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Strategies for High-quality Development of Greenhouse Vegetables in Zibo City, Shandong Province

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Abstract This investigation report got a clear picture of the general situation of the development of greenhouse vegetable industry in Zibo, and found out the existing problems such as frequent harmful weather, few special varieties and high-grade varieties of greenhouse vegetables, fragmentation of new technology promotion of greenhouse vegetables, low level of intensive seedling raising of vegetables, backward level of facility planting structure and equipment, *etc*. This paper puts forward the strategies for the future high-quality development of vegetables: promoting the adjustment of vegetable planting structure, rationally arranging vegetables for rotation, strengthening vegetable technical guidance, and innovating vegetable consumption patterns.

Key words Greenhouse vegetables, High quality, Strategies

1 Introduction

Zibo City is located in the middle of Shandong Province, and it is famous as one of the "three horticultural homes in the world"[1]. Due to climatic conditions, greenhouse vegetable has developed for a long time and presented a high level. Greenhouse vegetable has become the main industry for increasing local agricultural efficiency and farmers' income. With the basic balance between supply and demand of vegetables in China, local oversupply, and the increasing demand of the masses for the quality of vegetable products, the problems faced by the sustainable development of greenhouse vegetable industry are further highlighted[2-3]. High-quality development is the only way for the development of vegetable industry. Therefore, on the basis of in-depth investigation and research, this paper analyzes the problems existing in the production of greenhouse vegetables in Zibo City and puts forward the corresponding development strategies.

2 General situation of greenhouse vegetable production in Zibo City

Zibo City has a long history of vegetable planting. It is known as "Home of Tomatoes in China" and "Home of Watermelons in China"[4]. In 2022, the sown area of vegetables in the city was 28 000 ha, with a total output of 2.2 million t and a total output value of 5.1 billion yuan. The main vegetable crops for rotation are early spring stubble, delayed autumn stubble, overwintering stubble and seasonal vegetables in the open field in spring and autumn, realizing the coordinated development and balanced supply of early spring vegetables, extended autumn vegetables and winter vegetables. The sown area of greenhouse vegetables in the city was 13 500 ha, accounting for 47.6% of the total area; the output was 1.231 million t, accounting for 55.7% of the total output; the output value was 3.315 billion yuan, accounting for 65.0% of the total output value. There are three types of vegetable facilities: solar greenhouse, large and medium-sized arched sheds and small arched sheds.

In 2022, the planting area of vegetables in solar greenhouse was 10 000 ha and the output was 1 011 200 t; the sown area of vegetables in large and medium-sized arched sheds was 2 406 ha, and the output was 156 100 t; the sown area of vegetables in the small arched sheds was 973 ha, and the output was 64 100 t. Vegetable cultivars are mainly tomatoes, zucchini, watermelons, sweet peppers, cucumbers and kidney beans. Linzi District and Gaoqing County are the main producing areas of greenhouse vegetables in the whole city, and the sown area, output and output value of greenhouse vegetables separately account for 87.3%, 90.3% and 79.9% of that in the whole city.

3 Problems faced by greenhouse vegetable production

3.1 Frequent harmful weather Although the vegetable market in the whole city is in sufficient supply, the overall price of vegetables is higher than last year due to rainy and cold weather, seasonal factors and rising oil prices, which disrupts the market supply and easily causes panic among citizens. In the autumn of 2021 and 2022, the whole city suffered heavy rainfall in autumn, which had a serious impact on vegetable production[5]. Continuous rainy, snowy and smoggy weather can easily lead to sudden drop in temperature, insufficient light, increased humidity, and aggravation of vegetable diseases and pests such as gray mold, downy mildew and greenhouse whitefly. Long-term low light environment affects the photosynthesis of vegetables, which will cause yellowing, slow growth and development of vegetable leaves, and finally affect the formation of vegetable yield and quality.

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3.2 Few special varieties and high-grade varieties of greenhouse vegetables The production of greenhouse vegetables in the whole city is mainly concentrated in zucchini, tomato, watermelon, pepper, cucumber and other main vegetables, and they are mainly the conventional varieties, while there are few special varieties of characteristic vegetables and functional vegetables, especially the special varieties of vegetables which are resistant to low temperature, scant light, high temperature, humidity and disease and suitable for protected cultivation are rare. The lack of special varieties and long-term cultivation of single varieties easily lead to the problem of excessive application of chemical fertilizers and pesticides.

3.3 Fragmentation of new technology promotion of greenhouse vegetables More than 80% of vegetable production in the whole city is mainly based on household, and the ability to accept new technologies and new concepts is weak. Most of the production is based on experience, and the management is relatively extensive. And most of the employees are middle-aged and elderly people over 50 years old, and their overall quality, scientific and technological level and organization degree are not suitable for the development of greenhouse vegetables. Green, light and simple agriculture is the direction of agricultural development. However, in the actual production process, there are many single-link technologies, and there are not many supporting technologies in the whole process, especially green, light and simple high-efficiency integrated technologies, which affects the yield and quality of vegetables.

3.4 Low level of intensive seedling raising of vegetables The annual vegetable planting area in Zibo City is 2 080 ha, and about 936 million seedlings of various types are needed according to the average of 30 000 plants/ha. At present, there are 14 seedling raising enterprises in the city, with an annual total of about 150 million seedlings, and the self-sufficiency rate is only 16%. 84% of seedlings still need to be purchased from Shouguang, Qingzhou, Jiyang and other places, which restricts the development of vegetable industry in the city.

It is known that Weifang has more than 300 large-scale seedling raising enterprises, including more than 100 in Shouguang City, which not only meets the needs of local vegetable production, but also supplies seedlings in a large number to external markets. Shandong Anxin Seedlings, Weili Seedlings in Jinan and New Century Seedlings in Shouguang are all famous leading seedling enterprises in the whole province. Among them, Shandong Anxin Seedlings Co., Ltd. has a modern seedling greenhouse of 150 000 m^2, with an annual seedling raising capacity exceeding 200 million plants. The existing factory-based seedling raising enterprises in the city are small in scale, have not yet formed a dominant seedling industry, lacking strong leading seedling raising enterprises. There are only 3 enterprises with an annual total seedling raising quantity exceeding 20 million, among which Zibo Xinrun Agricultural Development Co., Ltd. is the largest seedling raising enterprise in the city, with a total seedling raising quantity of only 71.6 million in 2020.

3.5 Backward facility planting structure and equipment level Most of them are planted by individual households, the facilities are of low grade, with simple structure, poor lighting and heat preservation performance, which can not meet the requirements of light, simple, efficient and green production of planting facilities. In addition, with the improvement of mechanization level, the contradiction between the existing greenhouse structure and agricultural machinery operation has become increasingly apparent. Agricultural machinery has limited working space in old facilities, can't turn around, and has low use efficiency, which limits the improvement of production efficiency.

4 Strategies for high-quality development of greenhouse vegetables

4.1 Promoting the structural adjustment of vegetable planting industry Based on the overall industrial layout of "greenhouse vegetables in the northern plain, summer vegetables in the southern mountainous area and suburban vegetables in the central part", according to resource endowments and regional differences, it is necessary to promote and consolidate the advantages of Linzi greenhouse vegetables, Gaoqing watermelons and Yiyuan leeks, and optimize the vegetable variety structure. On the one hand, it is necessary to aim at the key and core technology problems of improved vegetable varieties, give full play to the role of government as a platform and bridge, promote joint major scientific research on improved vegetable varieties, summarize and integrate innovative breeding technology models, speed up the cultivation and popularization of new vegetable varieties with high yield, high resistance, high quality and high efficiency, and realize the upgrading of many varieties of disease-resistant and high-quality vegetables in the city.

On the other hand, it is necessary to introduce, demonstrate and popularize marketable high-quality new varieties, focus on resource elements, highlight characteristics, make overall arrangements and coordinate the city's advantageous vegetable producing areas, and especially focus on greenhouse vegetable production, so as to increase production, efficiency and income.

4.2 Rationally arranging vegetables for rotation According to the planting structure of vegetables in all districts, counties and functional areas, it is necessary to arrange the crops for rotation reasonably, especially the greenhouse vegetable crops. According to the fluctuation law of vegetable prices and market conditions, the vegetable varieties to be planted should be carefully selected, mainly involving solanaceous fruits, melons and beans that are resistant to low temperature and low light. It is necessary to focus on breeding and popularizing new vegetable varieties with high yield and high quality, and integrate the key technical system of green, simple and efficient greenhouse vegetables. According to different vegetable types and different growth stages, some fast-growing leafy vegetables with low temperature resistance, short growth period and high yield should be interplanted reasonably to further in-

crease market supply.

4.3 Strengthening vegetable technical guidance First, it is necessary to study and formulate technical opinions on vegetable production and disaster weather guidance in spring, summer, autumn and winter in a timely manner, so as to help guide farmers to quickly solve the difficulties and problems encountered in vegetable production and minimize disaster losses. Second, it is necessary to organize vegetable scientific and technical personnel at the city, district, county and township levels to go deep into the fields, communicate with vegetable farmers, understand their thoughts and expectations, and strive to solve the difficulties for the people in good time. Third, experts and professors from Chinese Academy of Agricultural Sciences, Shandong Agricultural University and other scientific research institutes should be invited to train young employees in vegetable standard parks, family farms and vegetable professional cooperatives in the whole city, so as to improve their scientific and cultural quality and operational skills, enhance the standardization, organization and scale of vegetable seedling raising and production, integrate and popularize the successful technical models in the whole city, and improve the management level in vegetable production. Fourth, it is necessary to improve the utilization rate of idle greenhouses, increase the production capacity of greenhouses and reduce the waste of resources through rational planting and combination of planting and breeding.

4.4 Innovating vegetable consumption patterns Small households, as the main body of the production of "vegetable basket products" in the whole city, have the disadvantage of decentralized operation, which makes "vegetable basket products" at the initial end of the value chain of agricultural products and cannot meet the needs of the big market. Relying on Zibo government cloud, it is necessary to build a platform architecture of "one standard, one platform, two centers, one service and N applications" (referred to as "1121 + N" architecture), adopt the "five-in-one" co-construction and sharing mode involving cities, counties, towns, villages and business entities, build a municipal digital agriculture and rural comprehensive service platform, collect data related to vegetable production and supply and demand data of agricultural products market, employ cloud computing for machine learning and deep learning, and establish a data model to solve the problem of matching between the supply side and the demand side.

According to the demand law of the consumer market and the new demands of consumers, it is necessary to actively create a new model of "online + offline" digital supply and marketing of agricultural products, and use new media platforms such as Tik Tok (Douyin), Quick Worker (Kuaishou) and Wesee (Weishi), as well as new agricultural business entities and new agricultural service entities. While promoting the famous and rare vegetable varieties in the city, we should build offline experience centers and carry out offline services to promote the transformation of "vegetable basket products" to standardization, refinement and digitalization, and realize the effective connection of "production-supply-marketing" of "vegetable basket products".

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