Studies on moisture content, storage condition and seed dimension on seed germination: A comprehensive study of the medicinal plant *Datura alba* Nees.

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Abstract

Medicinal plants play a crucial role in treating various common diseases and are often relied upon as essential home remedies in many regions. *Datura alba* Nees, recognized for its medicinal properties is the necessity for effective seed germination techniques to ensure consistent and enhanced yields. This study aimed to assess the impact of moisture content, storage conditions, and seed dimensions on the germination of *Datura alba Nees* over 4, 8, 12, 18, and 24 months. The germination percentage of *Datura alba* Nees seeds gradually decreased with increasing storage time from 4 to 24 months. At a storage temperature of 10°C, 45% of seeds germinated after 4 months, declining to 22.2% thereafter. Conversely, at 40 (±2) °C, the germination rate dropped to 8.9%. Notably, at 10°C, seed germination decreased from 45% to 27.2% over 24 months. Moisture content was sustained for up to 18 months across three storage methods: polythene bags, gunny bags, and cloth bags. Polythene bags maintained maximum moisture for the entire 24-month period, followed by gunny and cloth bags. Furthermore, a positive correlation was observed between seed weight and germination percentage. This study suggests a seed germination methodology to rapidly propagate numerous *Datura alba* Nees plants, contributing to the conservation and utilization of this medically valuable species.

Keywords: *Datura alba* Nees, moisture content, storage condition, seed dimension, seed germination.

1. Introduction

Plants have long been integral to the treatment of human injuries and ailments across the globe. The demand for medicinal plants is rising in both developed and developing nations, driven by an increasing appreciation for natural products. Herbal medicine plays a crucial role in both traditional and contemporary medical systems (Kirtikar and Basu 1994). All the things in plants that can help us feel better and how we can use them in medicine (Fabricant and Farnsworth 2001).

Image 1. Plant of *Datura alba*

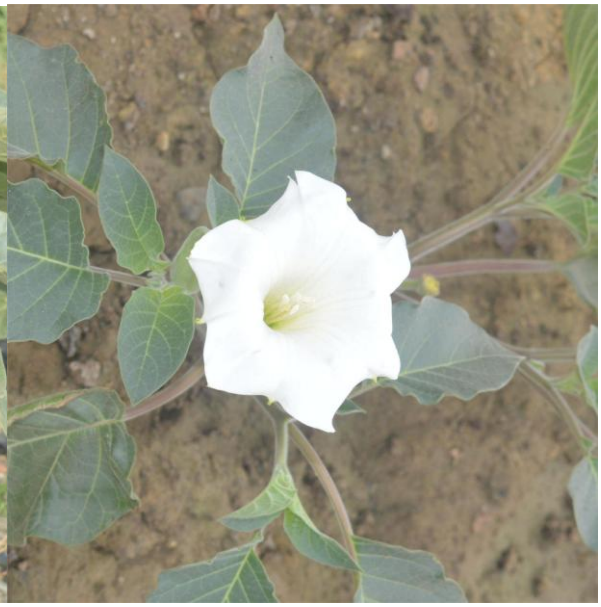

Image 2. Plant of *Datura alba*

Medicinal plants offer a diverse array of bioactive compounds recognized for their pharmacological effects. Indeed, a significant portion of conventional medications is derived from plant sources. One such plant is Datura spp., a flowering medicinal herb belonging to the Solanaceae family (Sayyed and Shah 2014). It is extensively cultivated in Europe, Asia, the Americas, South Africa, and various other tropical and subtropical areas (Gaire and Subedi 2013). Its toxic and medicinal properties.

Datura alba Nees, also called white thornapple, is a plant that's super important in traditional medicine all over the world. People have been using it for ages to help with all sorts of things (Gajalakshmi et al. 2016). Due to its medicinal properties, Datura has been traditionally utilized to treat conditions such as arthritis, pain, abscesses, headaches, rattlesnake bites, swellings,

sprains, and tumors. In Ayurvedic medicine, Datura is also employed for healing wounds, inflammation, bruises, and swellings, as well as for treating sciatica, ulcers, rheumatism, asthma, bronchitis, and general body aches. Additionally, it is applied as an ointment to alleviate the pain associated with rheumatism and sciatica. The juice extracted from the leaves, when combined with milk, is highly effective in eliminating intestinal worms like cestodes (Sharma et al.,2021).

It's super important to grow and keep *Datura alba* Nees seeds in a good way so we always have this useful plant around. We need to make sure the seeds are really good quality, so they can grow well and be healthy. One way to do this is by making sure the seeds are all the same size, which helps them grow better in the field. But it's tough to keep the seeds good for a long time because they can start to go bad if seeds are stored for too long (Khan et al., 2015).

Contrarily, non-uniform seeds perform poorly when grown in the field. To achieve seed uniformity, it is essential to sort the seeds using a seed grader based on size. Seed quality degrades easily, making long-term storage challenging. Therefore, in the present study, we examined the environmental factors affecting the lifespan of seeds in *Datura alba* including relative humidity, temperature and initial moisture content.

2. Materials and Methods

2.1 Seed Collection and Storage

The seeds of *Datura alba* were collected from Damoh district, M.P India. To minimize the risk of fungal growth, the seeds were surface sterilized by soaking them in warm water at 50°C for 20 minutes. After sterilization, the seeds were placed in cold distilled water to chill them. The seeds were then spread on germination paper and dried overnight at 20°C (Jain et al., 2021; Jain et al., 2022; Jain et al., 2023). For storage, the seeds were kept in sealed polythene bags at various temperatures: 10 (±1)°C, 15 (±1)°C, 28 (±1)°C, 40 (±1)°C, with 90 (±1)% relative humidity at room temperature. Special care was taken to maintain the seed quality during storage, considering factors such as initial seed moisture content, packing method, airtight container usage, and storage conditions with low temperature and humidity.

2.2 Seed Size and Weight

To ensure precise measurements, the weight of *Datura alba* Nees seeds was recorded with an accuracy of 0.01 mg using a screw gauge. For germination, seeds were placed in a seed germinator with two moistened, sterilized filter papers at 30 (±2)°C. The seeds were organized by size and weight, with 24 seeds per type placed in petri dishes. Germination was monitored daily, and newly germinated seeds were recorded. Germination was defined as the emergence of the radicle.

2.3 Moisture

The moisture content of the seeds was measured in triplicate using three independently collected samples, each consisting of 10 grams of seeds. The seeds were placed in paper bags and baked for 24 hours at 95°C. After baking, they were cooled in a desiccator and reweighed. Moisture content was calculated and expressed using the following formula:

Moisture Content (%) = (Fresh Weight- Oven dry weight)/Fresh weight × 100
This procedure was applied to seeds ranging in age from newly sown to 24 months old to measure their moisture content over time.

3. Results and Discussion

This study endeavors to explore key discoveries related to seed germination in valuable plant species, examining the impact of various factors such as seed collection methods, seed size, storage conditions, imbibition, seed viability, and environmental factors (Jain et al ., 2020).

Image 1: Seeds of *Datura alba* Nees

Image 2: Germinated Seeds of *Datura alba* Nees.

Table 1 Effect of different storage conditions and periods on seed germination of *Datura alba.*

Storage conditions	Storage period (in months)											
	Fresh seed		**4**		**8**		**12**		**18**		**24**	
	A	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Room temp.	60	58	54.30	52.30	51.20	48.50	42.30	40.00	30.50	32.00	32.20	28.25
10 (±1)°c	-	-	25.10	30.50	22.50	19.10	18.20	14.00	12.00	18.20	10.70	8.22
15 (±1)°c	-	-	38.00	35.70	18.30	28.40	24.80	26.20	24.20	23.70	22.50	20.30
28 (±1)°c	-	-	54.20	52.20	49.30	45.30	42.20	40.10	35.10	30.10	20.20	18.10
40 (±1)°c	-	-	15.20	10.50	8.50	6.00	2.00	1.10	-	-	-	-
90(±1) % Relative humidity	-	-	14.10	13.10	12.10	11.70	7.60	5.70	-	-	-	-
Partial vacuum	-	-	50.90	48.20	45.10	42.30	28.20	22.30	20.70	33.20	20.10	22.50

A. **Represent germination percent, B represents plant percent**

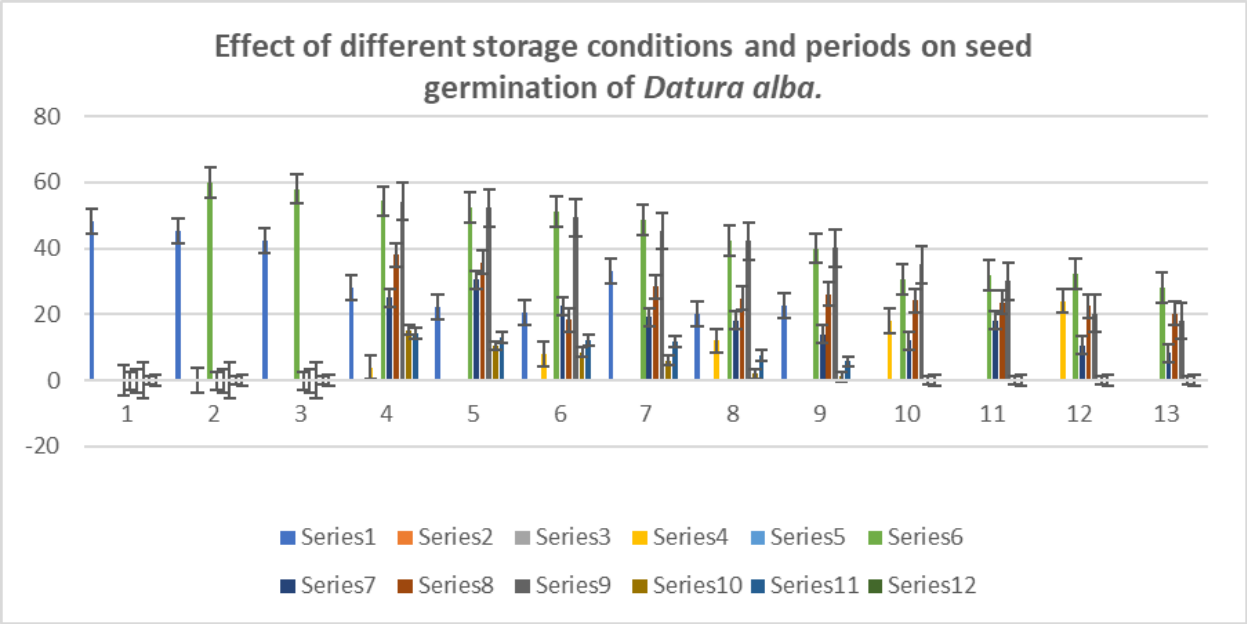

Fig.1 Effect of different storage conditions and periods on seed germination of *Datura alba.*

In *Datura alba* (Table 1 and Figure 1), there was a notable decline in germination percentage at room temperature over storage duration, decreasing from 60% to 32.20% after 24 months. This decline was less pronounced at both lower and higher temperatures. At (10±1) ℃, germination was 25.10%, while at (40±1) ℃, it dropped to 15.20%. Notably, germination percentages at (10±1) ℃ exhibited a decrease up to 8 months of storage, followed by a gradual decline up to 24 months. Similar trends were observed at (15±1) ℃, (28±1) ℃ and (40±1) ℃, with decreases observed up to 8 months followed by gradual declines up to 24 months. Moreover, when subjected to (90±1)% relative humidity at a constant temperature of 30℃, the seeds lost viability rapidly. In contrast, superior results were obtained under partial vacuum conditions. Here, 50.90% of seeds germinated, facilitated by a reduction in aerobic respiration rates, thereby excluding oxygen from the surrounding atmosphere of the seeds. Similar findings were reported by Jain et al., (2020) in *Androphytic paniculata*.

Overall it is evident that there was a decrease in germination percentage with an increase in the storage period from 4 to 24 months. Partial vacuum emerges as the most favorable condition for the germination percentage of medicinal plant seeds, particularly around 10℃, ensuring their viability for an extended period. The optimal outcomes for *Datura alba* species were observed under partial vacuum conditions, likely stemming from a reduction in the rate of aerobic

respiration, effectively excluding oxygen from the surrounding atmosphere of the seeds. Similar results were found in *Asparagus racemosus* by Jain et al., (2023), who also observed that reducing oxygen availability around seeds and decreasing aerobic respiration positively affect seed viability and germination rates, reinforcing the benefits of controlled storage conditions for seed preservation.

Table. 2 Effect of seed dimension and weight on germination percent of fresh *Datura alba*

Seed Weight (mg)	G%	Diameter (mm)	G%
5	70	1	65
10	75	1.2	68
15	80	1.4	70
20	82	1.6	72
25	85	1.8	75
30	88	2	78

G%=Germination Percent

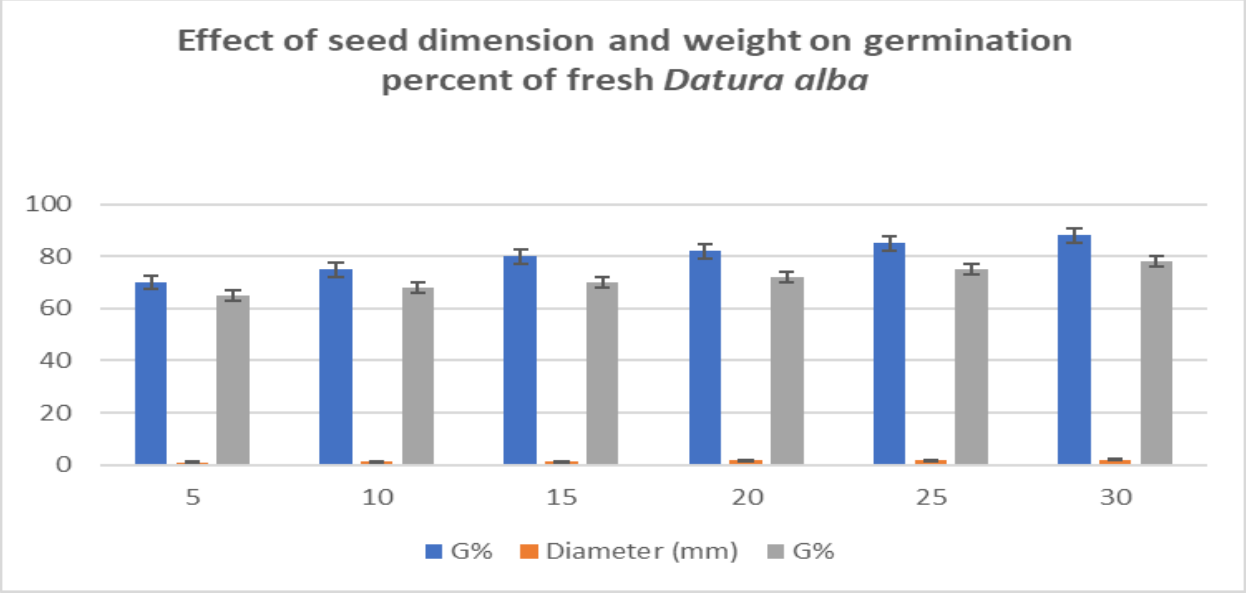

Fig. 2 Effect of seed dimension and weight on germination percent of fresh *Datura alba*

The data presented in Table 2 and Fig. 2 highlights a clear correlation between seed dimensions and weight with percentage germination. There is a notable positive relationship observed: heavier or healthier seeds tend to exhibit higher percentages of germination. This trend extends to seed width as well, with narrower and wrinkled seeds demonstrating lower germination percentages. This observation echoes findings from (Jain et al., 2020), who also noted a similar relationship between seed germination and size and shape.

4. Conclusion

The study on *Datura alba* Nees concludes that seed germination declines over 24 months, notably from 60% to 32.20% at room temperature. Lower (10°C) and higher (40°C) temperatures showed less pronounced declines, with germination rates of 25.10% and 15.20% respectively. High humidity (90% Relative humidity at 30°C) rapidly reduced viability, while partial vacuum conditions improved germination to 50.90% by reducing aerobic respiration. Seeds stored in a partial vacuum at around 10°C had the best viability. Additionally, there is a positive correlation between seed size and germination rate, with heavier, healthier seeds germinating more successfully. *Datura alba*'s pharmacological properties include relieving respiratory congestion, stimulating the central nervous system, treating skin infections, alleviating toothache and other dental issues, and reducing pain. Despite all parts of the plant being toxic, the ripe seeds contain the highest concentration of alkaloids. Consequently, they can be effectively used to treat symptoms resulting from organophosphate-induced toxicity and specific central anticholinergic effects. The leaf extract is consumed orally to address sinus infections, while the bark extract is applied externally to treat burns, ulcers, swellings, and various other skin infections.

Given the multitude of medicinal properties contained within *Datura alba*, enhancing its germination power becomes a crucial step toward maximizing its therapeutic potential. By improving germination rates, we can ensure a steady and reliable supply of this valuable plant, facilitating both traditional use and modern pharmacological research.

Techniques such as seed priming, which involves pretreating seeds to enhance their germination speed and uniformity, can be employed. Furthermore, optimizing environmental factors such as

soil composition, moisture, temperature, and light conditions can significantly boost germination and growth rates. Genetic approaches, including selective breeding and biotechnological interventions, might also be explored to develop strains with enhanced germination characteristics and higher medicinal compound yields.

Increasing the germination power of *Datura alba* not only supports its sustainable cultivation but also amplifies its availability for medicinal use. This can lead to more comprehensive studies and wider application in treating various ailments, ultimately contributing to improved healthcare outcomes. Enhanced germination also enables larger-scale production, which is vital for meeting the growing demand for natural remedies in both local and global markets. By focusing on these improvements, we can fully harness the medicinal benefits of *Datura alba*, ensuring its role as a cornerstone in natural and alternative medicine practices.

The pharmacological properties of *Datura alba* include relieving respiratory congestion, stimulating the central nervous system, treating skin infections, alleviating toothache and other dental issues, and reducing pain. Despite the plant's toxicity in all its parts, the ripe seeds contain the highest concentration of alkaloids. Consequently, they can be effectively used to treat symptoms resulting from organophosphate-induced toxicity and specific central anticholinergic effects. The leaf extract is taken orally to address sinus infections, while the bark extract is applied externally to treat burns, ulcers, swellings, and various other skin infections. Therefore, due to its numerous medicinal properties, increasing its germination power becomes even more imperative.

By adopting techniques such as seed priming, optimizing environmental conditions, and exploring genetic modifications, we can enhance the germination rates of *Datura alba*. This will ensure a reliable supply of the plant, making it more accessible for medical research and therapeutic applications. Enhanced germination power will not only facilitate sustainable cultivation practices but also allow for broader utilization of *Datura alba* in treating a wide range of health conditions, thereby contributing to better overall healthcare outcomes and meeting the increasing demand for effective natural remedies.

5. References

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