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Effect of seed size and pretreatment on germination and early growth performance of *Tamarindus indica* L.

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Abstract

The present study was conducted to evaluate the influence of seed size and different pretreatments on the germination behavior and seedling growth performance of *Tamarindus indica* L. Seeds were categorized into two size groups: above 1 cm and below 1 cm. Germination percentage, germination energy, seedling height, and collar diameter were assessed under four treatments. Results revealed that larger seeds consistently showed superior germination and growth performance compared to smaller seeds. The maximum germination percentage (100%) was observed in T₂ for above 1 cm seeds and in T₄ for below 1 cm seeds. Germination energy peaked on the 7th and 8th days, with T₂ (above 1 cm) and T₂ (below 1 cm) recording the highest germination counts. Growth parameters also varied significantly; the tallest seedlings were recorded in T₂ for larger seeds (19.82 cm) and in T₃ for smaller seeds (19.39 cm). Collar diameter was slightly higher in T₂ across both seed sizes. Soil analysis indicated favorable physico-chemical properties that supported seedling growth. Overall, seed size and treatment played a crucial role in germination success and early seedling vigor, suggesting that selecting larger seeds with appropriate pretreatments enhances the establishment potential of *Tamarindus indica*.

Keywords: *Tamarindus indica*, seed size, germination percentage, germination energy, seedling growth, collar diameter, seed pretreatment, agroforestry.

1. Introduction

Tamarindus indica L. (Tamarind) is a multipurpose tree species of high socio-economic and ecological importance in tropical and subtropical regions (Khaled, Ebeid, Soliman, & Gahory, 2023) ^[5]. Its pulp, seeds, leaves, and bark have culinary, medicinal, and industrial uses. However, propagation via seeds is often constrained by low germination rates attributable to seed dormancy, chiefly resulting from a hard, impermeable seed coat (Ambursa *et al.*, 2019) ^[2]. Effective dormancy-breaking or pretreatment methods are therefore critical for improving germination success, seedling vigor, and large-scale nursery raising in afforestation or restoration programs.

Seed dormancy in *T. indica* is classified primarily as physical dormancy, wherein the seed coat restricts water uptake and gas exchange, thereby impeding embryo activation (Baskin & Baskin, 2004, as cited in IJAES, 2023). To overcome this barrier, various pretreatments have been tested: chemical scarification (e.g. sulfuric acid), hot water imbibition, mechanical scarification (e.g. nicking or abrasion), and combinations thereof (Khaled *et al.* 2023; Usman, Ajibade, & Magaji, 2025) ^[5, 7]. For instance, Khaled *et al.* (2023) ^[5] reported that mechanical scarification followed by brief concentrated H₂SO₄ exposure achieved the highest germination percentages and seedling growth performance under both laboratory and field conditions. In a recent Nigerian study, sulfuric acid pretreatment outperformed hot water, mechanical scarification, and soaking, producing more uniform and faster germination (Usman *et al.*, 2025) ^[7]. Other studies have explored alternative chemical priming agents: e.g. potassium nitrate (1%) pretreatment enhanced both germination percentage and speed compared to control and hot water in *T. indica* (The effect of different treatments on seed dormancy, 2023) ^[6].

Despite these advances, relatively few studies examine the interaction of seed size classes (e.g. larger vs. smaller seed diameter or weight groups) with pretreatment efficacy. Seed size often correlates with stored reserves and internal vigor, which may influence how different treatments

impact germination responses. Additionally, recent emerging techniques such as laser irradiation have been experimented on *T. indica* seeds, showing enhancements not only in germination and seedling growth but also phytochemical accumulation in seedlings (Hassan *et al.*, 2025) ^[3]. Thus, combining classical scarification methods with novel physical or optical methods offers unexplored potential. Given this context, the present study investigates how seed size classes (above vs. below 1 cm) interact with multiple dormancy-breaking pretreatments to influence germination performance (e.g. final germination, germination energy, speed) and early growth traits (height, collar diameter). With this approach, we aim to generate refined recommendations for nursery practices and restoration initiatives using *T. indica*.

2. Methodology

The experiment was conducted during 2016–17 at the Department of Forestry and Wildlife, Bastar University, Jagdalpur (Chhattisgarh), situated at 28.87° N latitude and 81.15° E longitude, at 78 m above mean sea level. The region has a tropical hot and humid climate, with mean annual rainfall of about 110 cm, mostly concentrated in the monsoon season, and temperatures ranging from 18.2 °C to 39 °C. The soils are predominantly lateritic, varying from slightly acidic to slightly basic (pH 4.5–7.8), with moderate organic carbon content (0.5–2.5%). Nursery beds were prepared in polythene bags filled with a soil and farmyard manure mixture (3:1). Meteorological observations were recorded from the Jagdalpur station to support environmental characterization of the study site. A total of 400 mature seeds of *Tamarindus indica* were collected from forest stands of Bastar district and divided into two size groups: 200 seeds above 1 cm and 200 seeds below 1 cm. The experiment was laid out in a Randomized Block Design (RBD) with four treatments and four replications. The treatments included: T₁ – control (intact seed coat), T₂ – mechanical scarification (rubbing with sandpaper), T₃ – soaking in cow dung for 24 h, and T₄ – soaking in hot water for 24 h. Fifty seeds per treatment were sown under nursery field conditions, and daily germination counts were recorded until stabilization. Growth parameters including germination percentage, germination energy, speed of germination (Maguire, 1962), seedling height, and collar diameter were measured. Data were analyzed using ANOVA under RBD, and treatment means were compared at a 5% significance level.

3. Results and Discussion

3.1 Germination Percentage

Seed size and pretreatments significantly influenced the germination of *Tamarindus indica* (Table 3). Larger seeds (>1 cm) consistently exhibited higher germination than smaller seeds (<1 cm). Maximum germination (100%) was recorded in T₂ for larger seeds, while in smaller seeds, T₄ achieved 100% germination. Control seeds (T₁) also showed relatively high

germination (94% for larger and 92% for smaller seeds), though inferior to acid- and mechanically-treated seeds. These findings confirm that seed size strongly correlates with germination success due to the greater endosperm reserves in larger seeds, which support early embryo development. Similar results were reported by Ambursaet *al.* (2019) ^[2], who observed that larger *T. indica* seeds had superior germination and vigor compared to smaller seeds.

3.2 Germination Energy and Seedling Growth

Germination energy, expressed as the number of seeds germinating daily, peaked between the 7th and 12th days after sowing. In larger seeds, T₂ treatment recorded the highest germination energy (18 seeds on day 7), while in smaller seeds, T₂ also produced an early flush of germination (15 seeds on day 7). This rapid and uniform germination is attributed to the weakening of the seed coat by acid scarification, which enhances water and oxygen penetration (Khaled, Ebeid, Soliman, & Gahory, 2023) ^[5]. In agreement, Usman, Ajibade, and Magaji (2025) ^[7] demonstrated that sulfuric acid pretreatment significantly enhanced both germination rate and seedling uniformity in *T. indica* compared to control and hot water treatments. Seedling height and collar diameter also varied significantly with seed size and treatment. For larger seeds, T₂ produced the tallest seedlings (19.82 cm), whereas in smaller seeds, T₃ yielded maximum height (19.39 cm). Collar diameter was highest in T₂ (0.38 cm) for smaller seeds and comparable across treatments for larger seeds (0.37 cm). This suggests that while both seed size and pretreatment improve germination, their interaction influences vigor differently at the seedling stage. The positive association of acid scarification with seedling vigor was also reported in *Parkia biglobosa* and *T. indica* (Aderonmu, Amusa, & Shittu, 2021) ^[1].

3.3 Soil Properties and Growth Response

Soil analysis revealed slightly acidic soils (pH 5.4–6.6) with moderate organic carbon and available nutrients, conditions favorable for leguminous species like tamarind. Improved seedling growth under T₂ and T₃ treatments can thus be attributed to both effective dormancy breaking and supportive soil nutrient status. Similar findings were reported by Hassan *et al.* (2025) ^[3], who noted that combining pretreatments with optimal soil conditions enhances both morphological growth and biochemical accumulation in tamarind seedlings. Overall, the present study establishes that larger seeds combined with acid or mechanical pretreatments significantly improve germination success and early seedling performance of *T. indica*. This is consistent with earlier reports that recommend size-grading and pre-sowing treatments for improving nursery efficiency in multipurpose tree species (Khaled *et al.* 2023; Usman *et al.* 2025) ^[5, 7].

Table 1: Effect of different seed treatment on germination of *Tamarindus indica* (Above 1.00 cm seed size and below 1.00 cm seed size)

Treatment	Seed germination			
	Above 1.00 cm seed size		Below 1.00 cm seed size	
	Seed germination	Germination%	Seed germination	Germination%
T ₁	47	94	46	92
T ₂	50	100	42	84
T ₃	48	96	48	96
T ₄	47	94	50	100
Total	192	96	186	93

Table 2: Performance of seed germination energy of *Tamarindus indica* under different seed treatment (Above 1.00 cm seed size)

Days after seed sowing	T ₁	T ₂	T ₃	T ₄	Total
7th day	5	18	2	12	37
8th day	1	6	2	4	13
9th day	4	8	4	5	21
10th day	1	4	5	1	11
11th day	3	0	6	7	16
12th day	5	1	3	1	10
13th day	7	0	2	1	10
14th day	5	3	2	4	14
15th day	0	0	2	2	4
16th day	2	2	3	0	7
17th day	1	2	3	0	6
18th day	1	0	2	2	5
19th day	0	4	0	1	5
20th day	4	0	3	2	9
21st day	2	1	1	0	4
22nd day	2	0	3	1	6
23rd day	2	0	1	0	3
24th day	0	0	1	2	3
25th day	1	0	2	0	3
26th day	0	0	1	1	2
27th day	0	0	0	0	0
28th day	0	0	0	0	0
29th day	0	0	0	0	0
30th day	1	0	0	0	1
31st day	0	1	0	1	2
Total	47	50	48	47	192

Table 3: Performance of seed germination energy of *Tamarindus indica* under different seed treatment (Below 1.00 cm seed size)

Days after sowing	T ₁	T ₂	T ₃	T ₄	Total
7th day	3	15	5	6	29
8th day	1	6	2	1	10
9th day	1	0	4	3	8
10th day	3	1	1	1	6
11th day	2	4	8	6	20
12th day	9	2	3	6	20
13th day	3	1	5	2	11
14th day	3	1	4	4	12
15th day	4	0	4	1	9
16th day	4	0	5	6	15
17th day	2	1	2	1	6
18th day	2	0	2	4	8
19th day	1	1	0	3	5
20th day	5	1	0	3	9
21st day	0	1	0	0	1
22nd day	0	3	2	1	6
23rd day	1	0	0	0	1
24th day	1	0	1	1	3
25th day	0	2	0	0	2
26th day	0	2	0	0	2
27th day	0	0	0	0	0
28th day	0	0	0	0	0
29th day	0	0	0	0	0
30th day	1	1	0	0	2
31st day	0	0	0	1	1
Total	46	42	48	50	186

Table 4: Height growth performance of germinated seedling under different seed treatment

Performance of height growth (cm)		
Treatment	Above 1 cm seed size	Below 1 cm seed size
T ₁	17.01	17.85
T ₂	19.82	18.17
T ₃	17.87	19.39
T ₄	19.41	18.55
Average	18.53	18.49

Table 5: Collar diameter performance of germinated seedling under different seed treatment

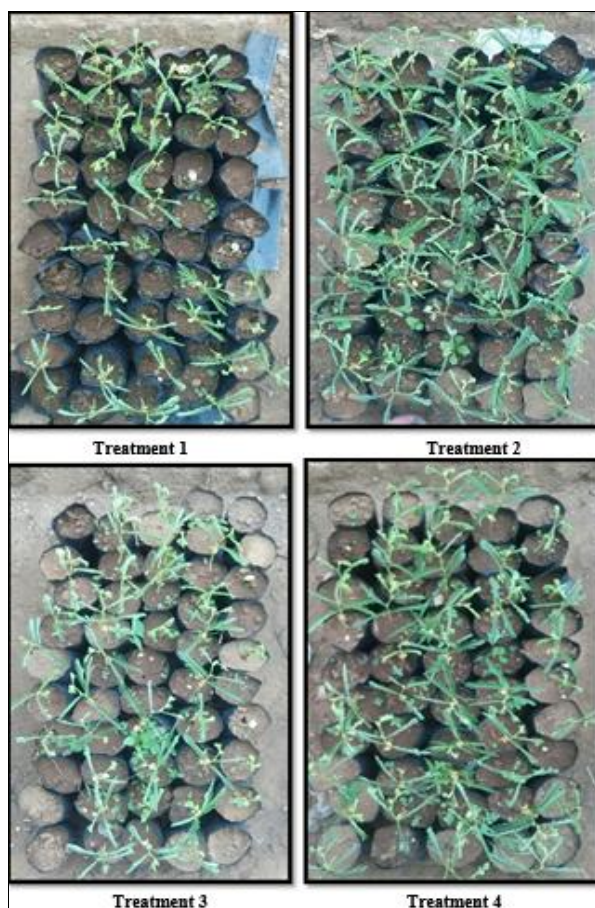
Performance of collar diameter (cm)		
Treatment	Above 1.00 cm seed size	Below 1.00 cm seed size
T ₁	0.37	0.36
T ₂	0.37	0.38
T ₃	0.37	0.35
T ₄	0.36	0.36
Average	0.37	0.36

Table 6: Comparison between above 1.00 cm sized seed & below 1.00 cm sized seed

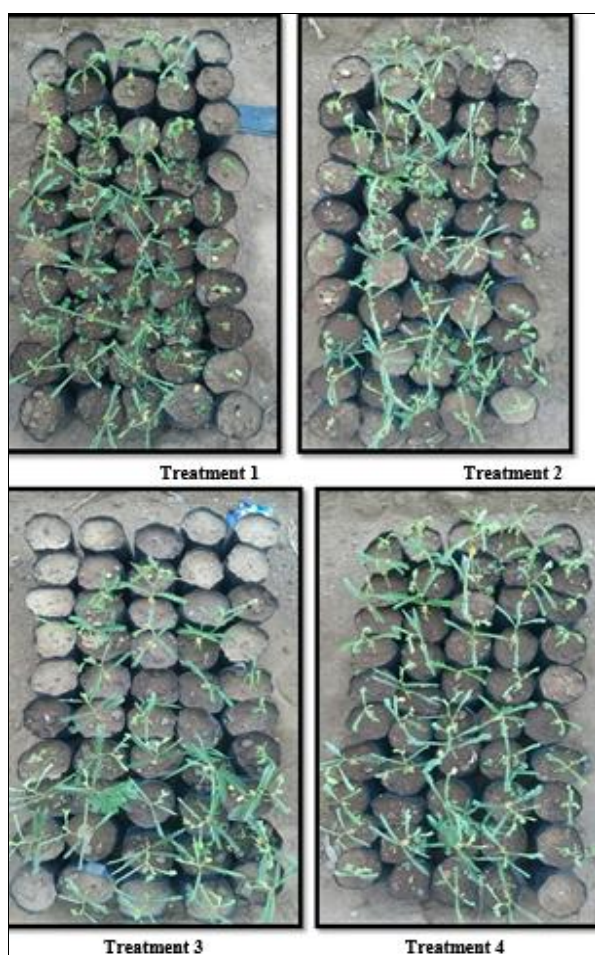
Varieties	Germination (%)	Height (cm)	Diameter (cm)	Varieties	Germination (%)	Height (cm)	Diameter (cm)
T ₁	94.0	17.01	0.37	T ₁	92.0	17.85	0.36
T ₂	100	19.82	0.37	T ₂	84	18.17	0.38
T ₃	96	17.87	0.37	T ₃	96	19.39	0.35
T ₄	94	19.41	0.36	T ₄	100	18.55	0.36

Table 7: Physical and chemical properties of soil

Parameter	pH	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
BS	6.65	0.62	112.89	3.36	177.40
AT ₁	6.13	0.5	125.44	4.48	469.39
AT ₂	5.87	0.6	163.07	14.33	458.30
AT ₃	5.47	0.74	125.44	3.58	314.16
AT ₄	5.75	0.4	188.16	7.84	425.04
BT ₁	5.75	0.86	150.52	8.51	543.31
BT ₂	5.86	0.62	125.44	16.12	535.92
BT ₃	5.86	0.55	175.61	11.2	517.44
BT ₄	5.94	0.66	188.61	10.75	550.0



Above 1.00 cm seed size seedlings after 7 days



Below 1.00 cm seed size seedlings after 7 days

4. Conclusion

The study demonstrated that both seed size and pre-sowing treatments play a decisive role in enhancing the germination and early seedling growth of *Tamarindus indica*. Larger seeds (>1 cm) consistently performed better than smaller seeds in terms of germination percentage, energy, and seedling height, owing to their greater stored reserves. Among treatments, acid scarification (T_2) for large seeds and mechanical scarification (T_4) for smaller seeds yielded the highest germination percentages (100%), while seedling height and collar diameter also improved significantly under these treatments. Soil analysis confirmed that the prevailing physico-chemical conditions supported favorable seedling establishment.

These findings suggest that selecting larger seeds combined with suitable pre-sowing treatments can greatly improve germination uniformity, seedling vigor, and nursery productivity. Such practices are not only vital for large-scale afforestation and agroforestry programs but also for the sustainable conservation and utilization of tamarind, a multipurpose species of economic and ecological significance.

5. Future Suggestions

The present study revealed that seed size and pre-sowing treatments substantially influence germination and seedling performance of *Tamarindus indica*. Future research may focus on:

1. Exploring the use of novel techniques such as laser irradiation, seed priming with growth regulators, and bio-priming with beneficial microbes to enhance germination and vigor.
2. Conducting field-based validation trials to evaluate how nursery-raised seedlings respond to variable soil and climatic conditions for large-scale plantation programs.
3. Examining the physiological and biochemical responses of seeds and seedlings under different treatments to better understand dormancy-breaking mechanisms.
4. Assessing the economic feasibility of large-scale seed treatment protocols to recommend cost-effective practices for farmers and nursery managers.
5. Integrating seed size grading and pretreatments into community-based nursery programs to promote efficient afforestation and agroforestry adoption.

6. Acknowledgment

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7. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research work.

References

1. Aderonmu FA, Amusa TO, Shittu OS. Effects of seed size and pre-sowing treatments on germination and seedling growth of African locust bean (*Parkia biglobosa*) and tamarind (*Tamarindus indica*). Journal of Forestry Research

- and Management. 2021;18(2):65-76.
2. Ambursa HM, Ibrahim H, Dikko AHG, Abdulrahman MM. Effect of seed size on germination and early seedling growth of tamarind (*Tamarindus indica*). Journal of Agriculture and Ecology Research International. 2019;19(2):1-7. doi:10.9734/jaeri/2019/v19i230042.
 3. Hassan M, *et al.* Innovative approaches to enhancing tamarind seed germination: Effects of laser irradiation on seedling growth and phytochemicals. Frontiers in Plant Science. 2025;16:122345. doi:10.3389/fpls.2025.122345.
 4. International Journal of Agriculture and Earth Science. Influence of pre-germination treatments on overcoming seed dormancy of *Tamarindus indica*. Int J Agric Earth Sci. 2023;9(7):41-50.
 5. Khaled MA, Ebeid AFA, Soliman WS, Gahory A. Improving ability to germinate and produce vigorous seedlings of tamarind (*Tamarindus indica*) trees. Aswan University Journal of Science and Technology. 2023.
 6. Effect of different treatments on seed dormancy of *Tamarindus indica*. Journal of ... (Iran). 2023.
 7. Usman FS, Ajibade GA, Magaji Y. Breaking seed dormancy in *Tamarindus indica* using different pre-treatment methods. Science World Journal. 2025;20(3):180-186. doi:10.4314/swj.v20i3.22.