emergent
Life Sciences Research

Research Article

Studies on morphometric traits and effect of pre-sowing treatments in seeds of *Mimusops elengi* L.

K. S. Nikhil, K. S. Venugopala Gowda, B. N. Sathish, Vinayak Upadhya, M. N. Ashwath

Abstract

Mimusops elengi L., (bullet wood) belongs to the family Sapotaceae and is a native tree species of Western Ghats, India. It is well known for its fruit, and fodder and is grown as an ornamental tree. Various parts of the tree are utilized in traditional medicinal practices. In this species, seed germination is rather difficult without pre-seed treatment. Hence, the present study was taken up to analyze the seed morphometric traits namely, seed length, seed width, and seed weight, and also to find the effect of different pre-sowing treatments on seed germination by following standard procedures. The study was conducted at the College of Forestry, Ponnampet, Kodagu district, Karnataka. The average length, width, and thickness of the seeds were 18.09 mm, 12.02 mm, and 6.33 mm, respectively. The maximum seed germination was observed in cold water treatment for 24 hours (34.44%) followed by GA_3 500 ppm (30%) and the minimum was observed in hot water treatment (1.1%). Although the germination was poor in this species, treating the seeds of *Mimusops elangi* with cold water for a day increases the germination by 34.4 percent.

Keywords germination, morphometric characters, pre-sowing seed treatments, Westernghats

Received: 07 April 2024
Accepted: 12 May 2024
Online: 16 May 2024

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Emer Life Sci Res (2024) 10(1): 123-128

E-ISSN: 2395-6658
P-ISSN: 2395-664X

DOI: https://doi.org/10.31783/elsr.2024.101123128

Introduction

India is one of the most diverse biodiversity hotspots globally, boasting an array of indigenous edible fruiting trees within its tropical confines. Among these, *Mimusops elengi* L. (Bakul) holds particular significance, serving multiple purposes including providing fruits and fodder, enhancing ornamental landscapes, and featuring prominently in traditional medicinal practices [1]. Belonging to the Sapotaceae family, *M. elengi* is native to the Western Ghats region of peninsular India. It is a slow-growing, large, evergreen tree primarily found in the Western Ghats, the dry evergreen forests of the Eastern Ghats, as well as in Andaman, Myanmar, and Sri Lanka. On the other hand, tropical and subtropical areas across the world are now home to this tree as well [2]. *M. elengi* holds a sacred status finding mention in religious texts and ancient Sanskrit literature. Its fragrant flowers are celebrated in the Puranas and revered akin to the flowers of the Hindu paradise [3]. The overexploitation of the species for its pharmacological and therapeutic qualities has put it in danger of extinction, despite its ecological and cultural significance. This has led to its inclusion in the IUCN Red List as a threatened species in the 2018 assessment. The main reasons it is threatened with extinction are fruit gathering and tree cutting, which prevents seeds from sprouting in their native environments.

When the tree reaches maturity, it will be between thirty and forty meters tall, with broad branches and thick, glossy, oval-shaped, narrow, pointed leaves. These leaves are recognized for their anti-toxic properties and have been historically employed by Sushrutha during instances of poisoning. The tree produces tiny fragrant flowers varying in color from white to yellow, with flowering typically occurring during the summer months and fruit ripening taking place from December to February. The fruit, an edible berry, is ovoid with a yellowish hue, while the seeds are greyish-brown, ovoid, and lustrous. Oil extracted from the seeds is utilized for cooking [4]. The wood of this species is prized for its strength and durability, commonly utilized in construction projects and for crafting tool handles, vehicle components, railway sleepers, and furniture. Seeds weigh approximately 1500–2000 seeds per kilogram, but due to their recalcitrant nature, they rapidly lose viability. Fresh seeds boast a 90% germination rate, with a common pre-planting practice involving soaking to soften their tough outer layer.

Despite its significant medicinal properties and the edibility of its fruits, information regarding the propagation of this species through seeds remains limited. It has been noted that seed propagation presents challenges, particularly without appropriate pre-treatment. Hence, the present study aims to investigate seed morphometric traits such as length, width, and weight and evaluate the impact of various pre-sowing treatments on seed germination following standard procedures.

Methodology

The study was conducted in the College of Forestry, Ponnampet, Kodagu district of Karnataka state in the year 2021. It is situated at 12 08’41.03” N latitude and 75 56’42.50” E longitude with an altitude of 867 m. The average rainfall of 2400 mm and the temperature varies from 10.5 °C in January to 34 °C in April. Seeds were collected from the nearby forest in Ponnampet, Kodagu. To record findings on various seed parameters, 100 healthy seeds were chosen at random. Average length (mm), width (mm), and thickness were measured using a digital calliper. 100 seeds weight (g) was measured using an electronic weighing balance. The germination study was carried out as follows (Table 1).

Table 1. Different pre-sowing seed treatment

Codes.	Treatments
T1	Cold water soaking for 24 hours
T2	Cold water soaking for 48 hours
T3	Hot water treatment (2 minutes)
T4	Gibberellic acid of 500 PPM (1 hour)
T5	Gibberellic acid of 1000 PPM (1 hour)
T6	Cow dung slurry (soaking for 1 day)
T7	Control (without any treatment)

Effect of pre-sowing treatments on germination

Seven different pre-sowing seed treatments were included in the completely randomized design (CRD) experiment, which had three replications. A total of 630 seeds stored for a month after collection were sown in the sand bed among all treatments, using 30 seeds per replication.

Collection of data and estimation of germination parameters

The daily germinated seeds were recorded and based on the germination count; we calculated the following parameters [5-6].

$$\text{Germination Percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} X\ 100$$

$$\text{Mean daily Germination (\%)} = \frac{\text{Cumulative germination per cent}}{\text{Total number of days}}$$

$$\text{Peak Value (PV)} = \frac{\text{Total germination per cent}}{\text{Number of days required to reach the peak germination}}$$

$$\text{Germination value} = \text{Mean daily germination x Peak value}$$

The data collected on various parameters were subjected to statistical analysis using SPSS software. Analysis of Variance was done to compare the mean and to know the extent of deviation from mean values.

Results

Seed morphometric characters

After collection, the seeds were carefully separated from inert materials, and 100 robust seeds were selected for morphological analysis. Table 2 presents the average measurements of length (18.09 mm), width (12.02 mm), and thickness (6.33 mm); the maximum length (21.78 mm), width (13.09 mm), and thickness (7.21 mm) and the minimum length (13.65 mm), width (10.21 mm), and thickness (5.85 mm) recorded. The total weight of the 100 seeds was found to be 49.3 grams.

Table 2. Mean values seed morphometric characters

S.N.	Observations		Value	Range
1	Seed Size	Average length (mm)	18.09	13.65-21.78
		Average width (mm)	12.02	10.21-13.09
		Average thickness (mm)	6.33	5.85-7.21
2	100 Seeds Weights (g)		49.3	

Effect of pre-sowing treatments on seed germination

Various germination attributes including germination percentage, mean daily germination, peak value, and germination value were computed from the germination data recorded on a daily basis to evaluate the impact of different treatments on germination variations. Table 3 and Figure 1,

Table 3. Influence of pre-sowing treatments on germination parameters of *M. elengi*

S.N.	Treatments	Germination percentage (%)	Germination Initiation period (Days)	MDG (%)	Germination speed	Peak value	Germination termination period (Days)	Germination value
1	T1	34.44	28	1.24	1.72	1.49	25	1.85
2	T2	17.78	30	0.67	0.81	0.84	22	0.51
3	T3	1.10	31	0.04	0.65	0.15	20	0.01
4	T4	30.00	28	1.08	1.33	1.36	25	1.47
5	T5	27.77	29	1.00	1.23	1.25	24	1.26
6	T6	5.55	31	0.25	0.73	0.37	21	0.07
7	T7	22.22	29	0.82	0.94	1.01	24	0.83
Mean		**19.81**		**0.77**	**1.06**	**0.92**		**0.86**
SEM ±		**1.79**		**0.05**	**0.05**	**0.07**		**0.09**
CD 5%		**5.3**						

illustrate the disparities in the effect of seed treatments on germination percentage. Among the diverse seed treatments, soaking in cold water for 24 hours (T1) exhibited the highest germination percentage (34.4%), followed by treatments with GA_3 at 500 ppm for one hour (30%), GA_3 at 1000 ppm for one hour (27.77%), control (22.2%), soaking in cold water for 48 hours (17.78%), cow dung slurry treatment (5.55%), and hot water treatment. Through a comparison using critical difference (CD) values @ 5% probability, the results indicated the significance of T1 when compared with T4, T5, T7, T2, T6, and T3. Although numerically low, the maximum mean daily germination, germination speed, peak value, and germination value were observed in seeds subjected to cold water soaking for 24 hours, followed by treatments with GA3 at 500 ppm for 1 hour, GA3 at 1000 ppm for 1 hour, the control group, soaking in cold water for 48 hours, cow dung slurry treatment, and hot water treatment.

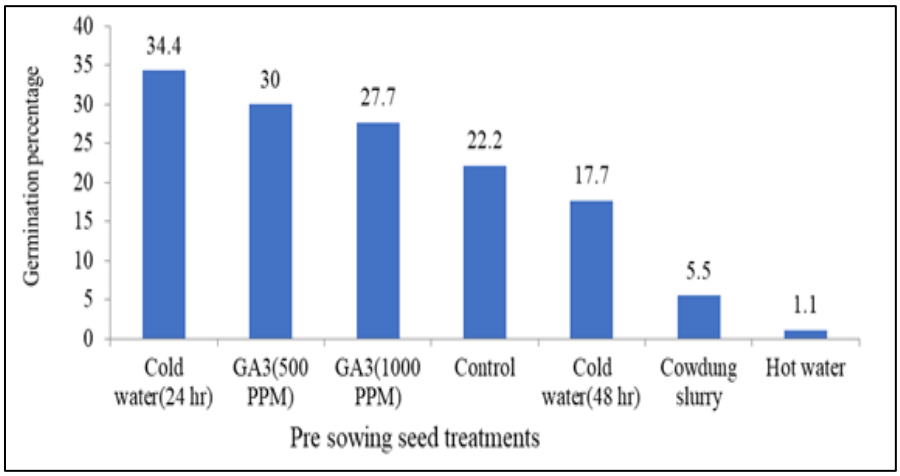

Figure 1. Germination percentage of different pre sowing treatments

Discussion

The *M. elengi*, a tropical tree species, bears edible fruits and blossoms twice annually, although it is not widely recognized. Typically, its solitary fruits contain a single seed [7]. Numerous research endeavors have demonstrated that seed size plays a pivotal role in the germination and growth rates of specific crops and forest tree species. Larger seeds of *M. elengi* have shown higher germination and growth rates compared to smaller ones [8]. A comprehensive analysis of 100 seeds revealed an average weight of 49.3 g, with length, width, and thickness of 18.09 mm, 12.02 mm, and 6.33 mm, respectively. Disparities in seed weight may also stem from variations in the genetic composition of parent material, as certain species exhibit genetically controlled seed characteristics [9-11]. Additionally, external factors such as rainfall, temperature, wind, and relative humidity may contribute to variations in seed weight [12]. Numerous elements, including the location of the seed within the pod and on the tree, can affect germination and the development of seedlings [13], as well as its orientation during sowing, as noted by Swaminathan et al., [6] in *Pongamia pinnata*. Their results showed that when pongamia seeds were sown vertically with the micropyle pointing downward, 92% of the seeds germinated. According to our investigation, a 24-hour (T1) cold water treatment broke the dormancy of the seeds, increasing the percentage of germination (34.4%). Comparably, cold water treatment for six hours produced maximum germination in *M. elengi*, with over 80 percent germination [6].

However, hot water treatment during the investigation did not positively influence seed germination, possibly due to embryo damage caused by high temperatures, as reported by Ashwath et al., and Gami et al., and [5, 14]. T1 (cold water treatment for 24 hours) exhibited the highest mean daily germination and peak value, followed by T4 (GA3 500 ppm for 1 hour). These findings align with research conducted by Abeje and Esayas [15], who observed increased mean daily germination and peak values with cold-water treatment in *Balanites aegyptiaca* and *Cordia africana*. The study findings align with

observations in *Senna spectabilis* by Zembele and Ngulube [16], emphasizing the efficacy of 24-hour cold water treatment across different plant species.

Conclusion

Over time, the use of *M. elengi* fruits has declined since ancient times, with many fruits dropping to the ground, where they are often wasted or consumed by birds and other animals. Despite being low in calories, these fruits are nutrient-rich. However, seed germination in this species varies regionally due to factors such as tough seed coats and low germination rates, compounded by relatively short seed viability. Nonetheless, seed production potential ranges from medium to heavy, influenced by climatic conditions. Pre-sowing seed treatment enhances embryo growth, shortens germination time, weakens seed outstart, and boosts successful germination rates. Since pre-sowing treatments significantly affect seedling growth across various fruit crops, incorporating seed morphometry and pre-sowing treatments is advisable for future propagation and multiplication programs of this important forest tree. With each kilogram of *M. elengi* containing 1500-2000 seeds, the required seed quantity for the plantation can be accurately calculated. Among various treatments, cold water treatment for 24 hours yields a germination percentage (34.44%), making it the recommended treatment for large-scale plantations to produce superior planting material.

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