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# Pre-sowing treatment of seeds and its impact on germination of *Gmelina arborea* Roxb

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**Abstract**
Khamer (*Gmelina arborea*) is a fast-growing multipurpose tree belongs to the family Lamiaceae (Verbinaceae). It has multiple uses ranging from particle board, plywood, core stock, furniture, carriages, sports, musical instruments to sawn. It is mainly propagated through seeds but the problem in seed germination is its hard seed coat which limits seed germination. So the present study was carried out at experimental area of Agroforestry plot of Tropical Forest Research Institute, Jabalpur in the year 2021 with an aim to find best pre-sowing treatment for enhancement of germination in *G. arborea*. Seeds were treated with different treatment includes growth regulators ($GA_3$ 100 and 200 ppm), acid scarification ($H_2SO_4$), cold water and untreated seeds as control. Among all the treatments seeds treated with $GA_3$ (200 ppm) recorded the higher germination percentage (98.88%) followed by $H_2SO_4$ (93.33%) as compared to untreated seeds in control.

**Keywords:** *Gmelina arborea*, pre-sowing treatments, dormancy, germination percentage, germination energy

## Introduction
*Gmelina arborea* Roxb. Commonly known as Khamer or white teak, is a light demander deciduous tree native to Asia with global distribution from India to South eastern Asian region and become popular among the farmers and avenue seekers. The tree grows in tropical and subtropical climatic condition of India. Natural regeneration of *G. arborea* was rated high in rainy seasons, it grows in rainfall varying from 750 mm to 4500 mm.
*G. arborea* is a fast growing, multipurpose short rotation, timber yielding species a belongs to the family Lamiaceae (Verbinaceae). It is found throughout greater part of India, Western Ghats, and from foothills of North-West Himalaya to Chittagong & throughout Deccan Peninsula (Central council for Research in Ayurveda & Siddha, 2001) [6]. The tree grows well in sandy loam well drained soil condition and attains height of 15- 20 m (Medicinal Plants Unit Indian Council of Medical Research, 2011) [19]. This plant is planted in gardens for avenue purpose. *G. arborea'* s root. is one of the important ingredients of '*Dashamoola'* and in particular 'Brihath panchamoola' (Murthy, 2012) [21].
The tree form is fair to good, with 6–9 m of branchless, often crooked trunk and a large, low-branched crown. The bark is thin and gray. The fruit is a drupe 2–2.5 cm long and contains 1–4 seeds. The number of seeds per kilogram varies from 1,250 to 2,750 (Kijkar, 2010) [15]. This tree is often planted along agricultural land and on village community lands and wastelands. A light demander and frost hardy tree which shows vigorous growth has good power of recovering from injuries. It is one of the productive timbers of the forests in fact the wood of this species is considered as one of the best timbers (particularly in tropics) because of its multiple uses such as particle board, plywood, core stock, furniture, carriages, sports, musical instruments and sawn. Pulp and paper industries along with fuelwood. In North East India stakeholders to private sectors as well as government sectors has already using *G. arborea* as fodder and industrial wood. It is widely grown as a component of agroforestry system in humid tropics (Verma *et al.*, 2017) [29].
Mensah and Agbagwa (2004) [20], conducted a study on *G. arborea* seeds with different treatments [chemical scarification with concentrated sulphuric acid ($H_2S0_4$), potassium nitrate ($KNO_3$), potassium nitrite ($KNO_2$) and alternating temperature regimes] to evaluate the best treatment for germination of *G. arborea* and found that chemical scarification for 10 minutes with concentrated $H_2S0_4$ was very effective in breaking seed dormancy in the species.
Kayode and Agbebi (2006) [13], examined the effects of immersion in cold water, hot water, conc $H_2SO_4$, vernalization and mechanical scarification on the germination and initial growth

development of *G. arborea* and found that manually scarified seeds had the highest germination percent, followed by cold, hot, vernalization and acid treatments, respectively.
Adebisi and Bello (2015) [1] has studied about fruit maturity, storage period effects on seed germination and seedling vigour attributes of *G.arborea* and resulted that the superiority gain in germination, seedling vigour, seedling shoot length and number of leaves of seeds from yellow brown and brown fruits across storage was 42, 82, 89 and 82%, respectively over seeds from black fruits.
Dijk (1991) [9] studied and reported that the seeds of *G. arborea* are associated with dormancy, which poses very serious limitations to their germination and probably imposes mechanical resistance to the growth of the embryos (Aghatise and Egahreveba, 1994) [2]. The delayed and irregular germination, as observed by Borrer *et al.* (1974) [4], hampers nursery management and efficiency. Thus pre-germination treatments is being considered necessary to break dormancy due to seed coat hardness as it will enable them to germinate uniformly and maintain high germination rates. Keeping the above facts in view, the present study was conducted with the objectives to evaluate pre-sowing treatment, germination percentage and germination energy of *G. arborea* seeds.

## Material and Methods

### Experimental site

The study was conducted at experimental area of Agroforestry plot of Tropical Forest Research institute, Jabalpur (lies between N 23.09 E 79.98 and N 23.10, E 79.98) in the year 2021. The climate of the study area is semiarid, received 1350 mm. rainfall in a year. The mean monthly minimum temperature varies between 5.3 to 6.1°C during December to January, and maximum temperature varies between 40 to 42°C during May to June, respectively, soil condition of experimented area was sandy soil with low nutrient availability.

### Treatment details of field experiment

The seeds of *G. arborea* were collected in the month of April – May, 2021 from selected CPTs at TFRI campus on agronet for dust and moisture free collectuon. Seeds were graded, de-pulped and dried before pre sowing treatment. Polybags having size of 8 X 6 inches were filled with mixture of sand, soil and well rotten FYM in the ratio of 1:2:1 respectively. To facilitate aeration and proper drainage, six perforations were made in polybags before filling them with prepared media mixture. After seed treatment, one seed per polybag was dibbled at 1 cm depth and then covered with a thin layer of soil. Seed treatment details are given below.

### Treatment details

$T_1$ - Untreated seeds (Control)
$T_2$ - Conc. $H_2SO_4$, for 10 minutes
$T_3$ - $GA_3$ (100 ppm), for 24 hours
$T_4$ - Cold water, for 24 hours
$T_5$ - $GA_3$ (200 ppm), for 24 hours

Observations on germination parameters were recorded each day up to one month till its final germination obtained.

### Days to initiation of germination

The polybags were observed daily, for seedling emergence. The days on which the first seedling emerged was expressed as days to initial germination (Sadat *et al.*, 2014) [23].

### Days to 50 percent germination

A number of days taken for 50 percent of the seeds to germinate in entire lot was considered as 50 percent germination (Coolbear *et al.*, 1980) [7].

### Days to final germination

The number of days taken for the last seedling emergence was recorded and expressed as days to final germination (Mauromicale and Cavallaro, 1995) [18].

### Germination percentage

The number of normal seedlings produced in each treatment was counted and average was expressed in percent (ISTA, 2003) [11].

$$\text{Germination percentage (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds sown}} \times 100$$

### Germination energy

Germination energy defined as the percentage by number of seeds in a given sample which germinate within a definite period such as 7 - 14 days under optimum condition was determined by Willan, 1987 [30]. Germination energy is also a measure of the speed of germination and hence, a measure of the vigour of seedlings (Willan, 1993) [31].
The germination energy is estimated by the formula given by Czabator, 1962 [8].

$$\text{Germination energy (\%)} = \frac{\text{Accumulative maximum percentage of germinated seeds}}{\text{Total number of seeds sown}} \times 100$$

### Statistical analysis of data

The experiment was carried out in Randomized Complete Block Design. Data were analyzed by analysis of variance (ANOVA) to detect significant differences between mean (Sheoran *et al.*1998) [5]. Significantly differing mean were tested based on F test value at 0.05 probability level. Variance in data has been expressed as mean ± standard error.

## Results and Discussion

### Germination Period

Seed germination was started from 10$^{th}$ day after sowing which was the initial reading and continued upto 30$^{th}$ day of sowing. The fastest initiation of germination (10th day), minimum period for germination (14 days) in case of seeds treated with 200 PPM $GA_3$ ($T_5$) for 24 hours and maximum days taken for 50 percent germination (20 days) in cold water treatment ($T_4$) for 24 hours and total germination period (28 days) was maximum in untreated seeds (control) i.e. $T_1$ which is shown in table 1, Fig 1. Similar finding was also reported by Maharana *et al.* (2018) [17].

**Table 1:** Effect of pre-sowing seed treatments on germination period of *G. arborea*.

| Treatments | Days to initiation of germination | Days to 50% germination | Days to final germination |
|---|---|---|---|
| $T_1$ - Untreated seeds (Control) | 12.00 | 20.00 | 28.00 |
| $T_2$ - Conc. $H_2SO_4$, for 10 minutes | 10.00 | 15.30 | 20.00 |
| $T_3$ - GA3 (100 ppm), for 24 hours | 10.50 | 16.00 | 19.50 |
| $T_4$ - Cold water, for 24 hours | 11.00 | 18.00 | 23.00 |
| $T_5$ - $GA_3$ (200 ppm), for 24 hours | 10.00 | 14.00 | 18.00 |
| C.D. (0.05) | ** | 3.54 | 3.78 |
| SE(m±) | 0.90 | 1.07 | 1.14 |
| C.V. (%) | 14.62 | 11.10 | 9.10 |

** Non significant

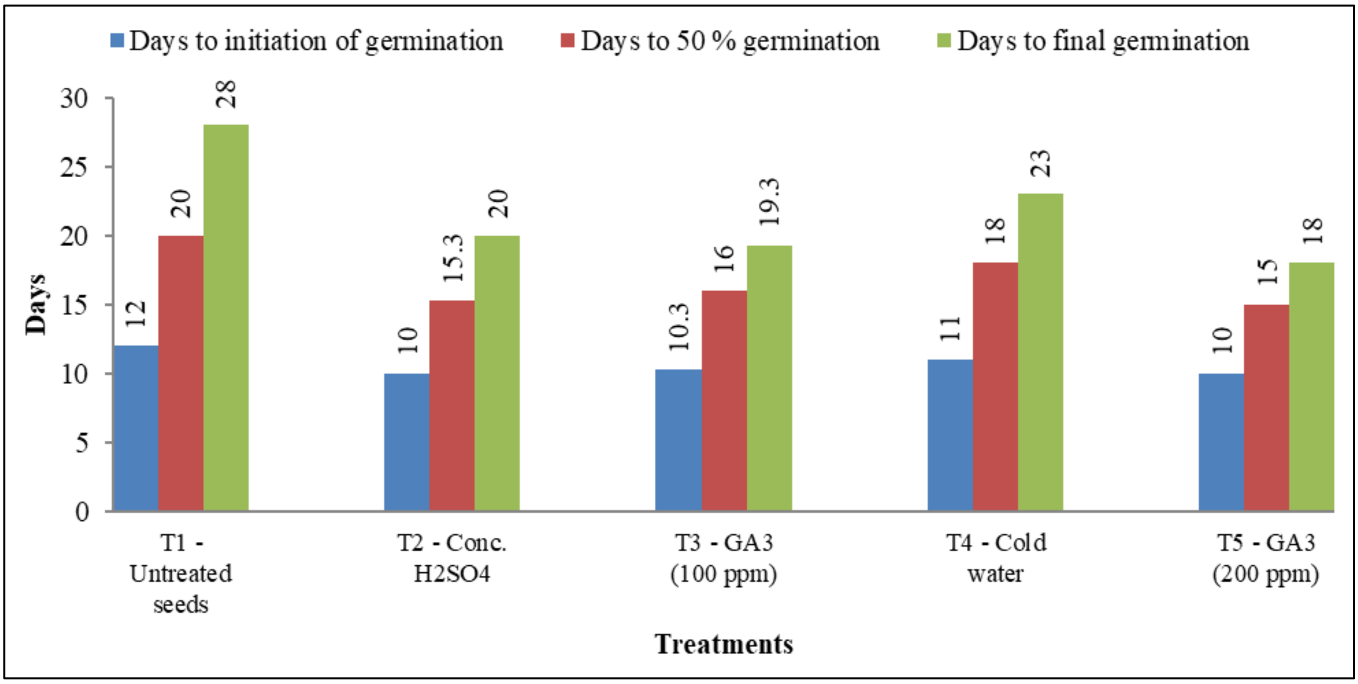


**Fig 1:** Effect of pre-sowing seed treatments on germination characteristics

## Germination percentage

The treatment with $GA_3$ (200 ppm) [$T_5$] was most effective in inducing highest germination percentage (98.88%) followed by $T_2$ i.e. conc. $H_2SO_4$ (93.33%) and $T_3$ i.e. $GA_3$ (100 ppm) (90.00%), the minimum germination percentage was found in both $T_1$ and $T_4$ (80.00%). The sequence of germination percentage is $T_5 > T_2 > T_3 > T_4 = T_1$ and is shown in table 2 and fig. 1. The result is supported by the reports of Sadat *et al.* (2014) [23] in *Cassia fistula*, Mensah and Agbagwa (2004) [20] in seeds of *Gmelina arborea*, Khan (2015) [14] and Thanuja *et al.* (2018) [27] in *P. marsupium*. The improved results in standard nursery media might be due to its high water holding capacity and maintenance of soil temperature with less fluctuation as compared to others. Similar results were also reported by Sondarva *et al.* (2017) [26] in *Khaya senegalensis*, Kumar (2016) [16] in *Terminalia bellerica*, and Sahoo and Thangjam (2017) [24] in *Parkia timoriana*.

**Table 2:** Germination percentage of various pre sowing treatments in *G. arborea* seeds.

| Treatments | Germination Percentage (%) |
|---|---|
| $T_1$ - Untreated seeds (Control) | 80.00 |
| $T_2$ - Conc. $H_2SO_4$, for 10 minutes | 93.33 |
| $T_3$ - $GA_3$ (100 ppm), for 24 hours | 90.00 |
| $T_4$ - Cold water, for 24 hours | 80.00 |
| $T_5$ - $GA_3$ (200 ppm), for 24 hours | 98.88 |
| C.D. (0.05) | 7.62 |
| SE(m±) | 2.30 |
| C.V. (%) | 4.50 |

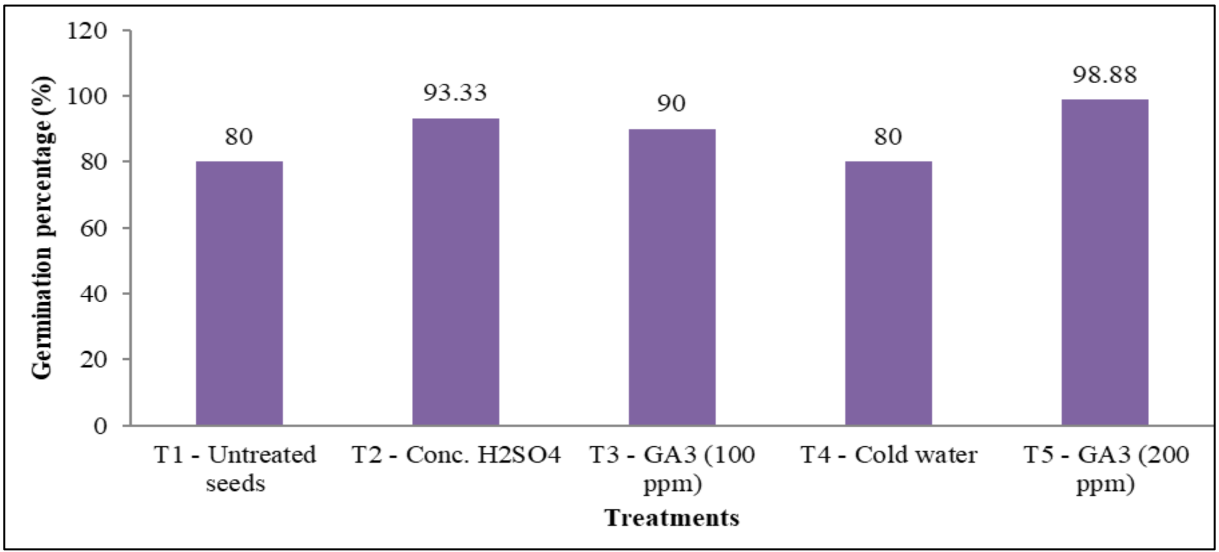


**Fig 2:** Germination percentage of various pre sowing treatments *G. arborea* seeds.

## Germination Energy

Germination energy was determined at 14 days after sowing and ranged between 33.33 to 53.33% (table 3, fig 3). The maximum germination energy 53.33% was observed in $T_5$ ($GA_3$, 200 ppm) followed by $T_3$ i.e. $GA_3$, 100 ppm concentration (48.33%), the minimum germination energy was observed in $T_1$ (untreated seeds) (33.33%). The sequence of germination percentage is $T_5>T_3>T_2>T_4>T_1$. Same result was also reported by Asiedu *et al.* (2012) [3] in *Bauhinia rufescens*. Also treatment $T_5$ which took fewer days to attain 50 and 100% germination rate exhibited greater energy period. Coefficient of velocity of germination increases as more seeds germinate and with shorter germination time (Busso *et al*., 2005) [5] and decreases as less seeds germinate and with a higher germination time (Isfahan and Shariati, 2007) [12].

**Table 3:** Germination energy (%) of various pre sowing treatments in *G. arborea* seeds.

| Treatments | Germination energy (%) |
|---|---|
| $T_1$ - Untreated seeds (Control) | 33.33 |
| $T_2$ - Conc. $H_2SO_4$, for 10 minutes | 46.67 |
| $T_3$ - $GA_3$ (100 ppm), for 24 hours | 48.33 |
| $T_4$ - Cold water, for 24 hours | 35.00 |
| $T_5$ - $GA_3$ (200 ppm), for 24 hours | 53.33 |
| C.D. (0.05) | 11.77 |
| SE(m±) | 3.55 |
| C.V. (%) | 14.21 |

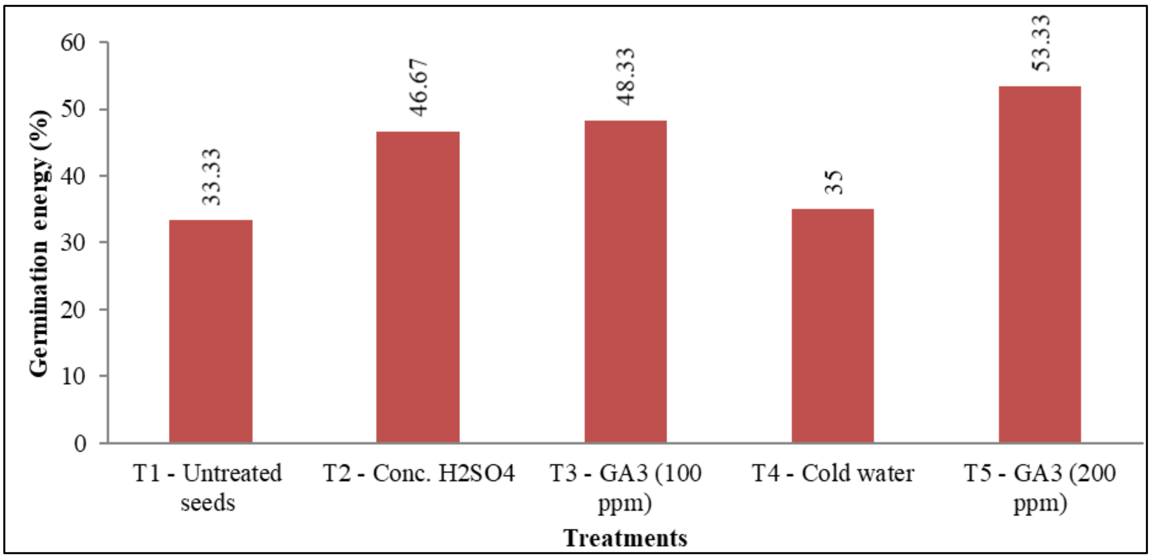


**Fig 3:** Germination energy of various pre sowing treatments *G. arborea* seeds.

The result also suggests that the acid and hormonal treatments also weakened the hardseedness of *G. arborea*. Uniyal and Nautiyal (1992) [28] had reported that availability of water promotes the process of hydrolysis of reserved food materials and thus enhanced seed germination process, all the seeds treated, were soaked in water before planting. Pre-soaking of seeds improves the germination by washing out any inhibiting compound that might be present in the seed (Negi and Singh, 1973) [22].

## Conclusion

In conclusion, results from this study suggest that pre-germination treatments are necessary for commercial plantation of *G. arborea* through seeds and preparation of quality planting material, as these treatments will enhance germination percentage as well as reduce the germination time for uniform wood production.

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