Tropical Agricultural Research and Extension. 2 (1): 26-29, 1999

Effect of seed treatment with hydrogen peroxide on germination and seedling vigour of teak (*Tectona grandis* Linn. f)

P. Masilamani and C. Dharmalingam
Department of Seed Technology, College of Agricultural Engineering, Tamil Nadu Agricultural University, Kumulur, Tiruchirapalli - 621712, Tamil Nadu, India.

Accepted 5 March 1999

ABSTRACT

The effect of pre-sowing treatments on the germination and seedling vigour of nine month-old teak drupes was studied. The drupes, subjected to pre-sowing treatments were germinated under open and mist chamber conditions. Soaking and drying of drupes for 5 days at an interval of 12 hours followed by soaking in 1.5% Hydrogen peroxide solution recorded 47% and 52% germination under the open and mist chamber conditions as against 29% and 15% respectively in the control. In addition to enhanced germination in mist chamber, seedling emergence took place within 8-12 days as against 12-18 days under open condition.

Key words: germination, Hydrogen peroxide, seedling vigour, Teak, *Tectona grandis*.

INTRODUCTION

Teak (*Tectona grandis* Linn. f) is the most extensively planted tree species in India and its planting has been increasing in recent years. Indian region is considered to be the known centre of its genetic diversity (Hedegart 1975). Teak is distributed over 8.9 million hectare. The success of large scale plantations is mainly due to its relatively fast growth, fire resistance, non browsability and high timber value (Tewari 1992). In recent years, teak as a plantation species has attracted both the government and the private sectors. Several seed problems in teak, such as poor and delayed germination and prolonged nursery period (Dharmalingam 1995) have been encountered. Therefore investigations on the influence of pre-sowing treatments and sowing condition on germination and vigour in teak were undertaken.

MATERIALS AND METHODS

Teak drupes were collected from top slip seed production areas (74°34`E longitude, 15°07`N latitude, 750 masl) of Tamil Nadu. The drupes were spread in gunny bags in the shade under ambient conditions for 9 months. Prior to germination, the 9 month-old drupes were subjected to the following pre-sowing treatments: (1) soaking in water followed by drying (S-D) for 6 days at 12 hr intervals, (2) S-D for 5 days at 12 hr interval and on the 6th day, soaking in one of 10 different concentrations of hydrogen peroxide (H_2O_2 - 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 %) solution for 12hr. Dry drupes served as the control treatment. The pre-conditioned and control drupes were placed for germination in sand contained in earthen pots (30 cm height and 30 cm upper width) and kept in either open sunlight (27° C and 72% RH) or in a sand bed inside a mist chamber (31°C and 86% RH) for 28 days in October 1995. The experiment was conducted in a factorial completely randomized design with five replications. Each replication consisted of 30 drupes. A germination period of 28 days as recommended by ISTA (1985) was adopted. The normal seedlings (one or more) produced by a single drupe was counted as one seedling and germination was expressed as percentage. The total number of seedlings produced by 30 drupes were also counted and the mean value was computed. For the estimation of dry matter production, ten seedlings were selected at random and dried in an oven maintained at 85°C for 24 hr after measuring their root and shoot length.

The vigour index (VI) was derived from the formula of Abdul Baki and Anderson (1973) as follows:

VI=Percent germination x Total seedling length (cm).

The data were subjected to t-test for significant difference (P=0.05) (Panse and Sukhatme 1967). Percentage values were transformed into *arc sine* values prior to statistical analysis. The mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

The results revealed that drupe treatment and sowing condition could significantly influence the germination and seedling growth of teak. Under open conditions, the highest germination of 47% was obtained with 1 and 1.5% H_2O_2 solution as compared with 38% for water soaking or 29% in the control.

Table 1. Effect of H_2O_2 presoaking treatment on germination (%) and total number of seedlings per 100 teak drupes sown (October '95 sowing)

Treatments	Open condition (27°C and 72% RH)		Mist chamber (31°C and 86% RH)	
	Germination (%)	Seedlings/ 100 drupes	Germination (%)	Seedlings/ 100 drupes
T_0 - Control	29^{c} (32.44)	36^{d}	15^{d} (22.51)	16^{d}
T_1 - S-D for 6 days	38^{b} (37.87)	44^{cd}	32^{c} (34.43)	37^{c}
T_2 - S-D for 5 days + soaking in 0.5% H_2O_2 12 hour	46^{ab} (42.42)	54^{abc}	46^{ab} (42.70)	52^{ab}
T_3 - S-D for 5 days + soaking in 1% H_2O_2 12 hour	47^{a} (43.09)	54^{abc}	51^{a} (45.38)	52^{ab}
T_4 - S-D for 5 days + soaking in 1.5% H_2O_2 12 hour	47^{a} (43.08)	62^{a}	52^{a} (46.15)	63^{a}
T_5 - S-D for 5 days + soaking in 2% H_2O_2 12 hour	41^{ab} (39.88)	47^{bc}	45^{ab} (42.32)	53^{ab}
T_6 - S-D for 5 days + soaking in 2.5% H_2O_2 12 hour	43^{ab} (41.16)	49^{bc}	45^{ab} (42.32)	54^{ab}
T_7 - S-D for 5 days + soaking in 3% H_2O_2 12 hour	42^{ab} (40.51)	50^{bc}	44^{ab} (41.55)	51^{b}
T_8 - S-D for 5 days + soaking in 3.5% H_2O_2 12 hour	43^{ab} (41.15)	57^{ab}	44^{ab} (41.54)	56^{ab}
T_9 - S-D for 5 days + soaking in 4% H_2O_2 12 hour	43^{ab} (41.23)	48^{abc}	45^{ab} (41.93)	50^{ab}
T_{10} - S-D for 5 days + soaking in 4.5% H_2O_2 12 hour	41^{ab} (39.87)	51^{abc}	42^{b} (40.39)	52^{ab}
T_{11} - S-D for 5 days + soaking in 5% H_2O_2 12 hour	42^{ab} (40.46)	57^{ab}	51^{a} (45.77)	59^{ab}
Mean	42 (40.26)	50.7	43 (40.42)	49.8

(Figures in parantheses indicate arc sine values).
Means followed by same letter in a column are not significantly different at 0.05 level by DMRT.

Hydrogen peroxide treatment was also effective for the drupes in the mist chamber with significantly better germination percentage than either no treatment (control) or the water soak only treatment. Although there was little difference in percent germination among the various hydrogen peroxide treatments, the best treatment gave 52% germination (the drupes soaked in 1.5% H_2O_2). The control drupes gave only 15%. Compared with open condition, use of the mist chamber resulted in 5% additional seedling germination with best treatments (Table 1). Results on total number of seedlings produced/100 drupes reflected a similar, but more clear trend as for germination (Table 1). In this case, soaking in H_2O_2 gave a clear advantage. The highest number of seedlings was obtained in the treatment with 1.5% hydrogen peroxide, in either the open condition or in the mist chamber with 62 and 63 seedlings per 100 drupes, respectively (Table 1). Seedling emergence under open condition was earlier (12-13 days), when the drupes were subjected to H_2O_2 treatment at different concentrations, than those drupes given soaking and drying treatment with water for 6 days (14 days). The control drupes took 18 days for seedling emergence. Under mist chamber condition, the emergence took place in 12 days in the control, but it occurred much earlier (8-9 days) in H_2O_2 pre-soaked drupes (Table 1).

Differences in dry matter production and vigour index values were significant due to seed treatments and sowing condition. The drupes soaked in 1% H_2O_2 solution gave maximum dry matter production (61 mg) and vigour index value (686), closely followed by 0.5% H_2O_2 soaking (51 mg dry matter production and 648 vigour index value) in open condition. Under mist chamber condition, the drupes subjected to soaking in 4.5% H_2O_2 solution registered maximum dry matter production of 36 mg seedling^{-1}, and the least of 22 mg seedling^{-1} by control drupes. Although there was no difference in the gemination percentage or number of seedlings per 100 drupes in the H_2O_2 treated drupes grown in open or mist chamber (Table 1), the dry matter production was much higher under open conditions (Table 2).

The enhanced germination with H_2O_2 application perhaps comes from its respiratory stimulant action, which accelerates the breakdown of food reserves thus providing a more rapid supply of energy and materials for synthesis in the growing points of the seeds (Copeland 1988). The findings of Ghosh *et al.* (1974) in *Pinus caribaea* and *Pinus patula* and those of Ching and Lin (1994) in *Cinnamomum camphora* also lend support to this contention. Besides, the exogenous application of H_2O_2 causes cracks in the hilum along the ridge of the

Table 2. Effect of H_2O_2 presoaking treatment on dry matter and vigour of 9 month-old teak drupes (October '95 sowing)

Treatments		Open condition (27°C and 72% RH)		Mist chamber (31°C and 86% RH)	
		DMP† (mg seedling^{-1})	Vigour index	DMP (mg seedling^{-1})	Vigour index
T_0	-Control	39^{c}	287^{c}	22^{b}	133^{c}
T_1	-S-D for 6 days	49^{bc}	470^{cd}	26^{ab}	524^{ab}
T_2	-S-D for 5 days + soaking in 0.5% H_2O_2 12 hour	51^{ab}	648^{ab}	25^{ab}	571^{ab}
T_3	-S-D for 5 days + soaking in 1% H_2O_2 12 hour	61^{a}	686^{a}	31^{ab}	544^{ab}
T_4	-S-D for 5 days + soaking in 1.5% H_2O_2 12 hour	46^{bc}	553^{a-d}	31^{ab}	657^{a}
T_5	-S-D for 5 days + soaking in 2% H_2O_2 12 hour	43^{bc}	450^{d}	26^{ab}	556^{ab}
T_6	-S-D for 5 days + soaking in 2.5% H_2O_2 12 hour	47^{bc}	498^{cd}	28^{ab}	499^{b}
T_7	-S-D for 5 days + soaking in 3% H_2O_2 12 hour	47^{bc}	505^{cd}	26^{ab}	500^{b}
T_8	-S-D for 5 days + soaking in 3.5% H_2O_2 12 hour	51^{ab}	576^{a-d}	25^{ab}	526^{ab}
T_9	-S-D for 5 days + soaking in 4% H_2O_2 12 hour	48^{bc}	521^{bcd}	27^{ab}	537^{ab}
T_{10}	-S-D for 5 days + soaking in 4.5% H_2O_2 12 hour	45^{bc}	543^{bcd}	36^{a}	567^{ab}
T_{11}	-S-D for 5 days + soaking in 5% H_2O_2 12 hour	53^{ab}	599^{abc}	30^{ab}	597^{ab}
	Mean	48	528	28	518

Means followed by same letter in a column are not significantly different by DMRT.
† DMP- Dry Matter Production.

seed coat which results in release of coat resistance, enhancing water absorption and oxygen uptake, thus increasing germination in *Cinnamomum camphora* seeds (Ching and Lin 1994). Whether such a role can be attributed to teak drupes remains nebulous and requires further investigation. Another important finding that emerged from the present study is the merit of using mist chamber for germination. Early emergence was also noticed along with enhanced germination. Normally, humid condition is conducive for rooting in soft hardwood cuttings. Germination studies in mist chamber condition are scarce, not only in teak but also in other forest species. ISTA (1985) also has prescribed a higher temperature (30°C) for germination of teak drupes. High germination in teak is attributed to high moisture (FAO/DANIDA 1985; Dabral 1976). These reports are consistent with the present findings. Temperature and relative humidity have high interaction effect on the germination of teak drupes (Masilamani and Dharmalingam 1997). Although the mist chamber enhanced drupe germination, number of seedlings produced and the rate of seedling emergence, the best seedling development was obtained in the open air. Further research should investigate germination under mist, but with proper timing to move the young seedling to open growing conditions to get the best quality seedlings. Soaking in 1.5% hydrogen peroxide solution and sowing in mist chamber condition can result in more number of seedlings from a seed lot. However, subsequent seedling growth seems to be hampered by leaving the young seedlings under mist too long.

ACKNOWLEDGMENT

The senior author is thankful to Sterling Tree Magnum (India) Limited, Chennai for financial assistance in the form of a fellowship for Ph.D. (Seed Technology) programme.

REFERENCES

Abdul-Baki AA and Anderson 1973 Vigour determination in soya bean seed by multiple criteria. Crop Sci. 13: 630-633.

Ching NH and Lin TP 1994 Mechanism of hydrogen peroxide in improving the germination of *Cinnamomum camphora* seed. Seed Sci. Technol. 12: 231-236.

Copeland LO 1988 Principles of Seed Science and Technology. Burgess Publishing Company, Minneapolis. pp. 368.

Dabral SC 1976 Extraction of teak seed from fruits, their storage and germination. Indian Forester. 102: 650-658.

Dharmalingam C 1995 Certain new approaches in bringing out the innate germination problems of teak (*Tectona grandis* Linn. f) seeds. In: Proc. Seed Technology Workshop. IFGTB, Coimbatore, India. pp 133.

FAO/DANIDA 1985 Training course materials in forest seed collection and handling. Chiang Mai, Thailand; Rome, Italy. 2: 453.

Gosh RC, Singh RP and Sharma KK 1974 Standardisation of nursery technique of tropical pines. 1. Hastening germination of *Pinus caribaea* (Var. hondurensis) and *Pinus patula* seeds. Indian For. 110: 403-421.

Gomez KA and Gomez AA 1984 Statistical Procedure for Agricultural Research, Wiley Inter-Science Publications, New York. pp. 680.

Hedegart T 1975 Seed collection of teak. In: FAO/DANIDA Training Course of Forest Seed Collection and Handling. 11: 274-279.

International Seed Testing Association 1985 International rules for seed testing. Seed Sci. Technol. 13: 229-355.

Masilamani P and Dharmalingam C 1997 An innovative method for early and enhanced germination of teak (*Tectona grandis* Linn. f) drupes. In: Proc. IUFRO Symposium on Innovations in Forest Tree Seed Science and Nursery Technology. Raipur, India. pp. 177.

Panse VG and Sukhatme RV 1967 Statistical methods for agricultural workers. Indian Council of Agricultural Research Publication, New Delhi. pp. 175.

Tewari DN 1992 A Monograph on teak (*Tectona grandis* Linn. f) International Book Distributors, Dehra Dun. India pp. 22-66.