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Effect of seed pre- treatments on germination and seedling characteristics of teak seed

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Abstract
Teak (*Tectona grandis* L.), is considered as one of the finest and most economically valuable timbers species in the tropics, exhibiting desirable technical and decorative properties. It's propagated through seeds and the main problem in seed germination limits seedling production. Current study was carried out to find out best germination enhancement pre-treatment. Seeds were subjected to eight treatments in four replications and the experiment was conducted in a completely randomized design. The results showed that mechanically scarified seeds + alternate wetting and drying seven cycle for 7 days resulted in increased more germination of 73.77 percent followed by mechanically scarified seeds + alternate wetting and drying three cycle for 3 days (71.11%) as against 57% in the untreated control treatment.

Keywords: *Tectona grandis***,** dormancy, mechanical scarification, vigour index

Introduction
Teak (*Tectona grandis* L.), is an important tropical celebrated timber speciesassociated to the family laminaceae. The species is naturally distributed in South East Asia mainly Myanmar, parts of India, Thailand and Laos (Kaosa-Ard 1981) [6]. Teak is typically a tree of the moist deciduous forest. It is also found to some extent in evergreen forest. Under optimum condition, this large deciduous tree can attain a height of 30m and a girth at breast-height of over 2m. The species is highly priced and cultivated as plantation tree in tropical and subtropical regions of the world. Teak is considered as one of the finest and most economically valuable timbers species in the tropics, exhibiting most of the desirable technical and decorative properties.
Mechanical dormancy is found to be present in *Tectona grandis* which results in delayed and sporadic germination by means of a valve structure that opens up for the radicle to emerge (Dias *et al*., 2019) [3]. Teak seed endocarp and mesocarp have a layer of palisade cells and with thick wall and they are covered on the outside by waxy cuticles, causing seed dormancy and hence poor germination rate. Physiological immaturity of the seed and chemical inhibitors present in the pericarp is also reported to contribute to the seed dormancy in *Tectona grandis* (Georgin*et al.*, 2014).Seed coat dormancy is common in the drier tropics, and systematic pre-treatment is necessary to obtain rapid and uniform germination. Both physical dormancy and chemical dormancy caused by hard seed coat or pericarp with cutinized layers impermeable to water and, by inhibiting chemicals present in the seed covering respectively occur in seeds also it is likely that they exist together in the same seed (Baskin, 2004) [1]. Therefore, the objective of this study is to determine the germination response of teak using different pre-germination treatments in the nursery.

Materials and Methods
The study was conducted at Tree Nursery of College of Forestry (40 m msl altitude, 10o 32'N latitude and 76o 26'E longitude), Kerala Agricultural University, Kerala, during June 2018 and June 2019. The area experiences a warm and humid climate with distinct rainy season. Teak seeds were collected from Nellikkutha, Nilambur North Forest Division. Seeds were size-graded using teak grading machine in Kerala Forest Research Institute (KFRI) with a mechanical sieve size of 9 mm mesh and kept separately in containers. Teak seeds were scarified by using mechanical scarification machine. Teak seed germination studies were conducted in a completely randomised design experiment with three replication, per replication 100 seeds were used. Mechanical scarified seeds were subjected to different soaking treatments. The pre-treatments were T1- Mechanically scarified seeds +Normal water soaking for 72 hours (WS 3 days), T2- Mechanically scarified seeds +Alternate wetting and drying one cycle for one day (AWD 1 day), T3- Mechanically scarified seeds + Alternate wetting and drying three cycle for 3 days (AWD 3 day), T4-Mechanically scarified seeds + Alternate wetting and drying seven cycle for 7 days (AWD 7 day), T5- Mechanically

scarified seeds + 80% concentrated H_2SO_4 for 5 min, T6- Mechanically scarified seeds + 80%concentrated H_2SO_4 for 15 min, T7- Mechanically scarified seeds + 80 0% concentrated H_2SO_4 for 25 min, T8- Mechanically scarified seeds + Normal water soaking for 24 hours (control).

Germination and seedling characteristics of the teak seedlings were evaluated as function of the pre-treatments. The salient results are presented hereunder

Table 1: Effect of pre-treatments on germination and early seedling growth of teak

Treatments	Germination %	Collar diameter (mm)	Seedling length (cm)	Root length (cm)	Vigour index
T1	61.33^{ab}	1.16	5.43^{ab}	11.76^{bc}	10.51^{a}
T2	59.44^{ab}	1.27	5.77^{a}	12.52^{ab}	10.16^{a}
T3	71.66^{ab}	1.38	5.99^{a}	13.36^{a}	15.59^{a}
T4	73.77^{a}	1.33	5.61^{ab}	13.14^{a}	15.13^{a}
T5	38.66^{c}	1.19	4.61^{ab}	11.02^{cd}	4.47^{b}
T6	31.11^{c}	1.22	4.19^{c}	10.66^{d}	3.33^{b}
T7	28.66^{c}	1.21	5.37^{ab}	10.02^{d}	2.68^{b}
T8	57.00^{b}	1.16	5.74^{a}	11.80^{bc}	10.39^{a}
F value	10.46	0.38	2.63	11.23	9.03
P value	0.000**	0.96 (NS)	0.01*	0.000**	0.000**

**Significant at 1% level * Significant at 5% level NS-Non Significant Treatments with the same superscript do not differ significantly

Results and Discussion

Effect of scarification treatments on germination percentage seed showed significant results with respect to different treatments (p=0.000). The highest germination percentage recorded in T4-Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) seven cycle for 7 days was 73.77 per cent followed by T3-Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) three cycle for 3 days (71.66%) and T1-(61.33%) (Table 1). Mechanical damage was able to improve the germination percentage though not fully but to a certain extent, as it seems that the water absorption and pressure developed by the protruding radicle are not enough h to rupture the seed coat.The reason behind the treatment effect might be expansion of cells during wetting and contraction during drying which resulted in weathering of seeds. Hence weathering would have facilitated penetration of required quantity of water inside the seeds and accelerated the initial process of germination *viz*., breakdown of food material and synthesis of enzymes, which was similar as reported by Walter *et al*. 1991 [12]. Lowest germination per cent for T7 Mechanically scarified seeds + 80% conc. H_2SO_4 for 25 minwas 28.66% and control recorded 57 per cent.In the present study, acid scarified could not influence germination with different various durations tested. For seeds scarified by sulphuric acid, failure to germinate may also be attributed to the duration spent by the seeds in the concentrated acid, which may have been too short to cause enough weakening of the seed coats or the duration may have been long enough to cause damage to the embryo thereby failing germination (Salisbury and Ross, 1992; Sajeevkumar *et al*., 1995; Geetha, 1996; Oboho and Urughu, 2010; Soliman and Abbas, 2013; Hussain *et al*., 2005 and Pinipis *et al*., 2011) [10, 9, 4, 7, 11, 5, 8]. Among the different treatments, collar diameter did not showed significant effect.

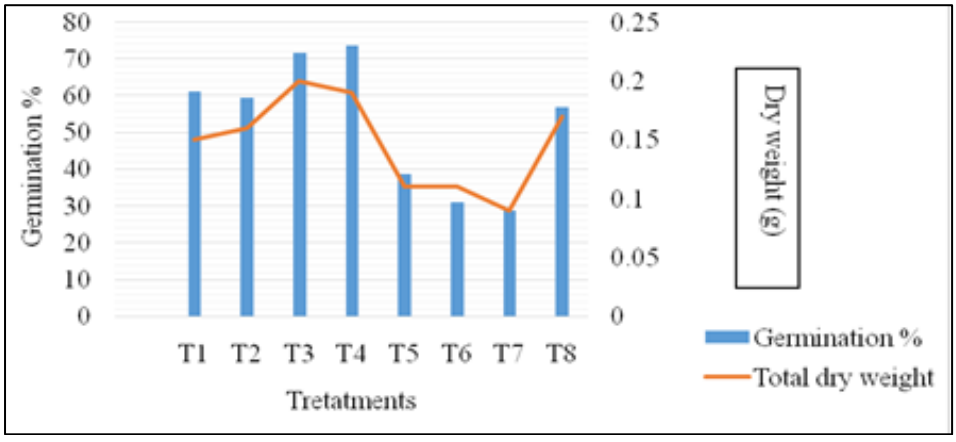

Fig 1: Effect of pre- treatment on germination % and dry weight on teak seedlings

The maximum seedling length recorded in T3-Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) three cycle for 3 days (5.99 cm) and minimum seedling length (4.19 cm). Among the different treatments the highest root length noticed in T4 -Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) seven cycle for 7 days (13.36 cm) followed by T3-Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) three cycle for 3 days and T2. Vigour index showed significant effect among the different treatments, the maximum vigour index recorded in 1989 (T3-Mechanically scarified seeds + Alternate wetting (12 hours) and drying (12 hours) three cycle for 3 days) same trend was noticed in dry weight (Fig 1).However, increase in vigour index might be due to higher germination percentage, since vigour index is the product of germination percentage x seedling dry weight (Boaler, 1966) [2], and lowest vigour index recorded (2.68) was T4-Mechanically scarified seeds + 80 0% concentrated H_2SO_4 for 25 min.

Conclusion

The results of this study showed that treatment combination of mechanically scarified seeds + alternate wetting and drying significantly increased the germination percentage and seedlings characteristic. Hence, a mechanical scarification prior to the pre-soaking treatment is highly recommended for improved seed germination and seedling growth in teak.

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