An Insight into Recalcitrant Seeds of Forestry Species in India

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ABSTRACT

Recalcitrant seeds, which cannot tolerate desiccation, pose significant challenges for the storage and germination of forestry species in India. This article provides insights into the characteristics, storage challenges, and germination requirements associated with recalcitrant seeds. The storage sensitivity of recalcitrant seeds limits their viability, affecting their availability for reforestation and afforestation programs. Immediate sowing in a suitable environment with high moisture levels and favorable temperatures is crucial for successful germination. Despite the challenges, the inclusion of recalcitrant species in forest restoration efforts is vital for maintaining biodiversity, ecosystem services, and supporting rural livelihoods. This article provides information regarding germination and storage viability of recalcitrant seeds. The conservation and utilization of recalcitrant seeds are inevitable for sustaining forest ecosystems and promoting sustainable development in India.

INTRODUCTION

Forestry plays a vital role in the sustainable development of any nation, including India. The success of forestry initiatives relies heavily on the availability of high-quality seeds, However, not all seeds are created equal. Some seeds, known as

recalcitrant seeds, possess unique characteristics that make them challenging to store and germinate, In India, several important forestry species, such as *Artocarpus heterophyllus, Shorea robusta, Dysoxylum malabaricum, Hopea odorata, etc.*

RECALCITRANT SEEDS:

Some researchers argue that recalcitrant seeds are highly sensitive to drying, emphasizing that any effort to reduce seed moisture content significantly affects their viability and subsequent germination. Conversely, others propose that controlled dehydration might enhance the storage capacity of recalcitrant seeds without a substantial loss in viability. A discrepancy arises concerning the maximum storage period for desiccation-sensitive seeds. Definitive research suggests that recalcitrant seeds have a limited storage lifespan, often measured in weeks or months, before experiencing substantial viability loss. Conversely, alternative theories propose that under specific storage conditions and treatments, the survival of recalcitrant seeds can be prolonged, extending beyond the conventional understanding.

1. ***Artocarpus heterophyllus* (Lam.)**
   The study conducted by Rekha *et al*., 2009 aimed to enhance the longevity of seeds of this spp. by exploring various temperature conditions. The results of these studies on *A. heterophyllus* seeds, demonstrating its viability for a period of ranging from 3-10 days. This behavior is typical of seeds characterized by moisture levels from 30% to 70%.

2. ***Shorea robusta* (Gaertn F.)**
   The studies done on *Shorea robusta* showing that its seeds remain viable up to 11 days. Fresh seeds of *Shorea robusta* exhibited a moisture content of 50.2%. Sal seeds exhibit true recalcitrant behavior, further highlighting the sensitivity of these seeds to the desiccation process and its subsequent impact on their viability.

3. ***Dysoxylum malabaricum* (Bedd. ex C. DC.)**
   Seeds that possess a moisture content of 55.64% show their recalcitrant nature. This study done by Pillai and Pandalai, 2015 highlighted that the shelf life of *D. malabaricum* seeds can be extended up to 12 weeks, representing about 38% of the original viability. Consequently, seeds stored under room conditions could not sustain vitality even for a week. Since these seeds exhibit a recalcitrant nature, they are intolerant to desiccation.

4. ***Hopea odorata* (Roxb.)**
   Fresh seed germination and viability test was conducted by Hoque *et al.*, 2020. The viability of Telsur remains up to 15 days (33.33%) considered at desired level. Seeds stored in refrigerator condition at 0-4^{0}C can be suitable for prolong viability of Telsur seeds.

CRYOPRESERVATION:

The effectiveness of cryopreservation as an approach for preserving recalcitrant seeds varies in research results. Some studies emphasize the capacity of cryopreservation to enhance seed viability and extend storage life, while others highlight conflicts and limitations, such as damage due to ice crystal formation and an inability to recover from cryopreservation pressure.

CHALLENGES ASSOCIATED WITH RECALCITRANT SEEDS:

The storage and germination of recalcitrant seeds present unique challenges that forestry researchers and practitioners in India must overcome. Firstly, the short shelf life of these seeds requires prompt processing and planting, delayed germination attempts can lead to

reduces viability and potentiality, complete failure. Moreover, the highly perishable nature of recalcitrant seeds necessitates specialized storage facilities with controlled temperature and humidity levels, which adds to the cost and logistics of seed management. Furthermore, ensuring the germination success of recalcitrant seeds can be problematic. The specific environmental conditions required by each species must be carefully understood and replicated to maximize the germination rate. This level of precision and knowledge can be time-consuming and resource-intensive. Consequently, failure to provide suitable conditions may result in low germination rates and a waste of precious forestry resources.

POTENTIAL SOLUTIONS AND FUTURE DIRECTIONS:

Despite the challenges associated with recalcitrant seeds, researchers and forestry experts in India have made substantial progress in finding solutions and improving the success rate of germination and storage. Significant advancements have been made in seed cryopreservation technologies, which involve freezing seeds at ultra-low temperatures. Cryopreservation methods have shown promising results in improving the longevity and viability of recalcitrant seeds. Additionally, the use of plant tissue culture techniques, such as somatic embryogenesis and micropropagation, have proven effective in mass producing recalcitrant tree species. These techniques enable the production of vigorous and disease-free planting material, providing a sustainable solution for large-scale afforestation programs in India.

CONCLUSION:

The article sheds the light on the intricate nature of recalcitrant freshly seeds, revealing the challenges and opportunities inherent in their storage and conservation. The conflicting theories which surround desiccation sensitivity and the limited storage lifespan of recalcitrant seeds highlight the need for further research and standardized approaches. This article highlights recent analysis of variability in storage behaviour among recalcitrant seeds and emphasize the seed-handling techniques and storage conditions to maximize viability. Further, there is a need for more research on recalcitrant seeds for developing technologies and better understanding for the preservation of recalcitrant seed germplasm. This perspective encourages a holistic approach to address the challenges in storage of these seeds, and ensuring the sustainable conservation of these invaluable genetic resources for the future resilience of forest ecosystem.

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