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VṚKṢĀYURVEDA AND CONVENTIONAL TECHNIQUES TO ENHANCE *RAUWOLFIA SERPENTINA* SEED GERMINATION

[1]*Dr. Sonal Singh Kushwaha and [2]Dr. Suman Panwar

[1]PG Scholar, Department of *Dravyaguna Vigyana,* Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh, India.

[2]Professor and HOD, Department of *Dravyaguna Vigyana*, Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh, India.

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***Corresponding Author**
Dr. Sonal Singh Kushwaha
PG Scholar, Department of Dravyaguna Vigyana, Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh, India.

ABSTRACT

India, renowned as the "Medicinal Garden" and "Botanical Garden of the World," boasts a rich tradition of utilizing plants for healthcare. Among these, *Rauwolfia serpentina* (*Sarpagandhā*) is particularly notable for its medicinal properties, especially in treating mental illness, hypertension, and insomnia. However, the plant faces conservation challenges due to its high demand and endangered status. This review examines the potential of integrating traditional *Vṛkṣāyurveda* methods with modern seed treatments to enhance the germination rates of *Sarpagandhā*. *Vṛkṣāyurveda*, the ancient Indian science of plant life, offers holistic and eco-friendly approaches using natural substances like milk, cow dung, and herbal mixtures. These methods align with sustainable agricultural practices and are rooted in centuries-old *Ayurvedic* principles. Modern techniques, including seed priming and the use of growth regulators, provide precision and efficiency in overcoming seed dormancy and enhancing germination rates. A comparative analysis reveals that combining these traditional and modern approaches can optimize seed vitality and plant health, offering a sustainable solution for the cultivation and conservation of *Rauwolfia serpentina*. This integrated approach holds promise not only for meeting the growing medicinal demand but also for preserving this valuable species for future generations. Future research should focus on refining these methods to ensure their practical applicability and long-term sustainability in agriculture.

KEYWORDS: *Rauwolfia serpentina*, *Vṛkṣāyurveda*, Germination rates, *Sarpagandhā*.

INTRODUCTION

India, often called the “Medicinal Garden” and “Botanical Garden of the World”[1] has a long history of using plants for health care. Among these, *Rauwolfia serpentina* (*Sarpagandhā*) stands out due to its significant medicinal properties. The root of this endangered plant is used to treat mental illness, hypertension, insomnia, snake and reptile bites, and rheumatism.[2] Known as the world’s first antihypertensive drug, *Sarpagandhā* has played a crucial role in the evolution of neuropsychopharmacology.[3] Due to its pharmacological benefits, the demand for *Sarpagandhā* has surged, leading to its inclusion in the IUCN Red List of Threatened Species and restrictions on its trade through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[4]

Vṛkṣāyurveda, the ancient Indian science of plant life, emphasizes a holistic approach to the well-being of all life forms[5], including plants, animals, and humans, as reflected in its core principle "*Sarvabhūteśucintana*." This holistic approach extends to branches like *Paśu Āyurveda* for livestock, *Hastya Āyurveda* for elephants, and *Aśva Āyurveda* for horses.[6] Ancient *Ayurvedic* scholars emphasized three foundational pillars[7]: *Āhāra* (food), *Nidrā* (sleep), and *Brahmacaryā* (celibacy or discipline), with *Āhāra* highlighting the journey from soil to plate. *Vṛkṣāyurveda* integrates traditional agricultural practices with *Ayurvedic* principles, enhancing plant vitality and germination rates through methods like those detailed in the *Bīja Utpatti Adhyāya*, which includes treatments using substances like *Vidaṅga, Bṛhatī, Tila, Vasā, Go-maya, Madhu, Kṣhīra,* and *Kamala Nāla.*[8]

This review aims to compare traditional and modern pre-sowing treatments for *Sarpagandhā* [*Rauwolfia serpentina* (L) Benth. Ex Kurz], focusing on enhancing its germination rates. Traditional treatments, as mentioned in ancient *Ayurvedic* texts like *Surpāla's Bīja Utpatti vidhī Adhyāya*, offer holistic and eco-friendly methods that align with sustainable agricultural practices. Modern treatments, while scientifically advanced, must be evaluated against these time-tested traditional methods to identify the most effective strategies for cultivating this vital medicinal plant. Addressing the low germination rate is crucial for meeting the growing demand and ensuring the sustainable use of *Sarpagandhā*.

IMPORTANCE OF SEED GERMINATION

Seed germination is a critical phase in plant cultivation, serving as the foundation for the growth and development of healthy plants.[9] Successful germination ensures that plants can establish themselves, access nutrients, and grow vigorously. This initial stage involves a series of steps, including water uptake, enzyme activation, and the emergence of the root and shoot, which collectively lead to the formation of seedlings.[10] Understanding and optimizing these processes are essential for enhancing germination rates and achieving robust plant growth.

For *Rauwolfia serpentina*, the germination process presents specific challenges that complicate its cultivation. One of the primary issues is the low germination rate, which ranges from 10% to 40%, significantly impeding large-scale propagation efforts.[11] This low rate is often attributed to the seed's dormancy, a natural mechanism that prevents germination under unfavourable conditions.[12] Overcoming this dormancy requires precise conditions and treatments to stimulate the seeds' metabolic processes and initiate germination.[13]

Effective pre-sowing treatments are crucial for addressing these challenges. Traditional methods, as detailed in ancient *Ayurvedic* texts like *Surpāla's Bīja Utpatti vidhī Adhyāya*, offer holistic and eco-friendly approaches that utilize natural substances such as *Vidaṅga, Bṛhatī, Tila, Go-maya, Madhu, Kṣhīra,* and *Kamala Nāla*.[14] These treatments, known for their antimicrobial and nourishing properties, can enhance the germination rate and overall health of the seedlings.

Modern scientific approaches to pre-sowing treatments also play a vital role. These methods often involve the use of growth regulators, controlled environmental conditions, and

advanced techniques like seed priming and scarification. Comparing traditional and modern methods is essential to identify the most effective strategies for cultivating *Rauwolfia serpentina*. This comparative analysis can provide insights into optimizing germination rates, ensuring the sustainable propagation of this valuable medicinal plant.

The successful germination and cultivation of *Rauwolfia serpentina* are vital not only for meeting the growing demand in traditional and modern medicine but also for conserving this endangered species. By addressing the specific challenges associated with its germination, researchers and cultivators can support the sustainable use and conservation of *Rauwolfia serpentina*, ensuring its availability for future generations.

TRADITIONAL PRE-SOWING TREATMENTS IN *VṚKṢĀYURVEDA*

Vṛkṣāyurveda, an ancient Indian text on plant life, offers valuable traditional knowledge on plant care. Key manuscripts, such as *Bṛhat Samhita*[15], *Kr̥ṣi Sūktī*[16], *Vṛkṣāyurveda* by *Surpāla*[17], *Bṛhat Śārṅgadhara*, and *Kr̥ṣi Parāśara*[18], *Śārṅgadhara paddhatī*[19] discuss various aspects of plant cultivation and disease management.

Among these, *Surpāla's Vṛkṣāyurveda* is particularly noted for its structured approach, organizing content according to the plant life cycle. It covers essential topics like seed treatments, soil preparation, sowing, and irrigation, offering a comprehensive guide for successful plant cultivation. The text emphasizes the importance of trees and environmental stewardship, linking these practices to spiritual well-being and suggesting that caring for nature aligns with virtuous living and spiritual growth.[20]

Surpāla's Vṛkṣāyurveda outlines various traditional seed treatment methods that combine *Ayurvedic* principles with agricultural practices to enhance germination and plant health.

One method involves treating seeds with milk and then drying them for five days, followed by fumigation with a mix of *Vidāṅga* and *Ghṛta*, which nourishes the seeds and leverages the therapeutic properties of these herbs.[21] Another technique includes sprinkling seeds with milk and applying a mixture of *Brāhatī bhasma* and *Tila* combined with *Ghṛta* to improve seed vitality.[22]

Surpāla also recommends rubbing seeds with a blend of cow dung and soil, followed by fumigation with *Vasā*, which utilizes the organic components of cow dung to boost seed viability.[23] Additionally, seeds can be treated by sprinkling milk, then rubbing them with a

mixture of cow dung, honey, and *Vidāṅga*, offering a holistic approach that integrates nourishing and therapeutic qualities.

For specific seeds like *Makaṅda, Jambū,* and *Panasa*, soaking in milk, drying, and then sprinkling *Brāhatī, Kamala Nāla,* and *Tila* can optimize germination. Pre-treatment methods for *Kṣhīrinī* and *Bakula* seeds involve these techniques followed by nipping or folding the seed heads to expedite germination.

For *Ervāru* seeds, *Surpāla* advises a treatment of jaggery mixed water followed by exposure to heat for three days, tailored to the unique characteristics of these seeds. The sowing process itself is highlighted with rituals including a purificatory bath, clean clothing, offerings to deities, and adherence to auspicious dates and lunar mansions.

In summary, *Surpāla's* methods in the *Vṛkṣāyurveda* reflect a comprehensive and thoughtful approach to seed treatment, integrating traditional knowledge with practical applications to enhance seed germination and plant vitality, consistent with the sustainable practices of *Vṛkṣāyurveda*.

Table 1: Bīja Utpatti Vidhi as Told in Vrikshayurveda by Surpala.[24]

NAME	INGREDIENTS	PROCESS	DAYS
Viḍaṅgādi Dhūpana	Milk, *Ghṛta, Viḍañga*	Sprinkle the milk on seeds, Fumigation with *Viḍañga* and *Ghṛta*.	5
Vasā Dhūpana	Milk, *Bṛhatī Bhasma, Tila Bhasma, Ghṛta*	Sprinkle seeds with milk., Apply paste of *Bṛhatī Bhasma, Tila Bhasma* and *Ghṛta*., Rubbed with cow-dung and clay soil., Fumigation with fat.	Not specified
Gomayādi Upacāra	Milk, Cow-dung, Honey, *Viḍañga chūrna*	Sprinkle the seeds with milk, rub them with cow-dung, Treated with honey and *Vidaṅga* powder.	Not specified
Bṛhatyādi Upacāra vidhi	Milk, *Ghṛta, Bṛhatī, Tila, Kamala nāla*	Soak seeds in milk., Dry excess moisture. Dusted with powders of *Bṛhatī*, *Tila*, *kamala nāla*.	Not specified
Śirṣa Kūrcitāgrama vidhi	Milk, *Ghṛta, Bṛhatī, Tila, Kamala nāla, Kṣhīrika Bīja, Bakula Bīja*	Soak seeds in milk, Dry excess moisture, dusted with powders of *Bṛhatī*, *Tila*, *kamala nāla,* Nip the heads of the seeds.	Not specified
Patra-putī vidhi	*Ervāru Bīja, Kūṣmāṇḍa Bīja, Patra putī,* Jaggery	Seeds wrapped and tied with platter, Spray jaggery solution over them, heated for 3 days and taken out.	3

CONVENTIONAL PRE-SOWING TREATMENTS

Seed priming is a technique that involves controlled hydration and drying to activate metabolic processes before germination, resulting in faster and more uniform seed growth. This method enhances seed development, nutrient uptake, water use efficiency, and overall crop yield, while also overcoming dormancy issues.

The effectiveness of seed priming depends on various factors, including the plant species, priming duration, medium, temperature, and concentration, as well as storage conditions. Common priming agents such as inorganic salts (KCl and KNO3), gibberellic acid (GA), and cytokinins can improve growth rates and germination by inducing biochemical changes like enzyme activation, metabolism of inhibitors, and cell repair.[25]

Priming techniques can be categorized into conventional methods—such as hydropriming, osmo-priming, nutrient priming, and bio-priming—and advanced methods that include nanoparticle priming and physical agent priming. Each technique is tailored to specific seed types and environmental conditions to optimize germination and seedling vigor.

Table 2: Various Seed Priming Techniques.

Conventional	Advanced
Hydropriming	Priming through nano particles
Osmopriming	Priming through physical agents
Halopriming	
Matric priming	
Nutrient priming	
Chemical priming	
Bio priming	
Priming with PGR	
Priming with plant extracts	
Thermo priming	
Drum priming	

COMPARATIVE ANALYSIS

Comparing traditional and modern seed treatments reveals key differences in effectiveness, sustainability, and environmental impact. Traditional methods, rooted in ancient practices, often emphasize natural, holistic approaches, incorporating substances like herbs, cow dung, and milk. These techniques, such as those found in *Surpāla's Vṛkṣāyurveda*, aim to enhance seed vitality and growth through time-tested, eco-friendly practices. They promote sustainability by relying on readily available, organic materials and often include steps that align with ecological balance and spiritual well-being.

In contrast, modern treatments, such as seed priming with inorganic salts or advanced techniques involving nanoparticles, offer precise control over germination conditions and can lead to faster and more uniform seed sprouting. These methods leverage scientific advancements to optimize seed performance and crop yield. However, they may involve synthetic chemicals or sophisticated technologies that could have varying environmental impacts, depending on the materials and processes used.

The sustainability of traditional methods is generally high, as they utilize natural resources and aim to preserve ecological balance. On the other hand, modern approaches, while potentially more efficient, can have mixed environmental effects, particularly if they rely on non-renewable resources or involve complex disposal processes for by-products.

In summary, traditional seed treatments offer a more sustainable and eco-friendly approach with deep historical roots, while modern methods provide efficiency and precision at the potential cost of environmental impact. The choice between these approaches depends on the specific goals of cultivation and the values prioritizing sustainability versus technological advancement.

INTEGRATION OF TRADITIONAL AND MODERN PRACTICES

- **Enhanced Plant Health:** Combining traditional *Vṛkṣāyurveda* methods with modern practices can enrich soil and improve plant health through natural, holistic approaches.
- **Improved Seed Treatments:** Integrating *Ayurvedic* seed treatments (e.g., milk, cow dung, herbal mixtures) with modern seed priming techniques can boost seed vitality, leading to better germination rates.
- **Increased Crop Yields:** Traditional organic farming practices, when merged with modern technologies like precision farming, can result in higher crop yields and improved soil health.
- **Sustainable Practices:** Blending traditional knowledge with contemporary methods supports sustainability by maintaining ecological balance and reducing reliance on synthetic inputs.
- **Effective Pest Management:** Combining indigenous pest control methods with modern integrated pest management strategies enhances pest control effectiveness while being environmentally friendly.
- **Successful Examples:** Organic Farming- Integration of traditional composting with advanced soil management practices has improved soil fertility and crop productivity;

Precision Agriculture- The use of traditional pest control methods alongside modern precision farming techniques has led to more efficient and sustainable pest management.

- **Comprehensive Approach:** Merging traditional *Vṛkṣāyurveda* with modern practices offers a holistic approach that leverages historical insights and contemporary advancements for optimal agricultural outcomes.

DISCUSSION

The findings highlight that both traditional *Vṛkṣāyurveda* methods and modern seed treatments offer distinct advantages for plant cultivation. Traditional methods are appreciated for their holistic, environmentally friendly approaches that promote ecological balance and reduce reliance on synthetic chemicals. Modern techniques, on the other hand, provide enhanced efficiency and precision, resulting in faster germination and improved growth outcomes. Integrating these approaches can leverage their respective strengths, leading to more effective and sustainable agricultural practices.

For *Sarpagandhā* (*Rauwolfia serpentina*), which is characterized by a stony, hard seed coat and exhibits low germination rates, the application of these methods is particularly promising. Traditional treatments such as milk and *Ayurvedic* herb fumigation, combined with modern techniques like seed priming, could significantly improve germination rates and seed viability. If successful, these integrated methods could serve as models for the conservation of other endangered species with similar germination challenges.

The integration of traditional and modern practices has important implications for future research and practical applications in agriculture. Research should focus on exploring the synergistic effects of combining these practices to optimize seed treatment and plant health. Long-term studies on the impact of these methods on soil health and ecosystem balance are crucial to understanding their broader environmental effects. In practice, developing new protocols that merge *Ayurvedic* principles with modern technology could enhance crop resilience and productivity while fostering a more sustainable approach to agriculture.

Current research has limitations, including a lack of comprehensive studies on the long-term effects of these practices on soil health and biodiversity. Empirical data on the efficacy of integrated methods across different environmental conditions is also needed. Future investigations should address these gaps by assessing the challenges of implementing integrated practices on a large scale, evaluating their economic viability, and determining the

most effective methods for various plant species and conservation contexts. If successful for Sarpagandhā, these techniques could play a crucial role in the conservation and sustainable management of other red-listed species with similar seed dormancy issues.

CONCLUSION

The integration of traditional *Vṛkṣāyurveda* methods with modern seed treatments offers a promising pathway to enhance the germination rates of *Rauwolfia serpentina* and other challenging plant species. Traditional practices, grounded in *Ayurvedic* principles, provide eco-friendly and holistic approaches that can complement modern techniques. By combining these approaches, it is possible to address the specific challenges posed by *Sarpagandhā's* hard seed coat and low germination rates more effectively. This synergy not only improves seed viability and plant health but also supports the conservation of endangered species. Future research should focus on optimizing these integrated methods to ensure sustainable and efficient agricultural practices, thereby contributing to the preservation of vital medicinal plants and enhancing overall agricultural resilience.

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