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Breaking Seed Dormancy in *Sesbania grandiflora*: A Simple Step Towards Better Germination

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Unlocking the Potential of a Fast-Growing Multipurpose Tree

Seeds may look small and lifeless, but inside each seed lies the potential to produce a new plant. However, not every viable seed germinates immediately after sowing. Some seeds remain dormant because of physical or physiological barriers that prevent water uptake or delay the processes required for germination. Breaking this dormancy is therefore an important step in successful plant regeneration. One such species in which seed germination can be a challenge is *Sesbania grandiflora*, a fast-growing leguminous tree commonly known as agati, katurai, vegetable hummingbird or West Indian pea. It is a multipurpose tree with considerable potential for agroforestry, soil improvement and other applications. The species can grow rapidly under suitable tropical conditions and is adapted to a relatively wide range of soils and rainfall conditions. Despite these advantages, poor germination and a prolonged germination period can restrict the regeneration of *S. grandiflora*. This makes seed dormancy-breaking treatments particularly important. A project carried out at the College of Forestry, Sirsi, therefore examined different seed priming and dormancy-breaking methods to determine which treatment could improve germination.

Why *Sesbania grandiflora* Matters

Sesbania grandiflora belongs to the family Fabaceae and is a fast-growing, soft-wooded tree. It can reach considerable height and generally has a straight trunk with relatively few branches. Its leaves are pinnately compound, while its attractive flowers may be white, yellowish, pink or red. The long, narrow pods contain numerous dark-brown seeds. The species is native to Asia and is now widely cultivated in humid tropical regions. It can be grown along field boundaries and low dikes between rice fields and may also be associated with grasses in agroforestry systems. The species performs well under warm and humid conditions, with optimal growth reported around 22–30°C and annual rainfall of about 2000–4000 mm. It can also tolerate several challenging soil conditions, including heavy clay, alkaline, saline, poorly drained and poorly fertilized soils. One of its important ecological and agricultural characteristics is its association with nitrogen fixation. As a leguminous tree, *S. grandiflora* can contribute to soil enrichment and therefore has relevance in sustainable agriculture and agroforestry. However, a useful tree is of limited value if its seeds cannot be established efficiently. The poor rate of germination and prolonged germination period were identified as important constraints to regeneration of the species. This provided the basis for studying different seed treatments.

What is Seed Dormancy?

Seed dormancy is a natural condition in which a viable seed does not germinate even when environmental conditions appear favourable. In many hard-coated seeds, the seed coat acts as a

physical barrier and restricts the entry of water and gases needed for germination. This is where seed priming and scarification become useful. Seed priming involves treating seeds before sowing in order to initiate certain physiological processes associated with germination. Scarification, on the other hand, involves weakening or breaking the seed coat so that water can enter more readily. Previous studies cited in the project report indicate that physical and chemical treatments can considerably improve germination in *Sesbania* species. Mechanical scarification followed by soaking in water, for example, has been reported to produce high germination. Hot-water, acid and chemical treatments have also shown positive effects in earlier studies. Research cited in the report also showed that gibberellic acid (GA_3) treatment could improve germination, while other studies demonstrated benefits from different seed-priming techniques. These findings suggested that selecting an appropriate pre-sowing treatment could make a significant difference to the establishment of *S. grandiflora*.

Putting Different Treatments to the Test

The study was conducted at Sirsi in Uttara Kannada district of Karnataka, an area located in the Western Ghats and known for its rich biodiversity. The study area has an elevation of approximately 611 m above mean sea level and a mean annual temperature of about 23.9°C.
Different approaches were used to treat the seeds. These included:

- **Hydropriming**, in which seeds were soaked in distilled water.
- **Chemical priming**, involving chemical treatments such as sulphuric acid and potassium nitrate, along with other treatments mentioned in the project.
- **Sand-paper treatment**, in which the hard seed coat was mechanically rubbed to facilitate water entry.

The experimental design was a Completely Randomized Design (CRD), with replications used to compare treatments. Germination percentage, number of days required for germination and germination speed were the major parameters considered. The purpose was straightforward: which treatment could help more seeds germinate, and which treatment could help them germinate faster?

The Results: One Treatment Stood Out

The results revealed considerable differences among the seed treatments. Water soaking resulted in 42% germination, with a germination speed of 3.395. Sand-paper treatment also recorded 42% germination, with a slightly higher germination speed of 3.62. Treatment involving ether and gibberellic acid (GA_3) produced 57% germination and a germination speed of 4.55. The most striking result, however, was obtained with concentrated sulphuric acid. Seeds treated with concentrated H_2SO_4 for 10 minutes recorded 70% germination, which was the highest value reported in the experiment. The same treatment also produced the highest germination speed of 5.74. In contrast, potassium nitrate treatment produced only 16% germination, with a germination speed of 1.04, making it the lowest-performing treatment reported in the study. These results demonstrate an important principle in seed technology: the success of germination does not depend simply on treating seeds, but on selecting the right treatment, concentration and duration.

Why Did Acid Treatment Perform Better?

The superior performance of acid treatment can be understood in relation to the hard seed coat characteristic of many leguminous species. Scarification weakens the protective outer layer of a seed, allowing water to enter and initiating the germination process more effectively. In the present study, the concentrated sulphuric acid treatment apparently provided a more effective dormancy-breaking effect than the other treatments tested. The result is consistent with earlier literature cited in the project, where acid scarification was also reported to improve germination of *Sesbania* seeds. The study therefore highlights the importance of overcoming physical barriers to germination. Once dormancy is effectively reduced, seeds can begin the germination process more rapidly and uniformly. However, concentrated sulphuric acid is a highly corrosive and hazardous chemical. Therefore, although the study identified it as the most effective treatment under the tested conditions, such treatment should only be carried out in an

appropriate laboratory or controlled setting by trained personnel using suitable safety procedures.

From Seed to Seedling: Why Faster Germination Matters

At first glance, an increase from 42% to 70% germination may appear to be simply a numerical improvement. In practical forestry and agroforestry, however, better germination can have much wider implications. Higher germination means that more viable seeds can potentially contribute to seedling production. Faster germination can also make nursery operations more predictable and improve the efficiency of raising planting material. For a fast-growing multipurpose tree such as *S. grandiflora*, improved establishment can support its use in agroforestry and soil-improvement programmes. The species is particularly interesting because of its ability to grow under a range of soil conditions and its value as a nitrogen-fixing legume. Thus, seed dormancy research may appear to be a small part of forestry, but it represents an important link between seed biology, nursery management, tree establishment and sustainable land use.

What the Study Tells Us

The experiment provides a simple but important message: breaking seed dormancy can significantly influence the success of seed germination in *Sesbania grandiflora*. Among the treatments reported in the project, concentrated sulphuric acid treatment for 10 minutes produced the best result, recording 70% germination and the highest germination speed of 5.74. Potassium nitrate produced the lowest germination, while water soaking and sand-paper treatment produced intermediate results. The findings support the idea that appropriate pre-sowing treatment can improve germination performance. At the same time, the report notes that germination results can vary depending on factors such as temperature and soaking duration. Further studies could therefore examine different concentrations, treatment durations and combinations of physical and chemical treatments to identify methods that are both effective and practical.

A Small Seed with Big Potential

The story of *Sesbania grandiflora* reminds us that successful tree establishment begins long before a seedling reaches the field. It begins with understanding the seed. A hard or dormant seed may appear inactive, but with the appropriate treatment, its germination potential can be unlocked. The study conducted at Sirsi demonstrates how a relatively simple seed-treatment experiment can provide useful information for improving regeneration of a valuable multipurpose tree. With its rapid growth, adaptability and importance in agroforestry and soil improvement, *S. grandiflora* has considerable potential. Improving its seed germination is one practical step towards making that potential easier to realize. In the world of forestry, sometimes better trees begin with simply giving a seed the right start.

Conclusion

The study on *Sesbania grandiflora* clearly demonstrates that suitable pre-sowing seed treatments can significantly improve both germination percentage and germination speed. Among the treatments evaluated, concentrated sulphuric acid treatment for 10 minutes recorded the highest germination (70%) and germination speed (5.74), indicating its effectiveness in breaking the hard seed coat and overcoming physical dormancy. However, because concentrated sulphuric acid is highly corrosive and hazardous, its use requires appropriate laboratory facilities, trained personnel and strict safety precautions. Improved seed germination can contribute to more efficient nursery production and better establishment of this fast-growing, nitrogen-fixing multipurpose tree. Considering the importance of *S. grandiflora* in agroforestry, soil improvement and sustainable land-use systems, identifying effective and practical dormancy-breaking techniques is valuable. Further studies involving different treatment concentrations, durations and safer alternatives could help develop methods that are both effective and suitable for wider nursery application.