RESEARCH ARTICLE

VARIABILITY STUDIES IN SEED MORPHOLOGY AND GERMINATION PARAMETERS OF *DALBERGIA LATIFOLIA* (ROXB.) IN KERALA

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Abstract: Thirty plus trees have been selected from dominant rosewood growing areas in Kerala based on growth attributes like tree height, girth at breast height, clean bole height and seed yield. Seeds were collected from these identified genetic resources and incorporated in the evaluation program. The thirty plus trees differed significantly due to various seed attributes coupled with the germination traits. Considering all the seed and germination attributes, the superiority of seven progenies *viz*., KLMYKUT 1, KLNLKAR 2, KLNLKAR 4, KLNMNEL 3, KLNMNEL 6, KLTMPLO 5 and KLTRMAC 6 were evidenced. The variability studies on growth attributes indicated that the genotypic co-efficient of variation was higher than the phenotypic co-efficient of variation for most of the characters and expressed that these characters are strongly under genetic control.

Keywords: *Dalbergia latifolia,* Seed morphological, Germination traits, Variation

INTRODUCTION

Dalbergia latifolia (Roxb.) belongs to the family of Fabaceae, predominantly a single-stemmed deciduous tree with a dome shaped crown of lush green foliage, which on wet sites is not shed. The trees reach a height of 20–40 m with a girth of 1.5–2 m. The bark is gray, thin with irregular short cracks, exfoliating in fibrous longitudinal flakes. Leaves are alternate, odd-pinnate, with 5-7 unequal-sized leaflets originating from the same rachis. Leaflets are broadly obtuse, dark green on top and pale on the bottom. Flowers are white in axillary panicles, 0.5–1 cm long. The brown pods are oblong-lanceolate and pointed at both ends. They contain 1–4 smooth brown seeds and do not open at maturity. The timber of *Dalbergialatifolia*is stronger and much harder than teak and has a slightly higher elastic limit than Burma teak (Pearson and Brown, 1932). Indian rosewood can be seasoned either in the air or in the kiln. It darkens in color during kiln seasoning, thereby gaining value. The hardwood is durable, and no treatment against insects and fungi is required. But the sapwood is perishable and hence needs treatment with preservatives.

For any tree improvement program, the determination of the species, or geographic source within the species, and the amount, kind, and cause of variation within the species are very important initial steps (Zobel and Talbert, 1984; Kumar and Luna, 2010). Abundant variation is available in trees in nature, which the foresters can tap and use to get the maximum improvement in a short span of time. Intensive studies on variation within species are necessary for the improvement programme to be successful. However, such studies on variation in *Dalbergia latifolia* genetic resources are not available and thus warrant intensive research.

Selection of superior or "plus" trees is a key factor in a genetic improvement program. The heritability of selected traits and the biology of a species contribute to the development of appropriate tree selection procedures and breeding plans based on economic importance. Since variability is a prime requisite for a tree genetic resources selection programme, it is necessary to detect the amount of variation existing within and between the populations. The estimation of heritability helps in assessing the heritable portion of variation and would help in selection. Hence, it is worthwhile to determine the heritable components, for which detailed studies are lacking in rosewood.

Genetic diversity is of primary importance not only for species persistence but also for its improvement. It is also important that considerable variability for economic traits exists in the population for profitable exploitation through breeding or selection. Traditionally, the genetic variation of trees is studied following the approaches of progeny testing and provenance trials. A clear understanding of the degree of divergence for economic characters in the species will be an added advantage (Kumaran *et al*., 2010; Kala *et al*., 2012; Kumar *et al*., 2014; Prabakaran*et al*., 2019). Studies on the genetic divergence in the species under investigation have not been undertaken, which underscores the need for intensive research. Hence, the current study was aimed at evaluating the genetic variation in seed physical and germination parameters collected from various parts of Kerala.

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MATERIALS AND METHODS

Plus trees of Rosewood

Dalbergia latifolia (Rosewood) seeds were collected from 34 identified plus trees in various parts of Kerala during the years 2017–2018.

- The collected seeds were processed as per the standards, and seed the morphological parameters (Seed length, seed width and hundred seed weight) were measured.
- Seeds from identified plus trees were tested for germination parameters, *viz.* mean daily germination, peak value of germination, germination value, germination rate and germination per cent.

Statistical analysis

The SPSS statistical package (version 2011) was used to analyse the observed data.The Duncan Multiple Range Test (DMRT) was performed at a 5% significance level to observe the homogeneous sub-set between the Plus Trees. The variability, heritability in the broad sense, genetic advance as percent of mean, phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were worked out for seed physical and germination traits, as suggested by Lush (1940), Johnson *et al*., (1955) and Burton (1952).

RESULTS AND DISCUSSION

In the current study, 30 plus trees from Kerala were screened based on morphological traits. Kumaran *et al*., (1991) collected seeds from 28 one parent families of neem in seven agro climatic zones of Tamil Nadu and studied variation and heritability of the seed length to seed breadth ratio and 100-seed weight.

Variation in seed morphological traits

Genetic analysis was performed on 30 progenies to maximize the potential of the available genetic resource base in rosewood for seed variability (Table 1). Significant variations were observed among 30 progenies of rosewood for all the seed attributes, *viz*., seed length, seed width, hundred seed weight, germination value, peak value, mean daily germination, germination rate and germination per cent. Seven progenies, *viz*., KLMYKUT 1, KLNLKAR 2, KLNLKAR 4, KLNMNEL 3, KLNMNEL 6, KLTMPLO 5 and KLTRMAC 6, showed high values for all seed parameters consistently. A plethora of workers have reported such seed variability due to progenies, seed sources, or provenances in several species, including *Toona ciliate* (Mohanraj *et al*., 2022); *Bixaorellana* (Umadevi *et al*., 2020); and *Azadirachtaindica* (Prabakaran *et al*, 2019).

Variation in seed germination traits

Among the seed characteristics, the 100-seed weight and germination rate, in combination with the germination percentage, were very effective in a practical tree improvement and utilization program (Table 2). In the current study, 100-seed weight varied between 4.79 g (KLTRMAC 6) and 7.85 g (KLMUADI 3). Considering the major seed attributes, KLNMNEL 3, KLTMPLO 5, KLNLKAR 2 and KLNMNEL 6 recorded high values, which were in the order of seed length (7.24 mm, 7.05 mm, 7.04 mm and 7.03 mm), seed width (5.54 mm, 5.95 mm, 5.76 mm, 5.76 mm and 5.75 mm). Four progenies, viz., KLMUADI 3, KLNWBEG 3, KLCHPAL 6 and KLSWMEP 7 showed high values for hundred seed weight (7.85 g, 7.80 g, 7.58 g, 7.20 g and 7.05 g), respectively) and thus proved amenable to immediate deployment.

Germination percent (78.1%, 76.8%, 71.1%, and 92.3%), mean daily germination (4.84, 6.08, and 5.25), peak value (3.66, 3.58, and 3.66), germination value (17.68, 21.94, and 17.68), and germination rate (4.34, 4.64, and 4.61) indicated the superiority of three progenies, namely, KLMYKUT 1, KLNLKAR 2, KLNLKAR 4.

Similar variation on seed morphology and germination attributes was observed in *Azadirachtaindica* (Prabakaran *et al*., 2019), *Mimosa scabrella* (Menegatti *et al*., 2019), *Delonixregia* (Mohammad and Abdul Rahman 2019) and *Prosopisjuliflora* (Reeja *et al*., 2018) which are attributed to the ecological factors observed in the place of collection (mother land) of the source material. The seed source variations were reported in many tree species (Ye *et al*., 2019) were controlled by site quality and climatic factors. Variations due to altitude (Barnett and Farmer, 1978) or region of collection (Bonner, 1984) were also documented. Hence the variation due to seed attributes and germination observed in the current investigation may be due to location and altitude, as evident from the above assertions.

Variability and heritability studies in rosewood seed morphological and germination attributes

The studies on seed attributes deployed in 30 progenies in the current investigation exhibited that the estimates of GCV were lower than that of PCV, which indicated that the characters studied were influenced by non-additive gene action. The germination rate recorded the maximum values for PCV (42.08 %) and GCV (41.51 %) followed by germination value, which recorded the PCV and GCV values of 36.54 % and 35.12 % respectively (Table 3).

The observations on seed physical attributes of 30 progenies of *Dalbergialatifolia showed that the* genotypic coefficient of variation was lesser than the phenotypic coefficient of variation, indicating that the characters studied were influenced by non-additive gene action. Similarly, high heritability levels were reported for fruit and seed traits in *Azadirachtaindica* from different provenances (Philomina, 2000). *Azadirachtaindica* (Prabakaran *et al*., 2019) lend support for the results obtained in the

current study; it was established that the phenotypic variances were greater than the corresponding genotypic variances for all the seed and germination attributes. The results indicated that the expressions of these characters were influenced by the environmental factors (Sahoo *et al.,* 2016) and the results are in consonance with the findings of current study.

With respect to the improvement of species, the genetic component of variation is the only important factor that transfers to next generation. Heritability assessment shows the effectiveness with which genotypic selection can be based on phenotypic performance (Gohil and Pandya 2009). The best improvements are made for characteristics that are strongly under genetic control and have a wide range of variability (Zobel, 1971).

In the present investigation, the heritability values of seed attributes were very high and the germination rate recorded the highest heritability and hundred seed weight recorded the lowest heritability. The high heritability exhibited by germination value, germination rate, mean daily germination, peak value and germination percent bears great significance for relaying these characters towards selection and improvement of genetic resources . Due to the provenance effect, similarly high heritability values for seed traits have been reported in *Santalum album* (Krishnakumar *et al.,* 2017) and *Azadiracthtaindica* (Prabakaran *et al.,* 2019), which is consistent with the current study's findings. The high heritability and genetic advance of the seed parameters revealed the inherited nature of the characters. The selection effect associated with such high levels of heritability may be under the control of additive gene action.

Table 1. Seed morphological attributes Plus Trees of *Dalbergialatifolia*

S. No	Plus Trees	Seed length (mm)	Seed width (mm)	100 Seed weight (g)
1	KLPKWAL 1	5.45	3.86	5.53
2	KLPKWAL 5	6.72*	4.87	5.15
3	KLNMNEL 1	5.55	4.09	5.21
4	KLNMNEL 3	7.24*	5.54*	5.60
5	KLNMNEL 6	7.03*	5.75*	5.47
6	KLCHPAL 1	5.65	3.97	5.91
7	KLCHPAL 6	4.96	3.97	7.58*
8	KLCHVEL 5	6.93*	5.34*	5.79
9	KLMKATP 1	6.02	5.14*	6.20
10	KLMYKUT 1	5.38	4.65	5.11
11	KLMYKUT 7	5.75	3.97	5.86
12	KLKNKAN 1	5.21	3.88	5.50
13	KLKNTAL 2	5.95	4.04	6.51
14	KLMUADI 2	6.78*	5.17*	5.78
15	KLMUADI 3	6.94*	5.28*	7.85*
16	KLMUNER 2	4.56	3.89	5.84
17	KLMUNER 4	4.69	3.68	5.47
18	KLTRMAC 1	5.87	4.07	5.96
19	KLTRMAC 6	6.09	5.19*	4.79
20	KLTMPLO 4	6.47*	5.64*	5.70
21	KLTMPLO 5	7.05*	5.95*	7.05*
22	KLKOKON 1	5.18	4.39	5.95
23	KLRAVAD 2	5.83	3.99	5.34
24	KLRAVAD 5	5.22	3.67	6.76*

25	KLNLKAR 2	6.17	5.76	6.47
26	KLNLKAR 4	4.85	3.86	5.30
27	KLSWMEP 4	4.98	3.22	7.01*
28	KLSWMEP 7	5.97	3.87	7.20*
29	KLNWBEG 3	7.04*	5.34*	7.80*
30	KLNWBEG 7	5.43	3.87	5.83
Mean		**5.90**	**4.53**	**6.05**
SEd		**0.19**	**0.28**	**0.31**
CD (0.05)		**0.38**	**0.56**	**0.63**

Table 2. Seed germination attributes Plus Trees of *Dalbergialatifolia*

S. No	Plus Trees	Germination (%)	Mean Daily Germination	Peak Value of germination	Germination Value	Germination rate
1	KLPKWAL 1	76.2*	4.09	3.50*	14.08	4.14*
2	KLPKWAL 5	43.8	2.07	2.06	4.16	1.21
3	KLNMNEL 1	58.7	3.64	2.63	10.37	0.97
4	KLNMNEL 3	68.0	5.43*	3.35	17.52*	2.43
5	KLNMNEL 6	69.4	5.15*	3.29	16.82	2.52
6	KLCHPAL 1	62.6	3.71	2.97	11.29	2.41
7	KLCHPAL 6	65.4	3.56	3.12	11.06	3.23
8	KLCHVEL 5	57.0	2.78	2.74	7.85	2.07
9	KLMKATP 1	59.2	3.68	2.78	10.35	1.51
10	KLMYKUT 1	76.8*	6.08*	3.58*	21.94*	4.64*
11	KLMYKUT 7	57.3	3.23	2.66	8.72	1.72
12	KLKNKAN 1	51.9	3.26	2.44	8.24	1.92
13	KLKNTAL 2	44.9	3.32	2.17	7.03	1.27
14	KLMUADI 2	34.1	1.80	1.61	2.89	0.97
15	KLMUADI 3	50.8	4.71	2.43	10.23	1.11
16	KLMUNER 2	54.2	4.34	2.60	11.28	1.92
17	KLMUNER 4	68.3	4.28	3.14	13.83	3.83
18	KLTRMAC 1	75.1*	7.52*	3.62*	27.12*	4.22*
19	KLTRMAC 6	79.6*	4.27	3.82*	16.42	4.54*
20	KLTMPLO 4	75.3*	4.53	3.64*	16.59	4.14*
21	KLTMPLO 5	72.8	6.63*	3.53*	23.85*	3.63
22	KLKOKON 1	69.4	4.69	3.25	15.44	2.72
23	KLRAVAD 2	70.8	4.25	3.31	13.7	3.12
24	KLRAVAD 5	74.5*	4.11	3.56*	14.44	3.98
25	KLNLKAR 2	71.1	5.25*	3.36	17.68*	3.61
26	KLNLKAR 4	78.1*	4.84	3.66*	17.81*	4.34*
27	KLSWMEP 4	71.7	3.15	3.42	13.48	3.68
28	KLSWMEP 7	70.5	4.43	3.35	15.36	3.80

29	KLNWBEG 3	72.5	4.67	3.43	14.46	3.87
30	KLNWBEG 7	66.6	5.21*	3.07	16.35	3.01
Mean		64.88	4.29	3.07	13.68	2.88
SED		**4.14**	**0.38**	**0.21**	**1.87**	**0.56**
CD (0.05)		**8.27**	**0.69**	**0.42**	**3.74**	**1.12**

Table 3. Genetic estimation of seed physical attributes of *Dalbergialatifolia* progenies

Traits	GCV	PCV	Heritability	GA(%) of mean
Seed length	6.17	11.56	27.93	9.68
Seed width	7.03	13.21	39.26	11.25
100 Seed weight	8.91	17.54	25.16	7.12
Mean Daily Germination	26.53	28.17	92.17	32.18
Peak Value of germination	19.86	21.39	89.53	24.58
Germination Value	35.12	36.54	96.85	41.59
Germination rate	41.51	42.08	97.56	85.07
Germination per cent	19.15	20.42	91.03	41.02

CONCLUSION

Seed morphological attributes of 30 plus trees of *Dalbergialatifolia* expressed wider variability in the evaluated seed parameters *viz.*,seed length, seed width, hundred seed weight, germination per cent, germination value, peak value, mean daily germination and germination rate. Considering all the seed characters investigated, seven progenies *viz*., KLMYKUT 1, KLNLKAR 2, KLNLKAR 4, KLNMNEL 3, KLNMNEL 6, KLTMPLO 5 and KLTRMAC 6 were found to express consistent superiority.

In seed traits of *Dalbergialatifolia*, germination rate followed by germination value and germination per cent recorded high genetic advances which indicated high additive genetic variance for these traits. Germination rate and germination percent could therefore be considered as important traits in *Dalbergialatifolia* for improvement programme.

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