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EFFECT OF SEED SIZE GRADING ON THE GERMINATION AND GROWTH OF TEAK (*TECTONA GRANDIS*) SEEDLINGS

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INDIRA, E. P., CHAND BASHA, S. & CHACKO, K. C. 2000. Effect of seed size grading on the germination and growth of teak (*Tectona grandis*) seedlings. The effect of size grading of teak seeds on seedling production and growth was studied in detail at the Kerala Forest Research Institute at Palapilly, Thrissur, India. The fruit (seed) characters were also studied. It was observed that most fruits belonged to the 9–12 mm grade and that 98% of the total seeds were of size from 9 mm up to 18 mm and more. The nursery experiments showed that fruit size did not have any influence on the survival and seedling growth. However, fruits with less than 9 mm diameter had low germination percentage leading to less number of seedlings.

Key words: *Tectona grandis* - teak seeds - seeds grading - seed germination - seedlings

INDIRA, E. P., CHAND BASHA, S. & CHACKO, K. C. 2000. Kesan pemeringkatan saiz biji benih ke atas percambahan dan pertumbuhan anak benih jati (*Tectona grandis*). Kesan pemeringkatan saiz anak benih jati ke atas pengeluaran dan pertumbuhan anak benih dikaji secara terperinci di Kerala Forest Research Institute di Palapilly, Thrissur, India. Ciri-ciri buah (biji benih) juga dikaji. Kebanyakan buah yang dicerap adalah dalam peringkat 9-12 mm dan 98% daripada jumlah biji benih adalah yang bersaiz daripada 9 mm hingga 18 mm dan lebih. Eksperimen tapak semaian menunjukkan bahawa saiz buah tidak mempunyai apa-apa pengaruh terhadap kemandirian dan pertumbuhan anak benih. Bagaimanapun, buah-buah yang bergaris pusat kurang daripada 9 mm mempunyai peratus percambahan yang rendah yang mengurangkan bilangan anak benih.

Introduction

For the last 150 years there have been efforts to establish standards for teak plantation technology. Standardisation of teak nursery practices has received much attention among foresters and scientists.

Studies have been conducted to correlate germination, survival percentage, vigour and seedling growth with size of seeds in teak. Eidmann (1934), Samapudhi (1967), Banik (1978), Kumar (1979) and Syam (1988) favour use of large-sized seeds for better germination and survival. No correlation between seed size and survival (Sarowart 1964) or seed size and growth in teak (Anonymous 1956, Sarowart 1964) has been reported. However, the conclusions, in most cases, are based on small samples. Although, an adequate availability of the preferred seed-grade in the seed lots is a major factor deciding its application at field level,

it is important to establish the optimum seed size. This aspect has not been hitherto looked into. Hence, this experiment was undertaken to study the seed characters such as size and weight of seeds collected from different sources and also to find out the effect of size grading on production and growth of teak seedlings.

Materials and methods

Seed collection

Teak fruits (generally known as teak seeds) were collected from natural forests, plantations, seed stands, seed orchards and individual plus trees to study the fruit characters. Fruits were also collected from six plantations and four seed stands of main teak growing areas in Kerala for nursery experiments. These areas are located at 8–11°N and 76–77° E and are of low to medium altitude. Newly fallen mature fruits were collected from these stands during January and February.

After collection, the fruits were dried and cleaned by removing the dried calyx. Experimental samples were drawn from these lots and their seed weight measured.

Size grading

The fruits were size graded using sieves of different mesh sizes. The different size-grades were 6 mm pass (< 6 mm), 6 mm retained (6–9 mm), 9 mm retained (9–12 mm), 12 mm retained (12–15 mm), 15 mm retained (15–18 mm), and 18 mm retained (> 18 mm diameter). The smallest (6 mm pass) and the biggest fruits were discarded since most of the smallest fruits were ill-developed and biggest (18 mm retained) were either absent or very few.

Nursery trial

In this experiment, four seed grades 1 to 4 corresponding to size classes 15–18, 12–15, 9–12 and 6–9 mm from two sources, i.e. plantation and seed stand, were used. Randomised block design was used with three replications for the trial. Standard raised nursery beds of size 12 × 1.2 × 0.3 m were taken at the Institute's Field Centre, Palappilly. Each bed represented a block which was divided into equal plots of 1.2 m^2. In each plot 24 × 24 (576) seeds were sown in equal spacing of 5 × 5 cm. Before sowing, the seeds were soaked overnight in water. Weeding was carried out regularly and the nursery was maintained for one year.

Each seed was observed daily for germination. At the end of one year, measurements on shoot length, collar diameter and stump diameter were taken after careful removal of the seedlings from the nursery bed. Seedlings with 1–2 cm stump diameter (diameter of the root at its maximum thickness) were taken as plantable.

Table 1. Percentages by number and weight of teak 'seeds' (fruits) in different size grades

Source	Size grade											
	18 mm retained (> 18 mm)		15 mm retained (15–18 mm)		12 mm retained (12–15 mm)		9 mm retained (9–12 mm)		6 mm retained (6–9 mm)		6 mm pass (< 6 mm)	
	% No.	% wt.	% No.	% wt.	% No.	% wt.	% No.	% wt.	% No.	% wt.	% No.	% wt.
Natural forest (n=19)	Nil	Nil	14.66	20.42	4.20	6.27	80.46 (99.32)	72.66 (99.35)	0.68	0.66	Nil	Nil
Plantations (n=18)	0.003	0.006	28.12	31.27	4.93	7.12	65.21 (98.26)	60.88 (99.28)	1.67	0.69	0.08	0.26
Seed orchards (n=72)	Nil	Nil	11.19	16.65	4.20	4.51	82.55 (97.94)	77.73 (98.89)	2.06	1.11	Nil	Nil
Plus trees (n=55)	Nil	Nil	21.82	30.88	5.76	6.62	70.47 (98.05)	61.80 (99.3)	1.82	0.65	0.13	0.04
Seed stands (n=21)	Nil	Nil	19.00	28.48	5.39	6.14	73.63 (98.02)	64.68 (99.3)	1.76	0.61	0.24	0.09

Figures given in parentheses under 9 mm retained column indicate cumulative figures for size grades above 9 mm.

Percentage of germination, total number of seedlings (TNS) and number of plantable seedlings (NPS) were estimated and they were subjected to analysis of variance after arcsin transformation. The grades were grouped according to the Duncan's multiple range test (DMRT).

Results and discussion

Fruit (seed) characters

The teak fruits fell mainly within the sizes of 6 to 18 mm. There were very few seeds larger than 18 mm or smaller than 6 mm. Most were of size 9–12 mm both by percentage by number (65.21–82.55) and percentage by weight (60.88–77.73) (Table 1). Also, it is evident that a significant part of the seeds (97.94 to 99.32% by number and 98.89 to 99.35% by weight) were of size greater than 9 mm.

The numbers of teak seeds per kg under different size grades are given in Table 2. There were 1000 seeds per kg above 18 mm, 1300–1400 seeds per kg of the size 15–18 mm, 1400–1600 seeds per kg of size 12–15 mm and 2000–2200 seeds per kg of size 9–12 mm. In the 6–9 mm size category, 2333 seeds per kg came from the natural forest and 4200–5500 seeds per kg from the other sources.

Table 2. Number of teak seeds per kilogram in different size grades

Source	Size grade				
	> 18 mm	15–18 mm	12–15 mm	9–12 mm	6–9 mm
Natural forest (n= 9)	na	1357	1419	2060	2333
Plantation (n=18)	1000	1411	1556	2100	5576
Seed orchard (n=72)	na	1389	1463	2190	4259
Plus tree	na	1335	1621	2167	5124
Seed stand	na	1389	1463	2190	4259

na - not available.

Seedlings

The effects of grading and seed sources on the germination percentage and numbers of total and plantable seedlings are shown in Table 3. The analysis of variance shows that there is significant difference between grades in respect of percentage of germination, total number of seedlings and number of plantable seedlings (Table 4). Grouping of seed grades shows that there is no significant difference among grades 15–18, 12–15, and 9–12 mm for percentage of germination, and numbers of total and plantable seedlings (Table 5). The grade 6–9 mm had shown poor performance with respect to germination which led to low percentages of total and plantable seedlings. Our results do not fully agree with those of other studies stating that larger teak seeds have better germination (Samapudhi 1967), germination increased with increasing fruit size in two provenances (Kumar 1979) and that size of the fruit is the primary factor determining

germination percentage (Banik 1978). Instead, we find that all seeds above 9 mm size, irrespective of size grades, have similar germination behaviour. Although Samapudhi (1967) noted that survival percentage decreases with the decrease in seed size, our studies show that seed size has no relation with survival, confirming the result of Sarowart (1964).

Table 3. Effect of grading on germination and total number of seedlings and number of plantable seedlings

Treatment	Germination (%)	Survival (%)	% TNS to TSS	% TNS to seeds germinated	% NPS to TSS	% NPS to seeds germinated	% NPS to TNS
Plantation seeds							
(Gr.15–18 mm)	13.54	10.37	10.07	74.37	7.29	53.84	72.4
(Gr.12–15 mm)	17.88	14.97	14.41	80.59	11.11	62.14	77.1
(Gr.9–12 mm)	14.02	11.02	10.42	74.32	5.21	37.16	50.0
(Gr.6–9 mm)	5.58	4.58	4.17	78.98	2.50	47.35	60.0
Seed stand							
(Gr.15–18 mm)	30.38	23.35	22.22	73.14	17.36	57.14	78.1
(Gr.12–18 mm)	26.30	21.48	20.83	79.20	16.15	61.41	77.5
(Gr.9–12 mm)	26.69	21.53	21.18	57.25	15.28	57.25	72.1
(Gr.6–9 mm)	10.56	8.75	7.92	75.00	6.67	63.16	84.0

TNS = total number of seedlings, TSS = total number of seeds sown, NPS = number of plantable seedlings.

Table 4. Effect of seed grading on % percentages of germination, TNS and NPS out of the total number of seeds sown

Source	DF	Mean sum of squares		
		% germination to TSS	%TNS to TSS	%NPS to TSS
Grade	3	211.10**	153.21**	128.02**
Source	1	479.42**	311.01**	326.52**
Repl	2	14.11	2.40	16.44
Grade x Source	3	14.61	11.04	17.76
Error	14	14.39	11.85	9.41

** significant at 1% level, TSS = total number seeds sown,
TNS = total number of seedlings, NPS = number of plantable seedlings.

Table 5. Grouping of seed grades with respect to percentages of germination, TNS and NPS

Grade	Germination %	TNS %	NPS %
2	22.09*	17.62*	13.63*
1	21.96*	16.71*	12.33*
3	20.36*	15.80*	10.25*
4	8.07	6.05	4.59

* Figures superscribed by * in each column are in the same group (5% level).

Table 6. Effect of seed grading on the percentages of TNS and NPS out of total number of germinated seeds

Source	DF	Mean sum of squares		
		% TNS out of GS	% NPS out of GS	% NPS out of TNS
Grade	3	41.91	156.69	161.86
Source	1	8.09	164.12	437.79*
Repl	2	68.47	323.01*	332.53*
Grade x Source	3	36.92	109.38	74.57
Error	14	55.79	78.20	85.94

* significant at 5% level, GS= germinated seeds,
TNS = total number of seedlings, NPS= number of plantable seedlings.

While the percentages of the total number of seedlings and the number of plantable seedlings out of the total number seeds sown were quite low for fruits of the 6–9 mm size grade, the percentage of plantable seedlings out of the total number of plants was as high as in other grades (Table 3). The analysis of variance (Table 6) also shows that there is no significant difference between grades with respect to the percentages of the total number of seedlings and the number of plantable seedlings out of the total number of germinated seeds which indicates that size of the fruits is not a determining factor in the growth of seedlings. This agrees with Anonymous (1955) and Sarowart (1964). In some other species, it is reported that larger seeds have advantage over smaller seeds in germination and seedling growth possibly due to their larger embryo, gametophytic tissue, cotyledonous tissue or initial leaf area (Farmer 1980). But in teak, there is no positive relation between fruit size and seed size (personal observation). From the present study it is clear that very small seeds below 9 mm diameter may be discarded to obtain higher overall germination percentage and higher numbers of total and plantable seedlings. But once the seeds are germinated, there is no difference in growth between seedlings of different grades. As less than two percent of seeds belong to this size grade, there is no need of any size grading in teak seeds.

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