the breeding area is significant for increasing sales and meeting market demand, and large-scale enterprises may find it easier to achieve results in this regard.

2.3 Staff composition and education level The staff composition is shown in Fig. 1. Due to the seasonal nature of tomato production, temporary staff constitute the main personnel of tomato seed companies, accounting for 86.8%. Temporary hiring can better adapt to this seasonal variation, helping companies flexibly control labor costs, but it can sometimes make it difficult to meet specific technical and professional requirements. Regarding the education level of practitioners, there is a lack of high-level talent; those with education below the college level form the main composition of the seed industry workforce in Lintong District, accounting for 90% of the total personnel. The proportion of highly educated practitioners with college degrees or above is very low, only 10%, indicating that there is still a significant gap in matching the knowledge-intensive industry required for facility agriculture and smart agriculture, and the shortage of scientific research talent in seed enterprises persists.

2.4 Age structure Among company employees, those aged 50 and above and those aged 40 – 50 account for a relatively high proportion, reaching 76% of the total personnel (Fig. 1). and this group may possess rich technical knowledge; among them, the leaders of Xi'an Tomato Research Institute, Jinpeng Seedling Co., Ltd., and Xi'an Qunxing Seed Industry Co., Ltd. are older and have extensive industry experience and management expertise. Practitioners under the age of 30 account for an extremely low proportion, only 6%, indicating that companies face challenges in attracting young talent, and the scarcity of young talent may lead to insufficient awareness of new technologies, innovation, and market trends, thereby limiting the flexibility of enterprise development. The seasonality and periodicity of tomato production cause seasonal labor shortages, compounded by the lack of professional knowledge among practitioners and the prominent issue of an aging workforce. Both these factors adversely affect the rapid development of the Lintong tomato industry.

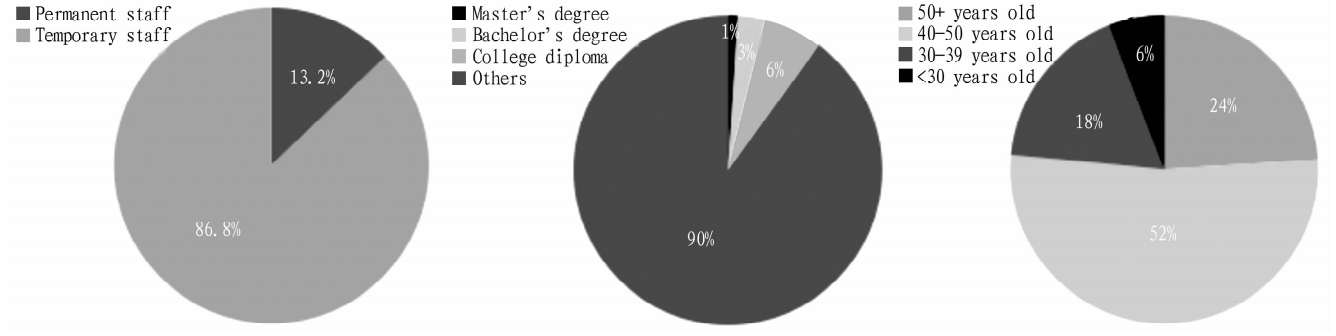

Fig. 1 Staff composition, education level, and age structure of tomato seed companies

2.5 Business scope The core business of these 15 tomato cultivation enterprises primarily focuses on breeding and seed production. They are dedicated to researching, developing, and cultivating new tomato varieties, and through the seed production process, they scale up the production of superior varieties to provide high-quality tomato seeds. The business scope of these enterprises covers multiple segments including production, breeding, scientific research, processing, and sales. Among them, Xi'an Tomato Research Institute, Jinpeng Seedling Co., Ltd., Xi'an Qunxing Seed Industry Co., Ltd., and Xi'an Qinsu Agriculture Co., Ltd. have established a relatively complete industrial chain. This comprehensive business model helps enterprises better meet market demands, enhance their competitiveness, and secure a position in the tomato seed industry.

2.6 Seed production methods As the requirements for crop growth environments continue to rise, traditional open-field seed production methods are facing increasingly severe problems such as unstable yields, declining quality, and reduced profitability. The area dedicated to open-field tomato production is decreasing year by year, conversely, the area under higher-cost facility cultivation methods like greenhouses and arched tunnels is increasing annually. The proportions of seed production methods used by these enterprises—open-field, plastic tunnels, and greenhouses—are 14%, 34%, and 52%, respectively (Fig. 2). The increase in greenhouse area reflects the tomato industry's pursuit of more efficient, more sustainable, and more controllable production meth-

ods. This choice is likely made to provide a stable growth environment across different seasons, ensuring the growth and development of tomatoes. Larger-scale enterprises, such as Xi'an Tomato Research Institute, Jinpeng Seedling Co., Ltd., Xi'an Qunxing Seed Industry Co., Ltd., typically occupy larger area and employ diversified seed production methods. This also reflects that larger enterprises possess greater capability and resources to experiment with different technologies and methods.

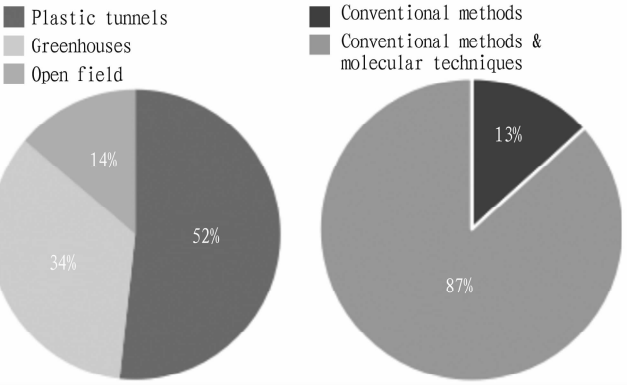

Fig. 2 Seed production methods and breeding techniques of tomato seed companies in Lintong District

2.7 Seed production form The parental lines used for seed production by these 15 enterprises are all self-supplied, indicating that they have adopted a vertically integrated seed industry model within the tomato cultivation sector. By using self-bred parental lines, enterprises can better grasp the genetic background and characteristics of their varieties. This facilitates the implementation of stricter quality control throughout the seed production process, ensures supply chain stability during the seed production cycle, and simultaneously reduces dependence on external factors. Building on this foundation, enterprises can continuously improve varieties and more flexibly develop new varieties adapted to market demands, thereby enhancing their own market competitiveness.

2.8 Breeding techniques 87% of the enterprises employ a combination of conventional methods and molecular techniques (Fig. 2) and this integrated approach may help enhance breeding efficiency and variety quality. However, Xi'an Jinsheng Seed Industry Co., Ltd. and Xi'an Lintong Changfeng Vegetable Research Institute primarily utilize conventional methods such as natural mutation selection and artificial hybridization. Old tomato variety materials are repeatedly used, breeding heavily relies on experience, and the methods are relatively traditional and singular. This may be related to their business strategies, technical level, and resource situation.

2.9 Seed yield The seed yield for large-fruited tomatoes in most companies ranges from 150 to 225 kg/ha. Jinpeng Seedling Co., Ltd. and Xi'an Changfengyuan Seed Co., Ltd. even achieve a high level of 270 kg/ha. This indicates that these enterprises possess relatively high production capacity and efficiency in large-fruited tomato cultivation and seed production. The seed yield for cherry tomatoes is generally between 75 and 150 kg/ha. Among them, varieties like 'Fenbeibei' from Jinpeng Seedling Co., Ltd. reach a maximum yield of 300 kg/ha; whereas Xi'an Qunxing Seed Industry Co., Ltd. and Xi'an Jiaxin Seed Industry Co., Ltd. have cherry tomato seed yields of only 45 – 75 kg/ha. High-yielding cherry tomato varieties may have a more competitive advantage in the market because they satisfy people's continuous pursuit of quality and taste. Differences in seed yield may be influenced by variety characteristics, cultivation management level, and technological innovation. In recent years, Xi'an Shijia Seed Industry Co., Ltd., Xi'an Changfengyuan Seed Co., Ltd., Jinpeng Seedling Co., Ltd., and the Tomato Research Institute have successively initiated research on seed production for fruit tomatoes. Their seed yields are generally between 120 and 180 kg/ha. This reflects the enterprises' proactive response to changes in market demand and their continuous expansion of product lines.

2.10 Registered varieties In recent years, the increasing number of registered varieties in Lintong District is a positive sign of progress and innovation in tomato breeding work. The number and types of tomato varieties cultivated by different enterprises also vary. Some enterprises focus on fewer varieties, while enterprises such as Xi'an Changfengyuan Seed Co., Ltd., Xi'an Tomato Research Institute, Xi'an Jinpeng Seedling Co., Ltd., and Xi'an Beidou Seedling Co., Ltd. have registered more than 10 different varieties each (Table 1). This may be related to their cultivation scale, market demand, and business strategies.

2.11 Promotion models and promotion cycles The promotion models adopted by most enterprises include self-production and self-marketing, order-based models, variety demonstrations, and participation in seed fairs/exhibitions, reflecting that enterprises employ diversified strategies in market promotion to meet different sales needs and market trends. Xi'an Shijia Seed Industry Co., Ltd.'s promotion approach is primarily based on the order model, indicating that this enterprise places greater emphasis on custom production based on market demand. This model helps to meet market demand more flexibly and improve sales efficiency. Whereas Xi'an Lintong Changfeng Vegetable Research Institute, Xi'an Qunxing Seed Industry Co., Ltd., and Xi'an Jinsheng Seed Industry Co., Ltd. focus on self-production and self-marketing, not involving the order model, which may be related to their business strategies and market positioning.

The promotion cycles vary among different enterprises, generally ranging from 2 to 6 years, which may be influenced by multiple factors such as variety characteristics, market acceptance, and the enterprise's own promotion efforts. Among them, Xi'an Changfengyuan Seed Co., Ltd., Xi'an Beidou Seedling Co., Ltd., Xi'an Jiaxin Seed Industry Co., Ltd., and Xi'an Lintong Changfeng Vegetable Research Institute have promotion cycles of 2 – 3 years. This shorter cycle indicates stronger market sensitivity, enabling them to adapt more quickly to market demands. Xi'an Qinsu Agriculture Co., Ltd., Xi'an Tomato Research Institute, and Xi'an Jinpeng Seedling Co., Ltd. have promotion cycles of 3 – 5

years, falling within the medium range, which may be related to moderate market acceptance and variety characteristics. Other enterprises may require a longer time to promote new varieties, this may be due to insufficient technical level and R&D capabilities of the enterprises, or their lower recognition in the market; a long cycle may require enterprises to invest more patience and resources to establish the market position of the varieties and gradually win consumer trust.

Table 1 Registered varieties of seed companies in Lintong District

No.	Breeding unit	Registered varieties
1	Xi'an Changfengyuan Seed Co., Ltd.	Tomato (17): Kuiguan 21, Kuiguan Pengyou, Kuiguan Hongli, Kuiguan Hongfu, Kuiguan Tianhong, Kuiguan Baoli, Kuiguan K239, Kuiguan Hongxing, Ailiguo, Yuanhong, Fukui, Kuiguan V81, Kuiguan No. 1, Kuiguan Fenyan, Kuiguan Hongfeng, Maofen 812, Kuiguan No. 6
2	Xi'an Qinsu Agriculture Co., Ltd.	Tomato (5): Qinshu 80, Qinshu Lingyue, Qinshu 218, Qinshu 219, Qinshu 107
3	Xi'an Shiyang Seedling Co., Ltd.	Shiyang 2211, Shiyang 2212, Shiyang 2306, Shiyang 2306, Shiyang 2308
4	Xi'an Tomato Research Institute	Tomato (10): Ruyi, Xiyou Fenti No. 1, Xiyou Fenti No. 2, Fenjiao, Fenti No. 1, Fenduan No. 1, Fenduan No. 2, Fenduan No. 3, Fenduan No. 4, Fenduan No. 5
5	Xi'an Jinpeng Seedling Co., Ltd.	Tomato (12): Jinpeng No. 1, Jinpeng No. 3, Jinpeng No. 5, Jinpeng No. 6, Jinpeng No. 8, Jinpeng No. 9, Jinpeng M6, Jinpeng M7, Jinpeng M215, Jinpeng M158, Jinpeng Xianai, Jinpeng 1521
6	Xi'an Shengmei Seedling Co., Ltd.	Shengmei 2167, Shengmei 2168
7	Shaanxi Dongsheng Seed Industry Co., Ltd.	Tomato (4): Dongsheng No. 1, Dongsheng 701, Dongsheng 702, Dongsheng 705
8	Xi'an Beidou Seedling Co., Ltd.	Tomato (14): Chunqiu 78, Beidou TM133, Beidou 168, Ouke 319, Duofen, Beidou Fenzuan, Beidou 09, Meirui, Kanasi, Oubao 335, Oubao 318, Beidou Xinguan, Fuxing 619, Pulada
9	Xi'an Jinsheng Seed Industry Co., Ltd.	Jinsheng – Jinhong Xinxiu, Jinsheng – Jinfen M-6, Jinsheng – Jinfen 928, Jinsheng – Jinfen M-5
10	Nianfeng Tomato Seedling Breeding Co., Ltd.	Yuanming Fenyunü, Fenmeina, Fenduoduo, Fenyana, Fense Jingling
11	Xi'an Qunxing Seed Industry Co., Ltd.	Tomato (5): Fenshengjia No. 6, Ruiqi No. 3, Ruiqi No. 1, Jingpeng Hongdun, Jingpeng Fenli
12	Xi'an Shijia Seed Industry Co., Ltd.	Tomato (5): Xishu 618, Xishu 1709, Qiangxuan No. 1, Maolü 848, Maofen 818
13	Xi'an Jiaxin Seed Industry Co., Ltd.	Honggangshi, Fendebao
14	Xi'an Lintong Changfeng Vegetable Research Institute	Changfeng – Jingpeng 101, Changfeng – Xinhongzao, Changfeng – Shanghai 918, Changfeng – Jingxuan Jinguan No. 1
15	Xi'an Zhongnong Fengnong Co., Ltd.	–

3 Current status of tomato industry development in Lintong District

In recent years, the area for facility-based tomato seed production in Xi'an has reached approximately 172 ha, with an annual production of about 50 000 kg, accounting for 28% to 38% of the total annual tomato seed sales volume nationwide. And series such as Maofen and Jinpeng have been widely promoted and cultivated in tomato-growing regions both domestically and internationally.

With the rapid development of China's tomato industry, the contradiction in market demand has become increasingly prominent. From a production perspective, continuous cropping brings significant challenges to cultivation due to resulting pests and diseases, as well as unstable ecological environmental conditions. Therefore, there is a constant need to update new varieties that are resistant to continuous cropping, disease-resistant, and adaptable to the environment. Production also needs to cope with the challenges posed by extreme weather. In the cultivation of new tomato varieties, labor shortages persist in labor-intensive tasks such as hybrid pollination and seed production. This significantly reduces the yield, efficiency, and stability of the domestic tomato seed industry, further exacerbating the risks in tomato production and the market.

4 Existing problems

4.1 Lagging breeding techniques, constraining variety innovation and development In recent years, advanced breeding techniques such as mutation breeding, radiation breeding, and space breeding have been applied in the variety development of some crops, but the majority of breeding work still relies on conventional methods such as natural mutation selection and artificial hybridization, and the current state of tomato breeding is no exception. Tomatoes originate from South America, making the acquisition of new breeding materials difficult. Old materials are repeatedly used, leading to greater difficulty in developing new varieties. Although there has been some progress in biotechnology breeding R&D, the technology is still relatively backward, and the new varieties cultivated lack competitiveness. The above factors collectively constrain the renewal and development of tomato varieties in Shaanxi.

4.2 Shrinking seed production base area, increasing production costs In the 1990s, the tomato seed production base centered on Lintong in Shaanxi was large-scale, with the tomato seed production area reaching over 666 ha. But today, affected by multiple problems, the area of the tomato seed production base has shrunk significantly, and production costs have been rising year by year.

Firstly, the shortage of rural labor is a major factor. With the acceleration of urbanization and the increase in employment options for farmers, there has been a massive outflow of rural labor, leading to difficulties in the management and maintenance of seed production bases. Secondly, labor costs have been rising year by

year. Due to the rural labor shortage, recruitment costs continue to increase, significantly driving up the production costs of tomato seed production. Continuous cropping problems also constrain the development of the bases. Long-term continuous cropping leads to the gradual accumulation of pests and diseases in the soil, causing pest and disease problems to become increasingly severe, reducing yield and economic benefits. To cope with these problems, some enterprises have had to go to other provinces to find new seed production bases, and the increase in management costs further raises the overall cost of tomato seed production.

4.3 Insufficient protection for new varieties, slow promotion of superior varieties Many breeding units and seed enterprises lack sufficient awareness of variety rights protection. Some breeding units or seed enterprises engage in variety counterfeiting/infringement behavior, meaning they use others' superior varieties without authorization, infringing on the rights of breeders. This unfair competition dampens the enthusiasm of breeders and hinders variety promotion; at the same time, breeding units and enterprises lack incentive mechanisms, resulting in insufficient motivation for independent R&D and promotion. Coupled with the limited technical level and R&D capabilities of enterprises, these factors collectively lead to the slow promotion of superior varieties.

4.4 Incomplete market management system, chaotic operational order Economic crop varieties are not subject to examination and registration, resulting in their management being in a vacuum state, lacking effective variety management and promotion methods. Due to weak supervision over the economic crop seed market, particularly the vegetable seed market, the operational threshold for enterprises is relatively low, and operational management is chaotic, with the tomato seed market being particularly prominent in this regard. Counterfeiting and infringement cases occur frequently. Phenomena such as "one variety with multiple names" and "one name used for multiple varieties" exist in the tomato seed market, making it difficult to distinguish authenticity. When infringement occurs, farmers are in a weak position regarding self-protection and rights defense, which in turn leads to a loss of confidence in the seed industry and creates negative impacts.

4.5 Narrow sales channels, singular profit model in tomato industry The promotion of tomato varieties in this region primarily relies on the traditional self-production and self-marketing model, *i. e.*, retailing seeds through agricultural input stores and wholesale markets; while the development of information-based sales channels such as online platforms, agricultural e-commerce websites, and professional seed sales websites is relatively limited.

5 Development strategies and recommendations

5.1 Strengthening technological innovation and variety development It is essential to deepen industry-university-research collaborative cooperation, leveraging the Qinchuangyuan Head Window Lintong Tomato Valley Innovation Collaboration Base, strengthen cooperation with universities and research institutions such as Northwest A&F University and the Chinese Academy of Agricultural Sciences, establish a national-level tomato germplasm resource bank and molecular breeding laboratory, and promote the application of cutting-edge technologies such as gene editing and smart breeding. It is necessary to accelerate the process of new variety cultivation, focusing on the R&D of high-value-added varieties with strong disease resistance, good storage and transport tolerance, and excellent taste (such as the Fenti series, Xiyou series), thereby breaking the monopoly of foreign varieties and enhancing the market competitiveness of domestic seeds.

5.2 Promoting industrial standardization and smart upgrade It is crucial to promote facility-based seed production technology, comprehensively popularize smart greenhouses and Internet of Things (IoT) technology on the existing foundation, achieving precise control over parameters such as temperature, humidity, and light, and shortening the seedling raising cycle. The advantages of facility seed production in terms of excellent quality, high yield, and early maturity should be leveraged. To boost industrial development, it is necessary to increase policy support, guide and improve production factors such as water conservancy facilities and transportation roads around the tomato seed production parks, to assist in the construction of industrial parks. It is important to innovatively develop smart agriculture, conduct technology integration demonstrations, and advance trials of soilless cultivation for cherry tomatoes; simultaneously, it is necessary to cooperate with the Provincial Modern Agricultural Equipment Research Institute, through introduction, absorption, and re-innovation, achieve the intellectualization of facility equipment, and centrally build a digital tomato seed production industrial park. Full-process standards should be established, setting up a standardized system from seed production and processing to packaging, introducing automated equipment such as inspection robots and spraying robots, to ensure seed purity and quality.

5.3 Strengthening brand building and market expansion It is imperative to build the core brand "Xiyou": existing variety resources such as Jinpeng and Qinhuang should be integrated, the brand identity should be unified, market influence should be expanded through exhibitions and e-commerce platforms, with the goal of covering 45% of the national small tomato pink-fruited variety market. International markets should be expanded into, leveraging Lintong's seed export qualification advantages, focusing on developing markets in Southeast Asia, the Middle East, and other regions, establishing overseas sales networks, and increasing international market share. At the same time, it is essential to promote the integration of the three industries (primary, secondary, tertiary) and rural revitalization, advance the deep integration of the seed industry with functions such as tourism, culture, science and technology, and education, to create a "golden signboard" for Lintong's rural revitalization. Integrated agriculture-tourism-culture projects should be developed, building a tomato museum and a smart agriculture display greenhouse, and developing tomato-themed picking tours and study tours, enhancing the added value of the industry.

5.4 Improving policy support and industry chain coordination Financial and policy support should be increased, implementing the *Ten Policies to Support Agricultural Development*, establishing a special fund to support enterprise technology R&D, and providing rewards to enterprises that pass new variety examina-

tions. An industrial integration demonstration park should be constructed, with the Tomato Seed Industry Smart Valley as the core, coordinating with surrounding streets to build a 66 700-ha standardized seed production base, developing deep-processed products such as tomato vinegar and tomato wine, and extending the industrial chain.

5.5 Strengthening intellectual property protection and talent cultivation A patent protection mechanism should be established, working with market supervision departments to severely crack down on infringement and counterfeiting, and supporting enterprises in applying for new variety rights patents. Professional farmers and expert teams should be cultivated, establishing workstations relying on Northwest A&F University and the Xi'an Tomato Research Institute, hiring agricultural experts to solve problems in tomato production such as disaster prevention and control, yield increase, and efficiency enhancement; thematic training sessions should be organized regularly, conducting seed production technology training, and enhancing farmers' capabilities in facility seed production and smart management levels.

5.6 Expanding sales channels, promoting industrial transformation and upgrading Diversified sales channels should be expanded, covering models such as direct-to-consumer sales, cooperative sales, and agricultural product e-commerce. Enterprises need to enhance their informatization level to more accurately grasp market demand and explore emerging sales channels. They should actively connect with national large-scale sales enterprise service platforms, promptly release sales information, expand online sales channels, and achieve seamless production-sales linkage. By participating in agricultural exhibitions such as the China Modern Agriculture Expo, Yangling Agricultural High-tech Fair (Yangling Agri-Hi-Tech Fair), and China International Agricultural Trade Fair, we should gather resources from various fields of "industry-university-research", which can not only broaden tomato seed sales channels but also help find partners and establish stable long-term cooperative relationships.

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