

Factors Affecting the Survival Rate of *Pinus armandii* Seedlings and Pest and Disease Control Strategies in Huidong County

Deng Xincheng¹, Zhou Chuanlin²

1. Sichuan Hexin Yuntian Agricultural Co., Ltd., Chengdu, Sichuan 610213, China

2. Yibin University, Yibin, Sichuan 644000, China

Abstract: *Pinus armandii* is one of the most important ecological and economic tree species in China, and the survival rate of its seedlings is directly related to the quality of afforestation projects and the level of sustainable forestry development. Huidong County possesses the largest area of *P. armandii* forests and the highest pine nut yield nationwide. However, during practical afforestation, seedling survival is constrained by multiple factors, among which pests and diseases are particularly prominent. Through field investigations, literature review, and interviews with local pine growers, this study systematically analyzes the main factors affecting the survival rate of *P. armandii* seedlings in Huidong County. The results indicate that pests and diseases are the key factors limiting seedling survival. On this basis, the major types of pests and diseases, their causes, and corresponding control measures are discussed in detail, and comprehensive prevention and control strategies are proposed. The findings of this study provide scientific references for improving seedling survival rates, reducing forestry production losses, and promoting the sustainable development of regional forestry.

Keywords: *Pinus armandii*; seedling survival rate; influencing factors; pest and disease control; Huidong County

0. Introduction

Since the reform and opening-up policy, China's economic level has continuously improved, and forestry construction centered on afforestation projects has attracted increasing attention both domestically and internationally. The survival rate of afforestation seedlings not only determines the progress of afforestation projects but also directly affects forest quality and ecological benefits. However, in afforestation practice, seedling survival is influenced by multiple factors, including site conditions, climatic factors, management practices, and pest and disease pressure. Huidong County is one of the regions with the largest *P. armandii* forest area and pine nut production in China. At present, however, less than 20% of *P. armandii* stands are fruit-bearing, and pine nuts are still mainly sourced from natural forests, while plantations contribute relatively little. Local pine growers conduct afforestation activities annually, yet during the seedling cultivation and early growth stages, seedling survival is affected by water availability, pest and disease infestation, and temperature fluctuations. Although the average survival rate reaches approximately 90%, economic losses remain inevitable under large-scale afforestation conditions. Therefore, this study focuses on the survival rate of *P. armandii* seedlings in Huidong County, systematically analyzes the main influencing factors, with particular emphasis on pests and diseases, and proposes corresponding control strategies to provide theoretical support and practical guidance for improving seedling survival.

1. Analysis of Factors Affecting Seedling Survival Rate

1.1 Research Methods

This study employed a combination of direct and indirect investigation methods. Field surveys were conducted in Huidong County and surrounding areas. Data on seedling growth and management were collected through on-site observations, consultation of relevant academic literature, and interviews with local pine growers. The influencing factors affecting seedling

survival were then comprehensively analyzed.

1.2 Results of Factor Analysis

The survey results indicate that the survival rate of *P. armandii* seedlings is mainly influenced by water conditions, temperature variation, site environment, and pest and disease infestation. Among these factors, pests and diseases exert the most significant impact and are the primary causes of seedling mortality and growth inhibition. Therefore, it is necessary to focus on the major pests and diseases affecting *P. armandii* seedlings and their control measures.

2. Major Pests and Diseases of *Pinus armandii* and Control Measures

2.1 Blister Rust

Blister rust is one of the most common diseases of *P. armandii*. Pine blister rust, caused by fungi of the genus *Cronartium*, is a major fungal disease affecting *P. armandii* in Huidong County. It is a heteroecious rust disease characterized by old cankers, cortical swelling, and blister-like structures on the bark surface. In severe cases, blood-like resin exudation appears on the bark. This disease spreads rapidly, has a high infection rate, and poses a serious threat to seedling growth.

Control measures: A 50% fenxiuqing suspension concentrate should be evenly applied to the rust and canker areas, extending approximately 10 cm above and below the infected sites, followed by wrapping with black plastic film to prevent oxidation and loss of efficacy. In addition, stand management should be strengthened by timely pruning of diseased and dead branches, improving ventilation and light conditions, and reducing stand humidity. Comprehensive sanitation should be conducted annually in autumn and winter, with infected residues collected and burned.

2.2 Canker Disease

Canker disease is a major disease affecting the branches and stems of *P. armandii*, with particularly high infection rates in seedlings, reaching nearly 100% in some nursery conditions. The disease is difficult to detect at early stages and initially appears as mild lesions on the bark surface. As the disease progresses, the affected areas gradually sink, internal tissues expand, bark peels off, and branches shrink. The color of infected tissues changes from green to reddish-brown or dark brown, accompanied by a distinct alcoholic odor. Canker disease often occurs when tree vigor declines and resistance weakens and may spread to cones, eventually causing whole-plant death.

Control measures: Prior to disease onset, Qingfuan should be diluted 50–100 times and sprayed on trunks and branches, supplemented with a 1000-fold calcium-selenium solution and 25% pyraclostrobin, applied once every 15 days. For infected plants, lesions should be scraped off and treated with undiluted Qingfuan applied evenly to the wounds. In severe cases, treatment may be repeated twice, combined with spraying an 800-fold calcium-selenium solution every 7 days. Preventive control may adopt a “chemical barrier” strategy by spraying a mixture of 3% Qingfuan aqueous solution (100-fold dilution) and 25% pyraclostrobin EC (1500-fold dilution) on the stem base after leaf expansion, applied every 3 days for five consecutive times to form a protective film.

2.3 Pine Weevil (*Curculionidae*)

Pine weevils are typical pests of pine trees and belong to the order Coleoptera, family Curculionidae. Adult insects cause concentrated damage in summer by gnawing on tree trunks, leading to resin exudation and gradual hollowing of the trunk. Affected trees suffer nutrient loss, exhibit needle yellowing and branch dieback, and eventually die.

Control measures: When infestation is detected, a 10-fold dilution of 3.4% omethoate may be sprayed on trunks, combined with trunk injection using insecticidal formulations. Forest sanitation

management should also be strengthened, with regular removal of pest sources to reduce infestation risk.

3. Analysis of Causes of Pest and Disease Occurrence

3.1 Strong Reproductive Capacity of Pests

Investigations indicate that forest pests and diseases exhibit strong reproductive capacity. Even under multiple control measures, a small number of surviving individuals can rapidly restore population levels, making reliance on chemical control alone insufficient for long-term management.

3.2 Simplified Structure of Artificial Pure Forests

In recent years, large-scale pure *P. armandii* plantations have been established in Huidong County. The simplified stand structure provides favorable habitats for pests and diseases, significantly accelerating their reproduction and increasing outbreak risks.

3.3 Risks of Exotic Species Introduction

With increasing openness and forestry technology exchange, some exotic tree species and pests have been introduced without sufficient risk assessment, leading to the emergence of new pests and diseases in plantations and increasing management difficulty.

3.4 Environmental Change and Increased Resistance

Climate change has enhanced the adaptability of pests and diseases, while long-term pesticide use has led to resistance development, further complicating control efforts.

4. Pest and Disease Control Strategies for *Pinus armandii*

4.1 Selection and Breeding of Multi-Combination Resistant Varieties

A multi-species and multi-functional resistance strategy should be adopted to cultivate superior varieties resistant to both major and secondary pests, thereby enhancing overall stand resilience.

4.2 Strengthening Quarantine and Prevention of Biological Invasion

Forestry quarantine management should be reinforced at the source to prevent the introduction of invasive pests and ensure ecological security.

4.3 Improvement of Pest Forecasting and Early Warning Systems

Information-sharing platforms and early warning mechanisms should be established to monitor pest dynamics in real time and scientifically determine control thresholds.

4.4 Enhancement of Technological Support for Protection

Scientific research and technology extension should be strengthened, integrating professional control with community-based management and reinforcing comprehensive silvicultural measures.

4.5 Promotion of Biological Control Techniques

Priority should be given to biological control methods, protecting natural enemies and maintaining ecological balance to achieve sustainable pest and disease management.

5. Conclusions

In conclusion, pests and diseases are the key factors affecting the survival rate of *Pinus armandii*

seedlings in Huidong County. Through systematic analysis of major pest and disease types and their causes, and by adopting comprehensive control measures centered on resistant variety selection, quarantine management, forecasting systems, biological control, and technological support, seedling survival rates can be effectively improved. As an important economic tree species, *P. armandii* requires scientifically sound seedling cultivation and pest management strategies. Implementing rational nursery techniques and integrated pest control measures will enhance yield and quality, promote local economic development, and protect forest resources and ecological environments.

References:

- [1] Wang M F, et al. *Pinus armandii* Seedling Cultivation Techniques and Pest Control Measures[EB/OL]. FX361, 2020-10-30 [2026-01-15].
- [2] Wang G F, Li M M. Integrated control techniques for major pests and diseases of *Pinus armandii* in Huidong County[J]. *Southern Agriculture*, 2025, 19(22): 34-36.
- [3] Zhang X X. Seedling cultivation and pest control techniques of *Pinus armandii*[J]. *Hebei Agricultural Machinery*, 2025(12): 119-121.
- [4] Zhang S T. Scientific approaches to *Pinus armandii* seedling cultivation and effective pest control strategies[J]. *Seed World*, 2025(10): 207-209.