Journal of Tropical Forest Science 13(1):93–98 (2001)

EFFECT OF ACCELERATED AGING ON GERMINATION AND SEEDLING VIGOUR OF TEAK *(TECTONA GRANDIS)*

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Received September 1998

MASILAMANI, P. & DHARMALINGAM, C. 2001. Effect of accelerated aging on germination and seedling vigour of teak (*Tectona grandis*). A study was made to assess the influence of accelerated aging of 10-month-old teak fruit stones on seed germination and seedling vigour. Aging was carried out in an aging chamber maintained at 100% RH and 40 °C. The fruit stones aged for 13 days showed 53% germination against 18% in the control in normal open condition after 28 days of sowing. Fruit stones in mist chamber gave 39% germination against 14% in the control after 11 days aging. Further forced aging enabled early germination which was associated with more seedlings per 100 fruit stones and better seedling vigour under both test conditions.

Key words: *Tectona grandis* - accelerated aging - fruit stones - seed germination - seedling vigour

MASILAMANI, P. & DHARMALINGAM, C. 2001. Kesan penuaan dipercepat terhadap percambahan dan kecergasan anak benih jati (*Tectona grandis*). Kajian dijalankan untuk menilai pengaruh penuaan dipercepat buah biji keras jati yang berumur 10 bulan terhadap percambahan biji benih dan kecergasan anak benih. Penuaan dijalankan di dalam kebuk penuaan yang dikekalkan pada 100% RH dan 40 °C. Buah biji keras yang dituakan selama 13 hari menunjukkan percambahan sebanyak 53% berbanding dengan 18% dalam kawalan dalam keadaan terdedah yang biasa selepas 28 hari penyemaian. Buah biji keras di dalam kebuk berkabus memberikan 39% percambahan berbanding dengan 14% dalam kawalan selepas 11 hari penuaan. Penuaan paksa seterusnya membolehkan percambahan awal yang bersekutu dengan lebih anak benih bagi setiap 100 buah biji keras dan kecergasan anak benih yang lebih baik di bawah kedua-dua keadaan ujian.

Introduction

Teak (*Tectona grandis* Linn. f) is one of the most extensive and durable timbers and has often been refered to as an "aristocrat" among timbers. It is mostly seed propagated. The problems in teak germination are multifarious. These include the germination inhibitors in the mesocarp (physiological block), thick and hard endocarp (physical barrier) and the requirement of after-ripening (morphological factor) associated with growth hormone imbalance in seeds (Dharmalingam 1995). Old drupes germinate moderately well compared to fresh ones (Vichien *et al.* 1974, Dasappa 1990, Masilamani *et al.* 1997). Accelerated aging is one of the stress tests for seed vigour (AOSA 1983). Its utility in predicting seed storability has been demonstrated with agronomic crop seeds (Delouche & Baskin 1973), but its applicability in improving tropical tree seed germination has been little investigated. Bonner (1974) used it in a study of seed lot vigour with cherry bark oak (*Quercus falcata*), while Pitel (1980) studied some of the biochemical changes (isozymes, amino acids and proteins) during accelerated aging of jack pine (*Pinus banksiana*) and red oak (*Quercus rubra*) seeds. Germination of fresh teak drupes is relatively low (8–10%) when compared to 2–3-y stored drupes (25–30%). The aim of this study was to determine the applicability of the accelerated/forced aging technique and sowing condition to improve the germination and seedling vigour of teak drupes.

Materials and methods

Teak drupes were collected (February 1995, late winter) from Top Slip seed production areas (15° 07' N, 74° 34' E; 750 m above sea-level) of Tamil Nadu, India. The drupes were spread on gunny bags under ambient condition for 10 months. Prior to germination, moisture content (ISTA 1976) was estimated in the ten-month-old drupes following the hot air oven (103 °C for 17h) method and then subjected to accelerated aging (McDonald & Phaneendranath 1978) by placing them in accelerated aging containers made of 5.5" × 5.5" × 2" plastic boxes with covers, each containing a bronze wire mesh seed holder. Drupes were held in a single layer on this screen wire. The boxes were then placed in an accelerated aging chamber maintained at 40 °C and 100% relative humidity at specified intervals (0, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 days) during the accelerated aging process. The sampled drupes were sown in sand-filled earthen pots (30 cm height and 32 cm upper width) and kept under open sunlight (24 °C and 66 % RH) and another lot were sown in a bed of 25 cm height laid in mist chamber (28 °C and 82% RH) during the month of December 1995. The experiment was conducted in factorial completely randomised design with ten replications of 30 drupes. After a germination period of 28 days as recommended by ISTA (1985), the normal seedlings (one or more) produced by single drupe were counted as one seedling and germination was computed and expressed as percentage. The total numbers of seedlings produced by 30 drupes were also counted and the mean value expressed as 100^{-1}. For the estimation of dry matter production, ten seedlings were selected at random and kept in an oven maintained at 85 °C for 24 h after measuring root and shoot lengths. The vigour index was derived from the formula of Abdul Baki and Anderson (1973):

$$\text{Vigour index} = \text{percentage germination} \times \text{total seedling length (cm)}$$

The results were subjected to an analysis of variance (ANOVA) and tested (*t*-tested) for significant difference (p = 0.05) (Panse & Sukhatme 1967). Percentage values were transformed into arc sin values prior to statistical analysis. The mean values of the experiment were compared using Duncan's multiple range test (DMRT) (Gomez & Gomez 1984).

Results and discussion

The results showed that the accelerated aging of fruit stones and germination conditions gave significant differences in their germination percentage and seedling growth. The maximum germination of 53% was obtained after 13 days of accelerated aging, compared with 18% in the control. Other treatments showed germination ranging between 24 and 43%. The germination percentage showed an increase with increase in period of accelerated aging, though not consistently, up to 13 days and beyond that it declined. The results of the counterpart drupes tested under mist chamber condition showed slightly deviated results with less amplitude, where the maximum germination percentage of 39% was recorded after accelerated aging for 11 days, against 14% in the control. However, in general germination in the mist chamber was less (20–39%) than in the open condition (24–53%) in various treatments (Table 1). Results on the total number of seedlings produced per 100 drupes reflected the same trend as germination under open and mist chamber conditions (Table 1). Enhancement of seed germination due to short period of accelerated aging was observed in water oak (*Quercus nigra*) by Blanche *et al.* (1990). Such enhancement is normal for all annual seed plants (Bourland & Ibrahim 1982), and is due to the increase in moisture content that brings the level of hydration closer to the minimal requirement for seed germination. The break-down of polymeric storage compounds also accounts for the enhancement (Blanche *et al.* 1990). Bonner (1984), in his preliminary work on southern pine seed, also observed germination enhancement by accelerated aging.

The period when accelerated aging enhances seed germination has been termed the "conditioned stage" by Bird and Reyes (1967), while the term "deteriorated stage" was used for the period when germination decreases until the seed dies. The first event during deterioration is believed to be caused by a loss of membrane integrity and increased cell permeability which allows large quantities of cellular compounds to diffuse out when the seed is placed for aging (Schnathorst & Presley 1963). The increase in membrane permeability in accelerated aged seeds in possibly due to changes in the molecular structure of the membrane (Somola 1974, Pitel 1980). The increase in metabolism during aging depletes food reserves and subsequently seed vigour declines (Blanche *et al.* 1990). With regard to seedling emergence, differences among accelerated aging treatments and growth conditions were evident. The drupes aged for 11 and 13 days emerged in 15 days while unaged drupes took 18 days to emerge. Earlier or beyond 13 days, the emergence was delayed by one or two days. Under mist chamber condition, the emergence took place 2–3 days earlier in the drupes aged for 7, 11 and 14 days than the unaged control drupes (Table 1). The resulting seedling dry matter production and computed vigour index showed significant differences among accelerated aging treatments and germination growth conditions (Table 1.)

The germination capacity of the teak drupes declined with increasing period of accelerated aging under both the testing conditions. Although the reasons are not clearly known, it is thought that subjecting drupes to consecutive hostile conditions, i.e. accelerated aging and germination in hot humid condition of

Table 1. Effect of accelerated aging (100% RH and 40°C) on germination (%), total number of seedlings/100 drupes, days to seedling emergence, dry matter and vigour of 10-month-old teak drupes

	Open condition (24 °C, 66% RH)					Mist chamber (28 °C, 82% RH)				
Treatment	Germination (%)	Seedlings/ 100 drupes	Days to emergence	DMP (mg seedling)	Vigour index	Germination (%)	Seedlings/ 100 drupes	Days to emergence	DMP (mg seedling)	Vigour index
T_0 - Control	18^{d} (24.79)	24^{c}	18^{c}	29^{e}	165^{d}	14^{c} (21.94)	19^{d}	12^{bc}	24^{b}	138^{c}
T_1 - AA for 5 days	30^{bc} (33.03)	38^{bc}	16^{ab}	34^{cde}	289^{cd}	20^{bc} (26.55)	21^{cd}	14^{c}	26^{b}	219^{bc}
T_2 - AA for 6 days	37^{bc} (37.16)	51^{ab}	16^{ab}	36^{bcd}	350^{bc}	21^{bc} (27.03)	24^{cd}	13^{bc}	28^{ab}	232^{bc}
T_3 - AA for 7 days	43^{ab} (41.14)	50^{ab}	16^{ab}	36^{bcd}	455^{ab}	29^{ab} (32.68)	39^{abc}	9^{a}	32^{a}	321^{ab}
T_4 - AA for 8 days	39^{ab} (38.55)	43^{ab}	16^{ab}	33^{de}	366^{bc}	24^{bc} (29.15)	30^{bcd}	13^{bc}	30^{ab}	280^{bc}
T_5 - AA for 9 days	30^{bc} (33.03)	40^{b}	17^{bc}	39^{abc}	322^{bc}	26^{abc} (30.62)	29^{bcd}	13^{bc}	27^{ab}	275^{bc}
T_6 - AA for 10 days	38^{bc} (37.93)	50^{bc}	16^{ab}	44^{a}	467^{bc}	24^{bc} (29.29)	30^{bcd}	12^{bc}	28^{ab}	297^{bc}
T_7 - AA for 11 days	39^{ab} (38.57)	53^{ab}	15^{a}	40^{ab}	419^{bc}	39^{a} (38.32)	54^{a}	9^{a}	29^{ab}	479^{a}
T_8 - AA for 12 days	39^{ab} (38.55)	49^{ab}	17^{bc}	35^{bc}	370^{bc}	32^{ab} (34.44)	47^{ab}	10^{a}	26^{b}	353^{ab}
T_9 - AA for 13 days	53^{a} (46.92)	64^{a}	15^{a}	37^{bcd}	584^{a}	29^{ab} (32.91)	37^{ad}	11^{ab}	30^{ab}	344^{ab}
T_{10} - AA for 14 days	31^{bc} (33.59)	43^{b}	17^{bc}	37^{bcd}	342^{bc}	33^{ab} (35.26)	33^{bcd}	9^{a}	29^{ab}	355^{ab}
T_{11} - AA for 15 days	24^{cd} (29.59)	43^{b}	16^{ab}	37^{bcd}	265^{cd}	24^{bc} (29.04)	31^{bcd}	12^{bc}	27^{ab}	246^{bc}
Mean	35 (36.07)	46	16	36	366	26 (30.60)	33	12	28	294

(Figures in parentheses indicate arc sin values).
Means followed by the same letters in a column are not significantly different by DMRT.
AA = accelerated aging.
DMP = dry matter production.

the mist chamber, would impair the germination process plausible in mist chamber. It is expected that the embryos of the seeds that did not germinate most especially after the conditioned state would have lost their viability. However, this approach has great potential for nursery men to utilise the acceleratedly aged drupes for immediate sowing without opting for storage. This area requires detailed studies.

Acknowledgements

The senior author is grateful to the Sterling Tree Magnum (India) Limited, Chennai, for providing the fellowship for Ph.D. (Seed Technology) programme and R. Umarani, Assistant Professor of Seed Technology, and N. Angamuthu, Range Officer, Tamil Nadu Forest Department, for their valuable suggestions and help.

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