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Distribution, Harm, and Risk Assessment of Solanum Rostratumin in Jilin Province

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Abstract: In July 2020, the People's Procuratorate of Qianan County, Jilin Province, discovered large-scale spread of the toxic plant, Solanum rostratum, which is native to North America, during an ecological environment inspection. This plant was listed as a national invasive species in the fourth batch in 2016. It is highly adaptable, rapidly reproduces, and suppresses the growth of surrounding crops and native plants, leading to soil infertility and ecological imbalance. If not removed in a timely manner, it will cause irreversible damage to agricultural production and the ecological environment in the Northeast Black Soil Region. To curb the further growth and invasion of Solanum rostratum this paper analyzes the distribution, actual harm, and control actions of Solanum rostratum in Jilin Province, in order to provide effective reference for similar areas to deal with alien species invasion.

Keywords: Solanum Rostratum; Jilin Province; Risk Assessment

1. Introduction

The invasive alien species are becoming a major ecological security challenge in China. Solanum rostratum as a typical high-risk invasive plant, has continued to spread even after being added to the national control list. In 2020, the Procuratorate of Qianan County, Jilin Province, first discovered this species growing in large patches. Subsequent investigations in Songyuan City confirmed that over 29,000 acres of land in the city were affected, with over 22,000 acres in areas like Chaganhua Town in Qianguo County. The plant's dense root system absorbs nutrients from the soil, and its abundant foliage blocks sunlight, reducing the yield of crops like corn and degrading grassland. Additionally, the plant contains toxins that pose risks to livestock and humans. This paper will outline the invasion spread path and disposal experience of Solanum rostratum, in order to explore more efficient regional joint prevention and control mechanisms.

2. Distribution of Solanum Rostratum

2.1 Analysis of Distribution in Jilin Province

The western plains of Jilin Province are the core invasion zone of Solanum rostratum, concentrated in the dry riverbeds, degraded grasslands, and abandoned farmlands of Songyuan City. The region’s flat terrain and black soil conditions provide a foundation for its spread, while human activities significantly reshape its spatial distribution. Transport by vehicles and agricultural machinery along road networks is a key carrier of seed dispersion. In Songyuan City, the species has become a core disaster zone, occupying 6,829 acres of farmland and barren hills in Qianan County. In Qianguo County, it explosively occupied 22,311 acres of the transitional area between grasslands and farmland, accounting for 77% of the total affected area in the city. Other counties have scattered infestations totaling less than a thousand acres. The plant shows strong invasion ability even in nutrient-poor environments, and can continue to spread by extending its root system, further damaging the ecological environment and causing economic losses [1].

2.2 Spread Rate and Trend of Solanum Rostratum

Solanum rostratum thrives in sunny environments, with vigorous growth, bright flowers, and high seed production when exposed to sufficient sunlight. Under such conditions, the flowers are vibrant, and the seeds are full and numerous. In contrast, the growth of Solanum rostratum in shaded slopes is less robust, although it is still capable of completing its life cycle. A typical plant of

Solanum rostratum produces 15-25 inflorescences, each bearing 10-20 flowers. Each berry can contain 55-90 seeds, and a single plant can yield between 10,000 and 20,000 seeds. These seeds are dispersed across regions through mechanisms such as attachment to animal fur, agricultural machinery tires, or via floodwaters [2]. After its invasion in Jilin Province, Solanum rostratum was able to radiate and cover a circular area with a radius of ten kilometers within three years. The optimal temperature range for seed germination is between 20°C and 30°C, with the highest germination rate occurring at 30°C. During the fruit maturation period in July and August, the dispersal radius of the seeds can expand to ten times the usual range [3].

3. Harm of Solanum Rostratum

3.1 Agricultural Harm

Solanum rostratum has an extremely strong adaptability, growing in various places such as garbage heaps, stone cracks, and abandoned lands [4]. It is highly drought- and water-resistant, thriving on roadside land, abandoned fields, and overgrazed pastures. Once it roots in farmland, it competes for resources: its vast root system absorbs deep nutrients and water, and its dense foliage blocks sunlight, causing crops to develop slowly or even die from lack of light. The chemical substances released by its roots directly inhibit the growth of crops like corn and soybeans, causing plants to become stunted and reduce yield. The impact on agricultural production also extends to the harvesting process. The dense growth of the plants blocks machinery paths, forcing harvesters to detour or stop working, significantly reducing efficiency. Unremoved root systems continue to generate new shoots, and seeds that mix with harvesting machines or fertilizer piles become a source of pollution, forcing farmers to repeatedly invest in labor and resources for removal, increasing overall production costs.

3.2 Impact on Ecosystem

Solanum rostratum spreads rapidly, not only occupying crop space but also increasing the risk of spreading pests and diseases [5]. Once it establishes itself in barren land or grasslands, its rapid growth causes the formation of dense clumps that compete with original crops and weeds for light, water, nutrients, and space, forcing insects and birds dependent on low-growing plants to migrate due to food shortages. Its roots release biochemicals that alter the soil's composition, disturbing the original microbial community and weakening humus conversion, leading to soil hardening. The toxins produced by the plant, such as solanine, not only remain on the leaves but also penetrate the soil through decaying branches, polluting nearby water sources during the rainy season. This results in poisoning and death of amphibians and small animals, which affects higher predators along the food chain.

4. Risk Assessment of Solanum Rostratum

4.1 Potential for Spread

Solanum rostratum is an annual plant that reproduces sexually, with the quantity of its fruits and seeds determining its reproductive ability and persistence [6]. When the fruit matures, it is covered with sharp spines that allow the seeds to attach to animal fur, bird feathers, and even the tires of vehicles, facilitating their spread to new areas several kilometers away. Additionally, the seeds have strong dormancy, with a hard, dense outer shell that allows them to survive harsh conditions like cold, drought, and herbicides, enabling them to remain dormant in the soil for decades until favorable conditions for germination occur. In terms of reproductive efficiency, each fruit contains dozens of seeds, which germinate rapidly under suitable humidity and temperature, forming dense vegetation faster than common weeds, quickly occupying and expanding its territory.

4.2 Environmental Risk Assessment

Solanum rostratum shows strong adaptability in northern China, leading to multi-dimensional environmental damage [7]. It competes for sunlight, water, nutrients, and space, forming dense communities that block light from reaching the ground, causing native herbaceous plants and shrub seedlings to die from lack of light. Its roots continue to secrete chemicals that alter the soil's microenvironment, inhibit nutrient absorption of neighboring plant roots, and disrupt soil microbial balance. This weakens the activity of mycorrhizal fungi, which are responsible for organic matter conversion, causing a continuous decrease in

organic carbon content in the soil. Additionally, during the rainy season, the alkaloids in the plant seep into nearby water bodies, reducing water quality and causing harm to amphibian eggs and aquatic insect larvae.

4.3 Social and Economic Risks

The widespread invasion of Solanum rostratum has become a systemic social cost burden [8]. Its toxins cause acute reactions such as respiratory failure and nerve paralysis in livestock that mistakenly consume fresh plants or the dry stems mixed with forage, leading to large-scale deaths in cattle and sheep. Mild poisoning results in slower weight gain in young animals, extending the breeding cycle and reducing profit margins. Public management costs are also growing, as farmers are forced to invest considerable labor to regularly remove the plants. Road maintenance departments need to repeatedly spray herbicides, but the chemicals only suppress current growth, without killing dormant seeds in the soil, resulting in a recurring "control-recurrence-reinvestment" cycle. Social health risks are also increasing, with children at risk of being injured by sharp seeds on the ground, and seasonal respiratory allergies increasing in residential areas due to airborne pollen. The spread of the plant to urban green spaces significantly raises municipal maintenance costs.

5. Prevention and Control Strategies for Jilin Province

5.1 Monitoring the Spread and Ecological Adaptability of Solanum Rostratum

To effectively curb the spread of Solanum rostratum in Jilin Province, it is necessary to establish a comprehensive risk assessment and early warning mechanism for the introduction of alien plants [9]. This should cover potential, known, and newly emerging distribution areas, such as abandoned farmland, roadside ditches, overgrazed pastures, vacant land around villages, and disturbed riverbanks and wetlands. Its various means of spread make its invasion path complex and difficult to predict. Therefore, monitoring requires substantial collaboration from multiple departments, including forestry, agriculture, environmental protection, and transportation. Regular field surveys and the use of drones for large-scale invasion area identification will provide real-time assessment information.

5.2 Restoring the Ecological Environment and Preventing Further Damage

When dealing with Solanum rostratum, simple "cutting" or "pulling" of surface plants is ineffective and short-term. The control strategy must combine "removal of existing threats" and "environmental restoration," involving comprehensive rehabilitation projects. Physical removal (mechanical or manual) should be organized during critical periods when seeds have not yet matured. The cleared plants should be properly disposed of to prevent secondary spread. To break the cycle of seed dispersal and regrowth, soil seed banks must be reduced by deep plowing and multiple tillings. In heavily infested areas, indigenous plants with economic or ecological value should be selected to control the spread of the invasive plant [10].

5.3 Reducing Social and Economic Risks and Strengthening Public Participation

The control of Solanum rostratum has wide-ranging impacts on agriculture, animal husbandry, ecological environment, and public health. Establishing a clear and efficient cross-sector collaboration system and organizing public participation is key to long-term disaster reduction and prevention. After clarifying the responsibilities of different departments, a "vertical" coordination system should be established, ensuring that information, resources, and commands flow efficiently. A reasonable compensation mechanism should be set up for crops damaged by clearing, and public awareness should be raised about the plant's appearance, hazards, and preventive measures.

6. Conclusion

Solanum rostratum on agriculture, ecology, and social life in Jilin Province. Effective prevention and control require a systematic strategy, including full monitoring of its distribution, removal of plants, and rehabilitation of the soil. The government should refine the division of responsibilities, streamline collaborative processes, and encourage public participation. By implementing these measures, Solanum rostratum can be controlled within a limited area, preventing further damage to land and crops, and ultimately protecting farmers'

interests and local ecological environments.

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References

[1] Liu, X., Li, Q., Ma, H., et al. Study on Flora of Invasive Alien Seeds in Yanbian Prefecture, Jilin Province. Seeds, 2024, 43(05): 86-92.

[2] Tian, Z., Zeng, J., Wang, Y., et al. Distribution and Risk Assessment of Invasive Plant Solanum rostratum Dunal in Ningxia. Journal of Ningxia Agriculture and Forestry Science and Technology, 2021, 62(08): 61-64.

[3] Wang H. L., He J. Y. Seed Germination Characteristics of Invasive Plant—Solanum rostratum Dunal. Journal of Inner Mongolia Forestry Science and Technology, 2017, 43(1): 13-18.

[4] Zhai, J. Distribution, Harm, and Control of Solanum rostratum Dunal in Zhangjiakou. Journal of Green Science and Technology, 2019, (11): 147-148.

[5] Sun, Y., Wei, C., Hang, X., et al. The hazards and prevention measures of the invasive alien species Solanum rostratum Dunal in Ordos City. South China Agriculture, 2024, 18(09): 53-56.

[6] Guo, J., Cao, W., Zhang, Y., et al. Prediction of the potential distribution area of Solanum rostratum in northeast China. Pratacultural Science, 2019, 36(10): 2476-2484.

[7] Meng, D., Dong, J., Jiang, H., et al. Prediction of the Potential Distribution Area of Solanum rostratum Dunal in Inner Mongolia under Climate Change. Acta Agrestia Sinica, 2025, 33(01): 213-221.

[8] Li X. F., Wang J. X., Xiao Z. G., et al. A study on chemical control strategies of Solanum rostratum under two different habitat conditions. Biological Disaster Science, 2024, 47(2): 284-290.

[9] Yang, J., Zhang, C., Xu, J. Research on the Survey and Control Strategy of Alien Invasive Plants in Minqin County. Gansu Science and Technology, 2025, 41(04): 94-99.

[10] Yuan, Z., Zhang, G., Zhang, Y., et al. Assessment of the replacement control effects of six forage species on the malignant invasive plant Solanum rostratum. Journal of Biosafety, 2024, 33(04): 336-346.