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Influence of presowing treatments on seed germination, seedling growth, and early development of teak (*Tectona grandis*)

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Abstract
Teak, a majestic timber cherished worldwide for its durability and rich golden hue, stands out as one of the most iconic industrial woods. The survival of this remarkable tree species is intricately intertwined with the ebb and flow of public demand, responding to the ever-changing needs of consumers. As global fascination with teak continues to rise, a wave, diving deep into the mysteries of nature to uncover specific microclimates that can dramatically boost the growth and vitality of this extraordinary tree. The study was carried out in an agroforestry nursery at Medicaps University in Indore, Madhya Pradesh, in 2024-2025. Under this research work, we analyzed various data related to commercial cultivation as well as the early development of *Tectona grandis* under six different seed presowing treatments, namely. (T_1) For 48 hours, seeds were submerged in hot water. (T_2) For seventy-two hours, seeds were submerged in cold water, (T_3) For 10 minutes, seeds were submerged in 80% H_2SO_4, (T_4) Seeds were submerged in Cow dung slurry for 24 hours, (T_5) seeds were submerged in GA_3solution (150 ppm) for 24 hours, and (T_6) Control. After five months, the seedlings' performance was evaluated. The findings revealed that the highest germination percentage, at 36.13%, was observed in T_3, where seeds were treated with H_2SO_4. Additionally, T_5, which involved seeds treated with a GA_3 solution, recorded the greatest collar diameter (1.40 cm), root length (30.73 cm), and seedling height (30.06 cm). In contrast, T_6, the control group, performed the least favorably. The study concluded that a 10-minute treatment with concentrated H_2SO_4 (80%) effectively enhances seed germination by breaking dormancy, while GA_3-treated seeds produce notably healthier seedlings.

Keywords: Seed treatment, water soaking, germination percentage, growth, and development

Introduction

Tectona grandis, commonly known as teak, was first formally described by Carl Linnaeus the Younger in 1782 in his work Supplemental Plantarum (Cardoso, 2015) [7]. This deciduous tree is characterized by its glossy upper leaf surfaces, hairy undersides, and relatively large leaves. In Hindi, it is referred to as "Sagwan," while in Assamese, it is known as "Segun." The first teak plantation was established in Nilambur, Kerala, by Conolly and Chotu Menon. Research indicates that the Sagwan tree is a valuable hardwood species (Choudhari and Prasad, 2018; Palanisamy, 2009) [8, 34] recognized for its exceptional physical properties (Venkatesh *et al.*, 2024; Midgley *et al.*, 2015) [46, 29], resilience, and aesthetic appeal, making it suitable for use in the development of degraded lands (Sanwo, 1987) [38]. Teak wood is notable for its moderate specific gravity, remarkable mechanical strength, and outstanding dimensional stability (Freitas, 1958) [11]. It also boasts corrosion resistance (Colbu *et al.*, 2021) [9] and is easy to process, offering good seasoning performance (Adetan, 2019) [1]. Additionally, teak wood is highly regarded for its weathering resistance and durability against decay (Bailleres and Durand, 2000).

Even though teak is valued for its high market value and is considered a superior species in many regions due to its quick growth and flexible seedling establishment (Indra and Basha, 1999), private farm teak cultivation is frequently hampered by its naturally low and irregular germination rates, which were identified by Jackson (1994) [18] due to the protected and irregular germination of untreated drupes. The low and inconsistent germination rates (Kollert and Kleine, 2017) [23] of teak not only result in the availability of seedlings and degraded timber quality but also escalate the management costs of teak nurseries. Research conducted by Adhikari *et al.*, (2021) [2] and Sudhakara and Jijeesh (2008) [41] clearly demonstrates that seed size and moisture content are critical factors influencing the germination of teak seeds, and they play a decisive role in causing seed dormancy.

Their morphological/physiological dormancy significantly influences teak true seed germination in addition to their mechanical and physical dormancy, as reported by Venkatesan *et al.*, (2024) [45]. Foresters face the challenge of finding a simple and efficient pre-seed treatment method for teak seed germination that reduces seedling failure rates. This is especially crucial because, although pre-sowing hydro-priming facilitates water absorption, activating and mobilizing enzymes, and providing access to stored nutrients, which may improve germination, many researchers have shown that such treatments can significantly increase the germination percentage of teak seeds (Palani *et al.*, 1996; Billah *et al.*, 2015) [33, 6]. Therefore, the goal of the study is to determine the best ways to break the dormancy of *T. grandis* seeds and to determine their germinability parameters and early seedling growth under nursery conditions.

Materials and Methods

The experiment was conducted in the agroforestry nursery, Medicaps University, Indre (M.P.), during the years 2024-2025. The study aimed to evaluate the impact of presowing seed treatments on the germination parameters and seedling initial growth of *Tectona grandis*. The site is located at 22°37′16.9″N latitude and 75°48′13.8″E longitude, standing 545 meters above mean sea level. The area has a mix of semi-arid and humid subtropical climates, featuring hot summers with temperatures between 25°C and 42°C and mild winters where temperatures range from 8°C to 28°C. The rainfall is approximately 700 mm to 950 mm. The soil in the area varies from medium black soil to shallow black, with a pH range of 7.0 to 8.5.

Trees with ideal morphological characteristics, such as vigorous height, optimal crown, and moderate tree age with high seed yield, were selected. Healthy seeds were sourced from healthy trees at Barwaha, Forest Division, Madhya Pradesh.

The study involved six pre-sowing treatments, such as seeds submerged in hot water for 48 hours (T_1), cold water treatment soaking for 72 hours (T_2), seeds were submerged in concentrated H_2SO_4 80% for 10 minutes (T_3), dipping in cow dung slurry for 72 hours (T_4), seeds were submerged in GA_3 solution (150 ppm) for 24 hours (T_5), control (T_6). Each treatment had four replications with 100 seeds per replication.

Each seed treatment's five seeds were planted in 5-by-7-inch poly-packets with a 2-cm depth. A combination of equal parts sand, dirt, and vermicompost made up the rooting medium. Urbanization presented problems for the availability of sunshine in the agroforestry nursery regions during the study period. Underground water was used for irrigation every two days. This keeps the soil moist and helps crops grow well. After the germination period ended, the germination percentage was calculated using the formula from Maguire (1962) [25].

$$\text{Germination \%} = \frac{\text{Number of germinated seeds}}{\text{Number of the total seeds}} \times 100$$

Seedling height and collar diameter were measured five months after sowing. The results were grouped by treatment, using six replications focused on different criteria. One-way analysis of variance (ANOVA) was completed within a complete randomized block design (CRD) and applied Duncan's multiple range tests at a 5% probability level to compare means. This method effectively evaluates the impact of various treatments on seedling growth.

Results and Discussion

Effect of different presowing treatments on seed germination

Teak is highly esteemed as a premier timber species, recognized for its exceptional adaptability across a range of soil conditions. Before introducing viable seeds into the germination process, it is essential to employ appropriate mechanical, chemical, or biological treatments to overcome the inherent dormancy that restricts effective germination. The germination percentage of teak seeds is notably low (Ngulube, 1986) [30]. The present study rigorously investigates the effects of various pre-sowing treatments on the germination, seedling growth, and overall development of teak. This research contributes significantly to advancing the understanding and cultivation of this valuable species.

The results indicate that seed germination was significantly improved with 80% H_2SO_4 treatment for 10 minutes, reaching a germination rate of 36.13% (T_3), followed by seeds treated with GA_3 at 30.03% (T_5), and hot water for 48 hours (T_1), 24.99% respectively. Control seeds (T_6) had a very list germination rate of only 20.00% which was technically at par with cold water treatment soaking for 72 hours (T_2), 20.28%. While seed treated with cow dung slurry for 72 hours (T_4) treatment resulted in intermediate responses of 23.49%. Hossain *et al.* (2002) [15] also concluded that sulfuric acid enhances germination percentages in their research. Numerous studies have shown that various pre-sowing techniques can increase the germination rate and accelerate the germination process (Teketay, 1996; Alamgir and Hossain, 2005; Azad *et al.*, 2010a, b) [43, 14, 36, 3, 4]. The role of hormones in breaking the dormancy of hard seeds is evident. However, GA_3 treatment did not effectively boost germination in this case, as reported by Seng and Cheong (2020). Generally, the pericarp of teak seeds is impermeable to water, which protects the seeds. It includes the seed or spores along with additional tissues that aid in dispersal. Additionally, the mesocarp and endocarp have thick-walled palisade cells covered by waxy cuticles, contributing to seed dormancy (Diameters *et al.*, 2009). Key limiting factors include the seed's physiological immaturity and the presence of chemical inhibitors within the pericarp (Georgin *et al.*, 2014) [12]. These inhibitors can be broken down and the seed coat softened by soaking the seeds in concentrated sulfuric acid or other chemicals. The positive effect of sulfuric acid on seed germination observed in this study is supported by Imani *et al.* (2014) [16], and similar improvements in teak drupe germination have also been documented by Manonmani (2003) [28]. The use of H_2SO_4 can enhance seed germination percentages, as stated by Khader and Chacko (2000) [20] and Nourmohammadi *et al.*, (2019) [32]. While gibberellic acid (GA_3) is commonly used to break physiological dormancy (Uarrota, 2021) [44], it may not be the most effective method for increasing the germination rate of teak seeds, which exhibit physical dormancy due to their hard seed coat. Consequently, GA_3 treatment produces limited effects when combined with H_2SO_4.

Impact of various presowing treatments on growth parameters of teak

The morphological development of seedlings, including height, collar diameter, and root length, is effectively summarized in Table 1. The research clearly demonstrates that pre-sowing seed treatment has a significant impact on collar diameter. Notably, the largest collar diameter of 1.40 cm is observed in seeds treated with gibberellic acid (GA_3) at 150 ppm (T_5), followed by the 80% sulfuric acid treatment (T_3), which results in a collar diameter of 1.16 cm, and seeds treated with cold-water treatment (T_2), 0.99 cm collar diameter. In stark contrast, the control group (T_6) displays the smallest collar diameter at 0.50 cm. While hot water for 48 hours (T_1), 0.60 cm, and seed treated with cow dung slurry (T_4), 0.90 cm diameter, showed intermediate results. Gibberellic acid (GA_3) is well-established as an agent that promotes vigorous vegetative growth, leading to marked increases in both the length and width of the collar region and other plant structures. This phenomenon explains the superior collar diameter observed in the GA_3-treated seedlings. Moreover, the effectiveness of GA_3 in enhancing cell elongation is robustly supported by the findings of Mäkilä *et al.*, (2023) [26]. Furthermore, sulfuric acid treatment unambiguously promotes germination and significantly enhances the development of both the plumule and radicle, which are critical components of the seed embryo.

Table 1: Effects of pre-sowing treatments on the germination rates, growth, and development of teak

Treatment	Germination%		Parameters(5th month)					
			Collar diameter(cm)		Plant Height (cm)		Root Length (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
T_1	24.99	4.37	0.60	0.07	22.71	0.91	26.23	1.58
T_2	20.28	2.97	0.99	0.31	24.97	1.64	19.88	3.28
T_3	36.14	3.38	1.16	0.16	28.49	0.78	25.43	3.30
T_4	23.49	2.34	0.90	0.12	21.02	1.16	23.20	1.24
T_5	30.03	1.09	1.40	0.14	30.06	2.70	30.73	0.85
T_6	20.00	3.83	0.50	0.07	19.13	0.45	17.68	2.57
SE(d)	4.50		0.23		2.08		3.32	
SE(m)	3.18		0.17		1.47		2.35	
C.V.	24.62		35.68		12.04		19.66	
C.D.	9.52		0.49		4.40		7.02	

Sulfuric acid treatment helps to break this dormancy by weakening the seed coat and allowing water and oxygen to penetrate more easily (Kher and Nataraj, 2015) [22]. This, in turn, stimulates the growth of the radicle (primary root) and the subsequent development of fasciculate roots, faster than the other treatment. An increase in radicle length after the seed was treated with sulfuric acid was also stated by Imani (2014) [16], Khaleghe *et al.* (2009) [21]. The collar is the region where the stem and root of a seedling join. A larger collar diameter signifies a stronger root system, which is essential for anchoring the seedling and absorbing water and nutrients from the soil. Vijayalakshmi and Jamaludheen (2020) [47] and Hadedy *et al.* (2024) [13] also reported a similar diameter.

Table 1 illustrates the significant differences in plant height among various treatments. The highest seedling height was observed in seeds treated with gibberellic acid (GA_3) solution (T_5), measuring 30.06 cm, which was statistically greater than those treated with 80% sulfuric acid (T_3), measuring 28.49 cm, and seeds treated with cold water for 72 hours (T_2), 24.97 cm. Conversely, the lowest seedling height after five months was recorded for the untreated seeds (T_6), at 19.13 cm. Seeds treated with cow dung slurry for 72 hours (T_4), 21.02 cm, which was at par with hot water treated seeds for 48 hours (T_1), 22.71 cm, both treatments yielded moderate results in height increment. The increased plant height in seeds treated with gibberellic acid (T_5) is likely due to enhanced cell elongation and division in meristematic tissues, as noted by Sheoran *et al.* (2019) [39]. Gibberellic acid is a plant hormone that regulates various developmental processes, including shoot elongation, by increasing both the number of cells and the length of individual cells. In contrast, the teak seeds treated with H_2SO_4 (T_3) exhibited lower seedling heights compared to treatment (T_5). While sulfuric acid does not directly promote cell elongation after germination, it effectively breaks down the physical barriers of the seed and ensures nutrient availability to the embryo. This early action resulted in better seedling growth compared to other treatments, except for treatment (T_5). Rout *et al.* (2021) [37] and Sonkamble *et al.* (2024) [40] reported similar findings in their study on the growth of *Saraca asoca* (Roxb.) using various concentrations of Gibberellic Acid (GA_3). Five months later, the teak seeds treated with GA_3 (T_5) had the maximum root length of 30.73 cm, which was significantly longer than the teak seeds treated with hot water (T_1), 26.23 cm, and seeds treated with concentrated H_2SO_4 80% for 10 minutes (T_3), 25.43 cm. Similarly, the seeds treated with cow dung slurry for 72 hours (T_4) exhibited a root length of 23.20 cm, whereas those subjected to cold-water treatment soaking for 72 hours (T_2) achieved 19.88 cm root length. Both treatments promoted moderate root development. The control group (T_6) had the shortest root length, 17.68 cm. Results revealed that applying GA_3 to seeds promotes cell division and elongation in a variety of plant tissues, including root meristems, which also promotes lateral root elongation; that's why seeds treated with gibberellic acid showed higher root length. These data revealed that GA_3 treatments were effective at promoting root growth, as they showed that root development was slower under hot water treatment and other circumstances. The presented results were also supported by Placido *et al.*, (2020) [35], while hot water-treated seeds had a good surrounding environment near the root; the heat also inhibited root growth barriers and a favourable microclimate for root development. Sometimes it may be given to better seed vigor. On the other hand, seeds treated with H_2SO_4 reported less root length compared to seeds treated with GA_3 (T_5) and seeds treated with hot water (T_1). It may be attributed to the harsh impact of the concentration of sulfuric acid, which can develop some chemical stress near the root zone.

Conclusion

The findings of this study reveal that pre-sowing treatments for teak seeds remarkably enhance the growth and development of seedlings. Teak (*Tectona grandis*) is known for its beautiful golden-brown wood. It is highly valued in the industrial sector for its durability and attractive appearance. The research uncovered that after five months, seedlings originating from seeds treated with GA_3 flourished, showcasing impressive heights, robust root lengths, and substantial collar diameters.

Furthermore, an extraordinary boost in germination rates was observed when seeds were delicately immersed in 80% sulfuric acid (H_2SO_4) for a brief yet impactful period of 10 minutes post-treatment. This meticulous process set the stage for vibrant and thriving seedlings, ready to embark on their growth journey.

References

1. Adetan DA, Oladejo KA, Okunade AT. A study of some mechanical properties of *Tectona grandis*. FUW Trends Sci Technol J. 2019;4(3):726-730.
2. Adhikari B, Dhital PR, Ranabhat S, Poudel H. Effect of seed hydro-priming durations on germination and seedling growth of bitter gourd (*Momordica charantia*). PLoS One. 2021;16(8):e0255258.
3. Azad MS, Paul NK, Matin MA. Do pre-sowing treatments affect seed germination in *Albizzia richardiameterna* and *Lagerstroemia speciosa*. Front Agric China. 2010;4(2):181-184.
4. Azad MS, Musa ZA, Matin A. Effect of pre-sowing treatments on seed germination of *Melia azedarach*. J For Res. 2010;21(2):193-196.
5. Baillères H, Durand PY. Non-destructive techniques for wood quality assessment of plantation grown teak. Bois For Trop. 2000;263:17-27.
6. Billah MAS, Kawsar MH, Titu AP, Pavel MAA, Masum KM. Effect of pre-sowing treatments on seed germination of *Tectona grandis*. Int J Bioinform Biomed Eng. 2015;1:37-42.
7. Cardoso S, Sousa VB, Quilho T, Pereira H. Anatomical variation of teakwood from unmanaged mature plantations in East Timor. J Wood Sci. 2015;61:326-333.
8. Choudhari PL, Prasad J. Teak supporting soils of India: a review. Open Access J Sci. 2018;2(3):98-200.
9. Colbu DE, Sandu I, Vasilache V, Earar K, Paraschiv ED, Sandu IG, *et al*. Study on the chemical composition of teak wood extracts in different organic solvents. iForest. 2021;14:329-336.
10. Caproni JRM, Wadt ALS, Silva PGS, Tavella LM, Oliveira JP. Quebra de dormência em diásporos de teca (*Tectona grandis* L.f.). Acta Amazon. 2009;39(3):549-554.
11. Freitas MCPG. Estudo das madeiras de Timor. II Contribuição. Lisboa: Ministério do Ultramar; 1958.
12. Georgin J, Bazzoti R, Perrando E. Inducing rooting of teak (*Tectona grandis* L.f.). REGET. 2014;18(3):1246-1256.
13. Hadedy SHA, Basheer SA, Idrees MS, Taee KAY. Sulfuric acid and hot water treatment effects on seed germination and growth traits of *Sesbania punicea* L. SABRAO J Breed Genet. 2024;56(1):444-452.
14. Hossain MA, Arefin MK, Khan BM, Rahman MA. Effects of seed treatments on germination and seedling growth attributes of horitaki (*Terminalia chebula* Retz.). Res J Agric Biol Sci. 2005;1(2):135-141.
15. Hossain MK, Khan BK, Koirala B. Effect of presowing treatment on *Tectona grandis* L.f. seeds and initial seedling development in the nursery. Pak J For. 2002;52(2):99-108.
16. Imani AF, Sardoei AS, Shahdadneghad M. Effect of H_2SO_4 on seed germination and viability of *Canna indica* L. Int J Adv Biol Biomed Res. 2014;2(1):223-229.
17. Indira EP, Basha SC. Effects of seeds from different sources on germination and growth in teak (*Tectona grandis* L.f.) nursery. Ann For. 1999;7(1):39-44.
18. Jackson JK. Manual of afforestation in Nepal. Kathmandu: Forest Research and Survey Center; 1994. p. 718-724.
19. Jamil M, Bashir S, Anwar S, Bibi S, Bangash A, Ullah F. Effect of salinity on physiological and biochemical characteristics of different varieties of rice. Pak J Bot. 2012;44(1):7-13.
20. Khader SA, Chacko KC. Seed characteristics and germination of *Thespesia populnea*. Indian J For. 2000;23(4):428-432.
21. Khaleghe A, Dehghan MN. Effects of sulfuric acid and hot water treatments on seed germination index of *Acacia sour hindi*. Iran J Hortic Sci. 2009;3:20-27.
22. Kher M, Nataraj M. Effect of sulfuric acid treatment on breaking of seed dormancy and germination of Indian doum palm (*Hyphaene dichotoma*). Environ Exp Biol. 2015;13:99-101.
23. Kollert W, Kleine M. The global teak study: analysis, evaluation and future potential of teak resources. IUFRO World Series. 2017;36:1-30.
24. Kurra RG, Benu Y, Purba NP, Aryani NKD, Manek LM. Teak seeds (*Tectona grandis* L.f.) germination based on sulfuric acid concentration and soaking time. J Belantara. 2024;7(2):209-217.
25. Maguire JD. Speed of germination in selection and evaluation for seedling vigour. Crop Sci. 1962;2:176-177.
26. Mäkilä R, Wybouw B, Smetana O, Vainio L, Solé-Gil A, Lyu M, *et al*. Gibberellins promote polar auxin transport to regulate stem cell fate decisions in cambium. Nat Plants. 2023;9(4):631-644.
27. Mala-Seng M, Cheong EJ. Comparative study of various pretreatment on seed germination of *Dalbergia cochinchinensis*. For Sci Technol. 2020;16(2):68-74.
28. Manonmani V, Vanangamudi K. Studies on enhancing seed germination and seedling vigour in teak (*Tectona grandis*). J Trop For Sci. 2003;15(1):51-58.
29. Midgley S, Somaiya RT, Stevens PR, Brown A, Nguyen DK, Laity R. Planted teak: global production and markets. ACIAR Tech Rep. 2015;85:1-150.
30. Ngulube M. Preliminary study on germination of pretreated teak (*Tectona grandis*) seed under nursery conditions. For Ecol Manag. 1986;17:147-151.
31. Njehoya CA, Bourou S, Awono PK, Bouba H. Évaluation du potentiel de germination de *Moringa oleifera* dans la zone soudano-guinéenne du Cameroun. J Appl Biosci. 2014;74(1):6141-6148.
32. Nourmohammadi K, Kartoolinejad D, Naghdi R, Baskin CC. Effects of dormancy-breaking methods on germination of water-impermeable seeds of *Gleditsia caspica*. Folia Oecol. 2019;46:115-126.
33. Palani MG, Dasthagir K, Kumaran K, Jerlin R. Effect of pre-sowing treatment on growth attributes of *Albizia lebbeck*. Ann For. 1996;4(1):85-88.
34. Palanisamy K, Hegde M, Yi JS. Teak (*Tectona grandis* Linn.f.): a renowned commercial timber species. J For Environ Sci. 2009;25(1):1-24.
35. Placido DF, Sandhu J, Sato SJ, Nersesian N, Quach T, Clemente TE, *et al*. The lateral root density gene regulates root growth during water stress in wheat. Plant Biotechnol J. 2020;18(9):1955-1968.
36. Alamgir M, Hossain MK. Effect of pre-sowing treatments on germination and initial seedling development of *Albizzia saman*. J For Res. 2005;16(3):200-204.
37. Rout S, Beura S, Khare N, Prusty AK. Role of gibberellic acid on seed germination and seedling quality of *Saraca asoca*. Front Crop Improv. 2021;9:2495-2500.
38. Sanwo S. Characteristics of crown-formed and stem-formed wood in plantation grown teak (*Tectona grandis* L.f.) in

Nigeria. J Inst Wood Sci. 1987;11(2):85-89.
39. Sheoran V, Kumar M, Sharma J, Gaur R, Saini H. Effect of scarification treatments on growth parameters of ber seedlings. J Pharmacogn Phytochem. 2019;8(1):658-661.
40. Sonkamble DS, Bhalerao RV, Bhosale AM. Effect of seed treatment on seed germination and growth of karonda (*Carissa carandas* L.) seedlings. Int J Curr Microbiol Appl Sci. 2024;13(11):26-34.
41. Sudhakara K, Jijeesh CM. Effect of germination conditions, grading and storage on teak (*Tectona grandis* Linn.f.) drupes. Indian For. 2008;134(2):241-249.
42. Tania SS, Hossain MM, Hossain MA. Effects of hydropriming on seed germination, seedling growth and yield of bitter gourd. J Bangladesh Agric Univ. 2019;17(3):281-287.
43. Teketay D. Effect of pre-sowing treatments, temperature and light on germination of five *Senna* species. New For. 1996;11:155-171.
44. Uarrota VG. Gibberellic acid promotes dormancy-breaking of rice seeds and formation of abnormal seedlings. Rev Cienc Agroveter. 2021;20(4):278-285.
45. Venkatesan S, Masilamani P, Babu RV, Eevera T, Janaki P, Sundareswaran S, *et al*. Evaluation of dormancy mechanism in teak (*Tectona grandis* Linn.f.) true seeds. Madras Agric J. 2024;111:1-3.
46. Venkatesh YN, Ashajyothi M, Rajarajan K, Sahu A, Chaturvedi V, Prathima PT, *et al*. Transcriptional and physico-chemical responses of *Tectona grandis* triggered by teak defoliator. Plant Stress. 2024;12:100468.
47. Vijayalakshmi KP, Jamaludheen V. Effect of seed pre-treatments on germination and seedling characteristics of teak seed. J Pharmacogn Phytochem. 2020;9(4):3361-3363.
48. White KJ. Teak: some aspects of research and development. FAO RAPA Publ. 1991;1991/17:1-120.