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ESTIMATION OF QUALITY OF EUCALYPT SEEDS FOR SOWING IN NURSERIES

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ABSTRACT

A study was conducted at Nilambur to determine the optimum seed rate of *Eucalyptus grandis* and *E. tereticornis* for sowing in nursery beds. Two sowing methods and four seed rates were tried. Line sowing registered higher percentage of seedlings on seed bed and plantable containerised seedlings (PCS) as compared to broadcast sowing. Though higher seed rates produced greater number of seedlings on seed bed, the percentage of seedlings that developed into PCS increased with decrease in seed rate. The quantities of seeds of varying germination capacities required for sowing on a standard nursery bed is presented in tabular form.

1. INTRODUCTION

Eucalyptus grandis Hill ex Maid. and *E. tereticornis* Sm. plantations. in Kerala, are generally raised using 16 to 20 weeks old containerised seedlings (CS). For production of CS, seed bed nurseries are prepared and the seeds sown during January-February. The seeds are then covered with a thin layer of soil and the beds provided with overhead shade. The beds are regularly watered and the seedlings pricked out to polythene containers when the seedlings become 8 to 10 weeks old. These seedlings attain plantable size 8 to 12 weeks after potting.

A survey of the eucalypt nurseries in 1981 indicated (J.K. Sharma, pers. communication) that the quantity of seeds used for sowing in standard seed beds of 12x1.2m size varied from 25 to 240 g (1.74 to 16.67 g/m^2)at different places. This wide variation in seed rate was possibly because of the absence of proper technical guidelines for arriving at the seed rates. This study was aimed at evolving a suitable method to determine the germinability of seeds and prefix quantity of seeds to be sown in a standard bed.

2. MATERIALS AND METHODS

Seeds of *E. grandis* (1 kg = 27,00.000 seeds) and *E. tereticornis* (1 kg= 31,16,000 seeds) obtained from the Genetics Division of Tamil Nadu Forest Department. These seeds were sown on raised nursery beds of 10 x 1m as per the experimental design indicated below. Before sowing, the beds were demarcated into 2 x 1 m treatment segments (plots). The germination capacity of the seed lots was also determined using polyurethane foam (Chacko, 1983).

The following were the treatments;

A. *Eucalyptus grandis*

Treatment	Method of sowing	Weight of seeds used (in g/m^2)
T I	Line sowing	8
T2	"	6
T3		4
T4		2
T5	Broadcast sowing	8
T6		6
T7	"	4
T8	"	2

Note: The germination capacity of seed samples used - 73.19%

B. *Eucalyptus tereticornis*

Treatment	Method of sowing	Weight of seeds used (in g/m^2)
T I	Line sowing	8
T2		6
T3	"	4
T4		2
T5	Broadcast sowing	8
T6		6
T7	"	4
T8	"	2

Note: The germination capacity of seed samples used - 54.01%.

The experiment was laid out under completely randomised design (factorial) with 3 replicates for each treatments in the KFRI nursery at Nilumbur.

In line sowing, the seeds were uniformly sown in drills made 10 cm apart along the breadth of the bed. The seeds were then covered with a thin layer of soil to a thickness equal to the size of the seeds. In broadcast sowing. the seeds were mixed with fine sand, uniformly sown over the bed and then covered with a thin layer of soil as above. The beds were provided with overhead coirmat shade and irrigated twice a day on nonrainy days (approximately 40 litres of water twice a day) using rose cans.

When the seedlings were 10 weeks old, they were pricked out from the nursery beds and visually classified into three quality classes based on their yigour. For this purpose, three sample strips (0.2 x 1m) were selected at random along the breadth of the bed in each of the treatments. The mean shoot and root lengths and the number of seedlings in each class were recorded replication-wise. Of this, 450 seedlings from each quality class were pricked out into polythene containers of 10 x 15 cm size and maintained in the nursery. The height and general health of these seedlings were recorded after 59 days. At this stage, the CS were 18 weeks old.

The total number of the 18 weeks-old seedlings suitable for planting was recorded in all the three classes. Healthy seedlings above 20 cm in height were counted for this purpose. This information was used to make necessary correction in the classification of seedlings done earlier at the time of potting and to estimate the total number of PCS.

Statistical analysis

The data on total number of *E. grandis* and *E. tereticornis* seedlings per 0.2 m^2 of seed bed at 10 weeks after sowing were tested for normality subjecting it to log transformation (Montgomeny & Peck, 1982).

The transformed data were subjected to analysis of variance using SPSS/PC programme package. Comparison among treatments was done using the value of critical difference at 5% level. The log transformed data was transformed back after applying necessary correction (Nigarn and Gupta, 1979). The percentages of germinable seeds that developed into 71 days old seedlings and PCS were subjected to analysis of variance after log transformation of the values.

3. RESULTS AND DISCUSSION

Measurements of the seedlings classified into the three quality classes at the time of potting are given in Table 1. The data shows higher shpot-root ratio for taller seedlings for both the species.

Table 1. Mean shoot and root lengths of the seedlings of different quality classes (in seed beds arter 10 weeks of sowing)

Species	Quality class	Mean shoot length (cm)	Mean root length (cm)	Shoot-root ratio
Eucalyptus grandis	I	32.6	7.3	4.5
	II	21.8	6.2	4.2
	III	11.3	3.6	3.2
E. tereticornis	I	29.4	6.7	4.4
	II	20.8	5.0	4.2
	III	10.9	3 1	3.5

The percentage of seedlings in three quality classes which established after pricking out into polythene containers and subsequently attained plantable standards are given in Table 2.

Table 2. Percentage of seedlings established in polythene containers after pricking out from seed beds (18 weeks after sowing)

Species	Percentage of PCS obtained from each quality classes		
	I quality	II quality	III quality
E. grandis	90	25	Nil
E. tereticornis	83	67	14

The data reveal that none of the III quality *E. grandis* seedlings in containers recovered to the plantable standards, where as recovery in the II quality was 25%. At the same time 10% of the I quality seedlings failed to establish. In *E. tereticornis,* the recovery in III and II qualities were 14% and 67% respectively whereas 17% of the I quality *E. tereticornis* seedlings were found not suitable for planting at the end of the observation period.

Analysis of variance on the number of seedlings in different quality classes and the total number of PCS did not reveal any significant interaction between seed rate and sowing method.

The effect of different seed rates of *E. grandis* and *E. tereticornis* on production of seedlings in seed bed and PCS is presented in Table 3. For both the species. total number of seedlings per unit area of seed bed (column 8) increased with increase in seed rate where as the percentage of germinable seeds that developed into seedlings (column 9) decreased with increase in seed rate. The total number of plantable seedlings (column 10) increased with increase in seed rates except in *E. tereticornis* where the values were not significantly different The percentage of germinable seeds that developed into PCS increased with decrease in seed rate indicating greater economy of seeds in low seed rates. The production of seedlings in seed bed and PCS in relation to the germinable seeds in different seed rates is presented in figure 1.

Effect of two sowing methods on seedling production is given in Table 4. The production of seedlings in seed bed and PCS was maximum in line sowings. However, in broadcast sowing a greater percentage of seedlings in seed bed attained plantable standards (column 11).

There are a number of reports to show that the seedling percentage generally lags behind the germinative capacity, and the lower the germinative capacity. the greater would be the divergence (Dent, 1948). In other words, seedlings which are raised from seeds of low germinative capacity are weaker and suffer more casualties than seedlings raised from seeds with high germinative capacity'. This principle was found true for seeds with lower viability due to prolonged storage. In the present study, the seedlings have been retained in seed beds for a period of 10 weeks before being pricked out into polythene containers. During this period major portion of the weaker seedlings suffered competition and died. In *E. grandis* with 73% germinability this figure worked out to 68 to 87% whereas in *E. tereticornis* with 54% germinability the mortality was 57 to 80%. Though this information is inadequate to establish a relation between germination capacity and seedling establishment it does not give any indication of a low ,establishment rate associated with low germination capacity in the case of a eucalypt nursery where the initial seedling density is fairly high.

Table 3. Number of seedlings in seed bed and the number of plantable seedlings for diffetent seed rates

Species	Seed-rate g\m^2	Correspond-ing number of germin-able seeds	Seedlings available in seed bed 10 weeks after sowing					PCS per m^2 of seed bed, 19 weeks after sowing			
			I Qual.	It Qual.	III Qual.	Totat*	Total no. per m^2	Total as a % of germin-able seeds	Total no.	Percentage of total seedlings at 10 weeks after sowing	Percent-age of germin-able seed
			.....	.....no. pen 0.2m^2							
1	2	3	4	5	6	7	8	9	10	11	12
E. grandis	8	15809	78^b(16%)	94^b(19%)	324^b(65%)	503^c(100%)	2515^c	16^a	481^b	19	3^a
	6	11857	58^b(14%)	76^b(18%)	279^b(68%)	420^{bc}(100%)	2100^{bc}	18^{ab}	360^{ab}	17	3^a
	4	7905	41^a(12%)	67^b(19%)	238^b(69%)	351^b(100%)	1755^b	22^b	283^a	16	4^a
	2	3952	41^a(17%)	44^a (18%)	154^a (65%)	250^a(100%)	1250^a	32^c	256^a	20	6^b
E. rereticornis	8	13464	48^a(9%)	82^a(16%)	379^b(75%)	531^b(l00%)	2655^b	l8^a	750^a	28	6^a
	6	10096	55(11%)	80^a(16%)	357^b(73%)	490^b (100%)	2450^b	26^{ab}	829^a	34	8^{ab}
	4	6732	45^a(12%)	78^a(21%)	244^{ab}(67%)	378^{ab}(100%)	1890^{ab}	28^b	626^a	33	9^b
	2	3366	37^a(13%)	66^a (23%)	186^a(64%)	291^a (100%)	1455^a	43^c	518^a	36	15^c

Figures superscribed by different letters in a column for a particular species are significantly different at P=0.05.

Figures in paranthesis indicate the percentage of seedlings in different quality classes.

* The total corresponds to retransferred log scale values after applying correction and hence differs from the actual total of I, II & III quality classes.

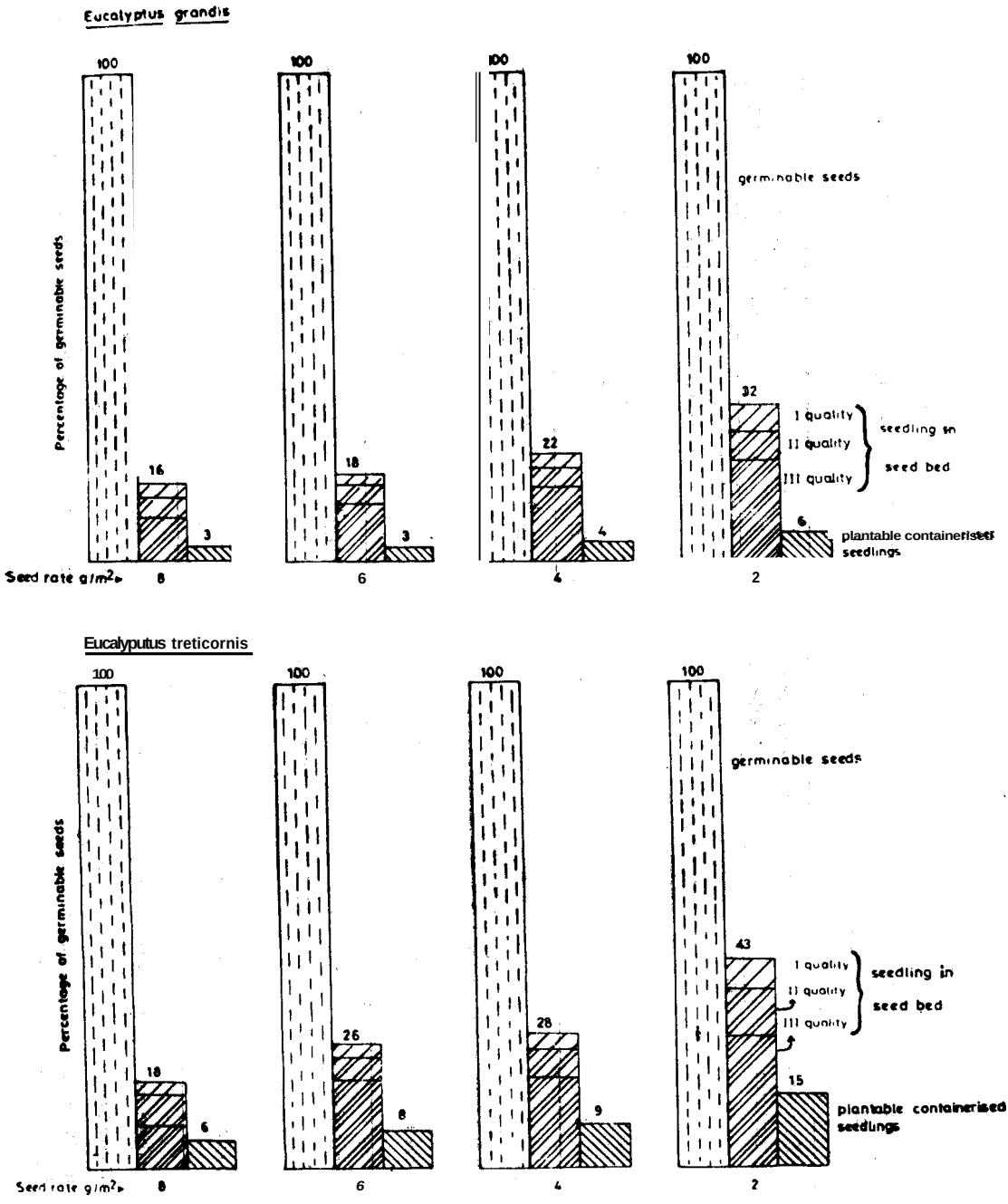

Fig. 1, Percentage of germinable seeds with different seed rates developing into seedlings in seed bed and plantable containerised

Table 4. Number of seedlings in seed bed and the corresponding number of plantable containerised seedlings for the two sowing methods

Species	Method of sowing	Seedlings available on seed bed at 10 weeks after sowing						Plantable containerised seedlings per m^2 of seed bed, at 19 weeks after sowing		
		I Qual.	II Qual.	III Quai.	Total*	Total number per m^2	Total as a percentage of germinable seeds	Total number	Percentage of total seedlings at 10 weeks after sowing	Percentage of germinable seeds
		.....number per 0.2 m^2								
1	2	3	4	5	6	7	8	9	10	11
E. grandis	Line sowing	54[a] (12%)	81[b] (17%)	336[b] (71%)	476[b] (190%)	2380[b]	275[b]	357[a]	15	4[a]
	Broadcast sowing	50[a] (18%)	55[a] (20%)	170[a] (62%)	286[a] (100%)	1430[a]	16[a]	307[a]	21	3[a]
E. tereticornis	Line sowing	56[b] (9%)	109[b] (17%)	483[b] (74%)	640[b] (100%)	3200[b]	42[b]	944[b]	30	13[b]
	Broadcast sowing	36[a] (14%)	53[a] (21%	164[a] (65%)	268[a] (100%)	1300[a]	17[a]	469[a]	36	6[a]

Figures superscribed by different letters in a column for a particular species are significantly different at P=3.05

Figures in paranthesis indicate the percentage of seedlings in different quality classes

* The total corresponds to retransferred log scale values after applying correction and hence differs from the actual total of I,II & III quality classes.

Therefore for practical purposes, the available data can be extrapolated to work out the quantities of seeds of different germination capacities for sowing on a standard nursery seed bed. Tables 5 and 6 provide the quantities of seeds with different germination capacities to be sown per m^2 of bed ta produce different numbers *of* PCS of *E. grandis* and *E. tereticornis.*

Table 5. Quantity of *E. grandis* seeds to be sown in one m^2 of nursery bed to obtain different numbers of Plantable containerised seedlings

PCS expected per m^2 of seed bed	256	283	369	481	
Germination capacity (%) of the seed lot	Quantity of seeds per m^2 (in grams)				
10	14.63	29 28	4391	58.56	
20	7.31	1464	21.96	29 28	
30	4.87	9.76	1464	19.52	
40	3 65	7 32	10.98	14.64	
50	2 92	5 85	8.78	11.78	
60	2 43	4.87	7.32	9.76	
70	2 09	4.18	6.27	8 36	
73.19	2	4	6	8	Test Sample
80	1.83	3.65	5 49	7 32	
90	1 63	3 25	4 88	6.51	
100	1.46	2 93	439	5.86	

Table 6. Quantity af *E. tereticornis* seeds to be sown in one m^2 of nursery bed to obtain different numbers of Plantable containarised seedlings

PCS expected per m^2 of seed bed	518	626	829	749	
Germination capacity (%) of the seedlot	Quantity of seeds per m^2 (in grams)				
10	19 8	21.6	32 4	43 2	
20	5.4	10.8	16 2	21 6	
30	3.6	7 2	10.8	14.4	
40	2.7	5.4	8.1	10 8	
50	2.2	4 3	6.5	8 6	
54 01	2	4	6	8	Test sample
60	1.8	3.6	5.4	7.2	
70	I .5	3.1	4.6	6 2	
80	1.4	2.7	4.1	5.4	
90	1.2	2.4	3.6	4.8	
100	1.1	2.2	3.2	4.3	

4. CONCLUSIONS AND RECOMMENDATIONS

Eventhough higher seed rates produced greater number of seedlings in seed bed, the percentage of seedlings that developed into PCS increased with decrease in seed rate. About 70% of eucalypt seedlings in seed bed which remained weak and suppressed died during the first 10 weeks.

Method of sowing influenced the production of seedlings in seed bed as well as the PCS. For both *E. grandis* and *E. tereticornis* line sowing registered higher percentage of seedlings in seed bed and PCS.

The study recommends line sowing of seeds of *E. grandis* and *E. tereticornis* in seed beds for production of maximum number of seedlings in seed bed and CS. The seedlings from seed beds when pricked out into polythene containers of 10 x 15cm size, 2 months after sowing, attain plantable size at the age of 18 weeks. The quantities of eucalypt seeds of different germination capacities recommended to be sown on a standard nursery bed of 12 x 1.2 m are presented in Tables 7 and 8.

Table 7. Quantity of *Eucalyptus grandis* seeds to be sown in standard nursery bed of 12 x 1.2 m.

PCS expected per standard bed of 12 x 1.2 m	3700	4100	5200	6900
Germination capacity (%) of the seedlot	Quantity of seeds (g) to be sown per standard nursery bed of 12 x 1.2 m.			
10	210	420	630	840
20	110	210	320	420
30	70	140	210	280
40	50	110	160	210
50	40	80	130	170
60	40	70	110	140
70	30	60	90	120
80	30	50	80	110
90	20	50	70	90
100	20	40	60	80

Table 8. Quantity of *Eucalyptus tereticornis* seeds to be sown in standard nursery bed of 12 x 1.2 m.

Number of PCS expected per standard bed of 12 x 1.2 m	7500	9000	12000
Germination capacity(%) of the seedlot	Quantity of seeds (g) to be sown per standard nursery bed of 12x 1.2 m		
10	160	310	470
20	80	160	230
30	50	100	169
40	40	80	120
50	30	60	90
60	30	50	80
70	20	50	70
80	20	40	60
90	20	40	50
100	20	30	50

For a given germinative capacity and an expected number of plantable seedlings, the quantity of seeds to be sown can be read out from the above tables. The germination capacity of a particular seed sample can be determined by employing polyurethane foam method as follows. A small quantity of seeds (say 1 g) may be broadcast sown on a foam sheet of 25 x 25 cm fully socked in water kept inside a tray of 30 x 30 cm. The number of seedlings that germinate upto 10 days may be counted. The germination percentage (capacity) may be worked out as follows;

$$\text{Germination capacity} = \frac{\text{No. of germinating seeds} \times 100}{\text{weight of seed sample in grams} \times \text{no. of seeds per gram}^*}$$

(* In the test sample it is 2700 for *E. grandis* and 3116 for *E. tereticornis)*

In disease prone areas it has been observed that a high seedling density on seed bed increases the chances of fungal diseases and hence it may be advisable to prefer a low seed rate. On the other hand, in relatively disease free areas, if the seed is less expensive compared to the nursery costs it may be economical to prefer a higher seed rate to produce maximum seedlings from unit area.

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