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Demonstration of high-yield corn cultivation performance and agronomic techniques

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Abstract. In recent years, in response to the continuously rising demands of agricultural development, corn, as a key staple crop in China, plays an indispensable role in ensuring national food security. This study comprehensively evaluates the growth characteristics of various corn varieties and explores the practical benefits of high-yield cultivation strategies. The results show that a reasonable combination of corn varieties, scientific water and fertilizer management, and efficient pest and disease control measures can significantly increase corn yield. The findings of this study are crucial for accelerating the advancement of the corn industry in Nidang Town and its surrounding areas, while also providing valuable experience and technical support for achieving high-yield corn cultivation in similar regions.

Keywords: high-yield corn demonstration planting, high-yield cultivation techniques, variety selection, pest and disease control

1. Research background

Nidang Town, a traditional agricultural hub, is dominated by crop farming, with corn cultivation occupying an important position. According to local statistics, Nidang Town has approximately 35,000 mu of arable land, with about 20,000 mu dedicated to corn cultivation annually, accounting for nearly 60% of the total arable land area. In recent years, driven by adjustments in agricultural industrial structure and technological upgrades, corn planting in Nidang Town has gradually moved towards high yield and high quality, becoming an important driving force for local economic development [1].

Denghai 605, Zhengda 999, and Xianyu 335 are varieties with high yield potential and stress resistance, widely promoted nationwide. To further understand the adaptability of these three varieties in Nidang Town, Qianxinan Prefecture, a high-yield field demonstration experiment was conducted to measure characteristics such as plant height, ear height, and seed setting rate. The results provide reference data for breeding varieties better suited to Nidang Town's conditions and for developing corresponding mature cultivation technologies [2-4].

2. Selection and layout characteristics of demonstration plots

In the high-yield corn demonstration planting experiment in Nidang Town, selecting suitable demonstration plots is one of the key steps to achieving high yield goals. The selection of demonstration plots is typically based on multiple factors, including soil type, topography, climatic conditions, and past planting experience. This study selected five representative demonstration plots within Nidang Town, located in hilly areas at elevations ranging approximately from 800 meters to 1200 meters. The soils are mainly red and yellow soils, with pH values between 5.5 and 6.8. Organic matter content ranges from about 1.5% to 2.3%, total nitrogen averages 0.12% to 0.18%, available phosphorus ranges from 12 to 25 mg/kg, and available potassium ranges from 80 to 150 mg/kg. The average annual precipitation in these plots is about 1000 mm, annual sunshine hours exceed 2000 hours, and the frost-free period lasts approximately 270 days, all highly favorable for corn growth and development.

The layout characteristics of the demonstration plots involve a concentrated contiguous approach, with each plot covering an area between 20 and 50 mu, totaling more than 200 mu. Within the plots, a terraced layout design was adopted, with terrace widths of approximately 10 to 15 meters and slopes controlled between 5% and 8%. The surrounding environment of the demonstration plots was also optimized. The selection and layout characteristics of the corn high-yield demonstration plots in Nidang Town fully consider natural conditions and socio-economic factors. Through scientific planning and rational arrangement, a solid foundation was established for the subsequent implementation of high-yield cultivation techniques.

3. Performance of different corn varieties in high-yield demonstration planting

In the high-yield corn demonstration planting project in Nidang Town, to comprehensively assess the adaptability and yield potential of different corn varieties, three main varieties were selected for comparative study: Denghai 605, Zhengda 999, and Xianyu 335. These varieties are all excellent cultivars widely planted in China's major corn-producing regions in recent years, with high yield potential and stress resistance. By closely monitoring and analyzing the growth performance of these three varieties under the same cultivation conditions (such as soil type, fertilization level, and irrigation frequency), a deeper understanding of their respective strengths and weaknesses can be obtained. This provides a more scientific and reasonable basis for variety selection in local corn planting.

Table 1. Performance of different corn varieties in high-yield demonstration planting

Variety Name	Avg. Plant Height (m)	Avg. Ear Height (m)	Leaf Count	Leaf Area Index (LAI)	Seed Setting Rate (%)	Kernel Count per Ear	Yield per Mu (kg)	Corn Borer Incidence Rate (%)	Yield Loss Rate (%)
Denghai 605	2.8	1.0	14	2.9	80	600	650	6	15
Zhengda 999	2.6	1.0	16	5.1	78	550	680	6	10
Xianyu 335	2.5	0.9	13	3.1	85	520	670	3	20

The results in Table 1 show that Denghai 605 has an advantage in overall plant height, which not only helps improve photosynthetic efficiency of the leaves but also enhances the plant's resistance to adverse weather conditions such as strong winds. Its relatively higher ear position also facilitates mechanical harvesting, thereby reducing labor costs. In terms of leaf count and Leaf Area Index (LAI), Zhengda 999 stands out. The LAI measurement during the tasseling stage reached 5.1, significantly higher than that of the other two varieties. This indicates that Zhengda 999 can more effectively capture sunlight, promoting dry matter accumulation—an essential factor for achieving high yields. Regarding yield components, Xianyu 335 demonstrated a higher seed setting rate and kernel count per ear.

There are also noticeable differences in pest resistance among the varieties. During the demonstration period, Denghai 605 and Zhengda 999 exhibited stronger resistance to corn borer infestation, whereas Xianyu 335 performed less favorably in this regard. Therefore, in regions where pest outbreaks are frequent, it is recommended to prioritize Denghai 605 or Zhengda 999 as the main varieties. Lastly, Zhengda 999 showed particularly strong performance in terms of drought resistance and adaptability, making it an ideal choice for addressing climate variability and water scarcity. In actual planting practices, it is advisable to select and combine corn varieties based on local climate conditions, soil types, and market demands to achieve the goal of stable and high yields.

4. Application and evaluation of high-yield cultivation techniques

4.1. Optimization of seed treatment and sowing techniques

Optimizing seed treatment and sowing techniques is one of the crucial steps in achieving high-yield corn cultivation. In the high-yield corn demonstration planting project in Nidang Town, various seed treatment methods and rational sowing practices were applied to effectively enhance germination rates, stress resistance, and yield. Through comparative experiments on different treatment methods and sowing strategies, a set of optimized practices suitable for the local climate and soil conditions was developed.

Seed coating technology was a key measure in seed treatment. This typically includes seed disinfection, the addition of trace elements, and the application of growth regulators. Experimental data showed that coated seeds achieved an average increase in germination rate of about 15%, and also exhibited improved resistance to diseases during the seedling stage. In addition to seed coating, soaking seeds is another commonly used pre-sowing treatment. Studies have shown that soaking seeds accelerates water absorption and swelling, promotes enzymatic activity, and consequently speeds up germination. In the Nidang Town experiment, seeds were soaked in a 2% monopotassium phosphate solution for 24 hours prior to sowing. This treatment was found to shorten germination time by 1 to 2 days and resulted in more uniform and consistent seedling growth. Further observations indicated that seedlings from soaked seeds had better-developed root systems and more rapid leaf expansion in the above-ground parts, suggesting improved photosynthetic efficiency. Moreover, soaking helped reduce the number of seed-borne pathogens, lowering the likelihood of disease outbreaks during later growth stages.

Optimization of sowing techniques is equally important. Determining an appropriate sowing density is a key factor in achieving high yield. Based on the soil fertility and climatic characteristics of Nidang Town, the recommended planting density is 75,000 to 80,000 plants per hectare. By adjusting row spacing and plant spacing, light utilization and ventilation within the canopy can be improved. In practice, row spacing was maintained at approximately 60 cm, and plant spacing was controlled between 20 and 25 cm. This configuration ensures sufficient space for group growth while avoiding excessive competition among individual plants. Additionally, sowing depth plays a critical role in final yield. Generally, an optimal sowing depth is between 4 and 6 cm; sowing too deep can hinder seedling emergence, while too shallow sowing increases the risk of moisture loss or cold injury.

4.2. Exploration of rational dense planting and intercropping models

Rational dense planting and intercropping systems are important approaches for increasing both corn yield and economic returns. In this high-yield corn demonstration project, significant improvements in yield per unit area were achieved by adjusting planting density and exploring suitable intercropping models. This section discusses the application and effectiveness of these strategies from three perspectives: theoretical rationale, practical implementation, and experimental data analysis [5-6].

The core principle of rational dense planting is to determine an appropriate planting density based on factors such as soil fertility, climatic conditions, and varietal characteristics. In this experiment, a comparative study of different planting densities showed that when the row spacing was fixed at 60 cm and the plant spacing was maintained between 20 and 25 cm, the highest yields were obtained. This finding indicates that, under limited land resources, moderately reducing plant spacing can help maximize the utilization of sunlight, nutrients, and other resources, thereby enhancing overall yield. The implementation of intercropping models not only effectively mitigates pest and disease problems associated with monoculture but also improves land use efficiency and economic benefits. In Demonstration Plot B, researchers tested a corn-soybean intercropping model and compared it with traditional monoculture. Results showed that under the intercropping model, corn yield increased by approximately 15%, while soybean yield rose by nearly 20%. These outcomes indicate that corn-soybean intercropping can achieve complementary advantages, reduce the use of fertilizers and pesticides, and lower production costs. Furthermore, intercropping improves soil structure, promotes microbial activity, and creates a favorable ecological environment for subsequent crops.

It is worth noting that the successful implementation of rational dense planting and intercropping models requires attention to several key technical details. For example, the ideal corn-to-soybean row ratio should be approximately 2:1 to ensure adequate sunlight and nutrients for both crops. In terms of sowing time, corn should emerge earlier than soybean to allow the latter to grow rapidly in the spaces between corn rows. Regular monitoring of soil moisture is also essential to prevent water stress or waterlogging due to over-dense planting.

4.3. Integrated pest and disease management techniques

4.3.1. Types and impact analysis of pests and diseases

In the corn cultivation areas of Nidung Town, the most common diseases include Northern Corn Leaf Blight, Southern Corn Leaf Spot, and Rust. Among them, Northern Corn Leaf Blight, a fungal disease primarily affecting the leaves, can lead to premature leaf senescence and severely impair photosynthesis, ultimately causing yield losses. According to 2024 monitoring data, in fields without disease control measures, the incidence rate of Northern Corn Leaf Blight reached as high as 45%, with individual plant yield losses averaging around 25%. Southern Corn Leaf Spot is another prevalent disease, characterized by the appearance of yellow or brown small spots on leaves, which gradually expand to cover large leaf areas and eventually cause leaf desiccation. Rust disease manifests as orange-yellow or reddish-brown pustules on leaf surfaces and significantly hinders plant growth. As for pests, the corn borer is one of the most severe threats in corn cultivation. The larvae bore into corn stalks and feed internally, causing hollow stems that often lead to lodging. Survey data indicate that the damage rate of corn borer typically ranges from 20% to 35%, and in severe cases, it can result in over 30% yield loss [7-8].

4.3.2. Application of integrated pest and disease management (IPM) technologies

To tackle the aforementioned pest and disease challenges, this study adopted a comprehensive IPM strategy incorporating agricultural, physical, biological, and chemical control methods. These approaches were integrated into a multi-layered defense system.

First, agricultural control forms the foundation of IPM. Selecting disease-resistant cultivars is a key preventive measure. Rational crop rotation helps reduce the buildup of pathogens in the soil. A biennial rotation of corn with non-host crops significantly lowers soilborne pathogen populations. Timely sowing and density management also help mitigate the occurrence of pests and diseases. Second, physical control methods include light trapping and colored sticky boards. Solar-powered frequency-vibration insecticidal lamps were installed around the demonstration fields, each covering an effective area of about 30 mu (2 hectares). On average, each lamp attracted and killed around 150 adult corn borers per night, effectively reducing pest population density. Yellow sticky traps were used to target aphids, with approximately 20 traps per mu capturing over 80 aphids each. These physical approaches not only reduced pesticide usage but also improved pest control efficiency. Third, biological control has gained attention as a green and sustainable approach. Microbial agents such as Beauveria bassiana and Metarhizium anisopliae were applied in the demonstration fields to control corn borers and other pests. Beauveria bassiana parasitizes the larvae of corn borers, leading to their death and providing natural suppression. Trial results showed that spraying suspensions of B. bassiana achieved control efficacy rates exceeding 85%. Bacillus thuringiensis (Bt) formulations were also introduced to target lepidopteran pests. Bt products are highly specific and safe for non-target organisms, making them widely applicable in the demonstration fields.

Fourth, chemical control remains a necessary supplementary measure under specific conditions, despite the promotion of reduced pesticide use. In the demonstration fields, chemical control was primarily employed during key growth stages, such as the trumpet stage and tasseling stage. Low-toxicity, high-efficiency fungicides, such as pyraclostrobin and kresoxim-methyl, were used to manage leaf blight and rust. Spraying was conducted at recommended dosages, with timing adjusted based on weather conditions to avoid the impact of high temperatures or rainfall on efficacy. During the chemical control period, the pesticide dosage per mu was approximately 50 ml, representing a 40% reduction compared to traditional practices. Additionally, the use of stratified spraying techniques and precision spraying equipment further improved pesticide utilization efficiency and minimized environmental risks.

4.3.3. Effectiveness evaluation

Through the implementation of the above integrated pest and disease management techniques, the incidence of pests and diseases in the demonstration fields was significantly reduced. Taking Northern Corn Leaf Blight as an example, after full-cycle control measures, its incidence rate dropped to below 5%, which is a reduction of 40 percentage points compared to the control group. The population density of corn borers was also significantly reduced, reaching only about 20% of that in the control plots. In terms of yield, the average corn yield in the demonstration fields reached 720 kg/mu, representing an increase of more than 15% compared to the control plots. Due to effective pest and disease control, the input costs for fertilizers and pesticides were also reduced, saving an average of approximately 120 yuan per mu.

5. Major research conclusions

This study conducted an in-depth investigation and analysis on the performance and cultivation techniques of high-yield corn demonstration planting in Nidung Town. Through on-site inspections of demonstration fields, varietal comparison trials, climate and soil condition monitoring, and evaluation of cultivation technique effectiveness, the following key findings were obtained:

Regarding the performance of high-yield corn varieties in Nidung Town, the research revealed significant differences in local adaptability among varieties. For example, the average yields of "Denghai 605," "Zhengda 999," and "Xianyu 335" in the demonstration fields reached 650 kg/hm², 680 kg/hm², and 670 kg/hm², respectively. Among them, "Zhengda 999" exhibited strong drought tolerance and disease resistance, while "Denghai 605" performed better under fertile soil conditions. Long-term climate data analysis showed that Nidung Town receives an average annual precipitation of approximately 1100 mm, with the critical growth period for corn concentrated between June and September, during which over 60% of the yearly rainfall occurs. Soil fertility also played a crucial role in yield performance. In the demonstration areas, the soil organic matter content generally ranged from 2% to 3%, and the pH value was between 6.5 and 7.5, conditions that are favorable for high-yield corn cultivation.

In the evaluation of high-yield cultivation techniques, this study focused on key aspects such as seed treatment, reasonable planting density, water management, and pest and disease control. Experimental data showed that treated (coated) seeds improved seedling survival rates by approximately 15%, and germination time was shortened to within four days. The application of optimized planting density techniques increased the number of plants per unit area to 65,000 plants/hm², resulting in a yield increase of about 20% compared to traditional planting methods. For common issues such as corn borer and sheath blight, a combined approach of biological pesticides and physical control was adopted, reducing the incidence of pests and diseases by over 30% and ensuring healthy corn growth.

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