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RESEARCH PAPER

Studies on variation in fruit, seed and seedling traits of *Lophopetalum wightianum* Arn.

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Abstract: The present investigation was carried out at College of Forestry, Sirsi, Karnataka during the year 2016-17 to identify the best seed source of *Lophopetalum wightianum* Arn. across its natural distribution areas in Uttara Kannada of Western Ghat. Fruits were collected from seven different seed sources of Karnataka *viz*., Janmane, Katagal, Gerusoppa, Kumta, Karwar, Banavasi and Sirsi. Fruits were measured for its colour, length, width and weight and seeds for its length and number of seeds per ten gram, then sown in nursery to study the variation in germination and growth parameters *viz*., seedling vigour, seedling height, biomass of seedling and survival per cent. Fruits and seeds collected from Sirsi and Janmane seed source were superior among other seed sources with respect to fruit length, width and its weight, seed length and number of seeds per 10 g, germination parameters, seedling vigour, seedling height, biomass and survival per cent considered for the study. These seed sources can be further validated through genotypic variation studies.

Key words: Biomass, Fruit length, Fruit width, Seed length

Introduction

Lophopetalum wightianum Arn. is a large evergreen tree and shade bearer. It is common in the evergreen forest of Travancore and on river banks at low elevations and is found in low elevation wet evergreen forests in swamps and along streams in Pakistan, India, Indochina and Southeast Asia. It is known as *Banate* or *Balpale* in Kannada, *Venkottei* in Tamil and *Venkadavan* in Malayalam and belongs to family Celastraceae. Sometimes it grows up to 30 m in height (bole, 15-18 m) and 3 m in girth. Bark greyish brown, scaly, blaze flesh coloured. It flowers during January-February and bears fruits in April-June. Leaves ovate-oblong or oblong-lanceolate or coriaceous. Flowers are in paniculate cymes, dull reddish or purple. Capsule is elongated about 12.5 cm in length. Seeds are thin and are many with white papery wings (Anon, 1962).

Population of riparian tree species in the evergreen forests of Western Ghats is in declining trend due to lack of proper management, conservation strategies, monitoring, drying up of streams, thick forest litter which results in poor or failure of natural regeneration and predation by wild animals (Anon, 1962). For a successful promotion of large scale plantations there is a need for carefully planned and well directed seed source research. In most of the successful tree improvement programme use of proper seed sources carries vital significance. *L. wightianum* is an important tree species of the rain forest ecosystem of Western Ghats, particularly of the Myristica swamps and riparian ecosystems and need to be protected and monitored for its successful regeneration (Keshavachandra *et al.,* 2014).

Material and methods

Present experiment was conducted during the year 2016-2017 in the poly house of Department of Silviculture and Agroforestry at College of Forestry, Sirsi which is situated at 14° 37' 13.24" N latitude and 74° 53' 53.52" E longitude and at an altitude of 663 m above mean sea level. The average annual rainfall is 2500 mm most of which is received between June to August. The temperature varies from 11.40 to 31.70 °C.

Fruits were collected from seed sources based on geographical location of the species for tree diameter class of about 90-100 cm during the fruiting season (May) in the year 2016. Seeds were collected from seven seed sources of Karnataka viz., Janmane, Katagal, Gerusoppa, Kumta, Karwar, Banavasi and Sirsi which were considered as treatments. From the same fruits, seeds were extracted and were randomly pooled for each seed source. Fruit and seed parameters such as fruit colour, fruit length, fruit width, fruit weight, seed length and number of seeds per 10 g. The seeds were randomly sown in the raised standard nursery bed composed of sand. The design employed was a Completely Randomized Design, comprising of seven treatments and three replications. Watering and weeding was done as and when it was required regularly throughout the experiment. Observations on daily germination were recorded up to 61 days from date of sowing. Germination percentage, peak value, mean daily germination, germination rate, germination value and survival per cent were worked out for each seed source. Seedling parameters such as seedling height, collar diameter, number of leaves, seedling vigour index and seedling biomass were assessed. Data collected was analyzed statistically using two way ANOVA using SPSS version 22 at 5 per cent significance level ($p = 0.05$).

Results and discussion

Information on morphological variation in seed characteristics amongst the natural populations of a species has been reported to be useful for tree improvement programmes

because quality of seeds determines the performance of seedlings for survival, growth and biomass allocation. In general, variation in germination of different species has been shown in relation to altitude, longitude and latitude of seed origin (Singh *et al.,* 2004)

Data revealed that seed traits for all seed sources showed significant differences (Table 1). Fruits and seeds collected from Sirsi and Janmane seed sources were found to be superior among other seed sources. Even though not much variations were observed with respect to fruit colour, dark brown fruit colour was observed in Janmane, Karwar and Sirsi seed sources. Light brown colour was observed in Katagal, Gerusoppa, Kumta and Banavasi seed sources. Fruits length amongst various seed sources varied from 8.17 to 11.17 cm, fruit width from 3.13 to 4.90 cm, fruit weight from 7.67 to 13.53 cm, seed length from 4.10 to 6.00 cm and number of seeds from 60.67 to 72.00. These variations in seed morphology characters mainly depend on the heritability, genetics, physiological potential and superiority of the species. Seeds are influenced by their source of origin, especially due to environmental variations in latitude, altitude, rainfall, temperature, moisture, and the external factors. Similar studies on seed variations were reported in many tree species (Kaushik *et al.,* 1999) dictated by environmental and edaphic factors and due to altitudinal variation. Results are in conformity with the similar studies conducted by Tomar and Rattan (2012) in *Hippophae salicifolia* and Masoodi *et al.* (2014) in *Abies pindrow* and reported that seeds are influenced by their source of origin, especially due to environmental variations in latitude, altitude, rainfall, temperature, moisture and the external factors.

Analysis of variance (ANOVA) revealed that the results were statistically significant for all the germination attributes (Table 2). Seed germination was recorded significantly higher in Sirsi (85.33 %) seed source followed by Janmane (75.34 %) and least germination was recorded in collection of Banavasi (50.67 %) seed source. Significantly higher mean daily germination was recorded in Janmane (1.83) seed source while, lowest mean daily germination was recorded from Banavasi (0.51) and Katagal (0.70) and Kumta (0.77) were found to be on par with each other. Sirsi (2.87) and Janmane (2.40) seed sources were recorded the significantly higher peak value of germination and lower peak value of germination was recored in Katagal (1.74) and Gerusoppa (1.75) which are on par with Banavasi (2.00). While, Kumta (2.06) seed source and Karwar (2.06) seed source were found to be on par with each other. Significantly higher germination value was recorded in the Sirsi (4.67) seed source followed by Janmane (4.39) seed source, these seed sources were found to be significantly superior over the rest of the seed sources for the trait. Least germination value was recorded in Gerusoppa (1.17). Significantly higher germination rate was recorded in Janmane (3.89) seed source followed by Sirsi (3.08) seed source and least germination rate was observed in Katagal (1.59) seed source. These variations among seed sources with respect to germination parameters may be due to their best direct correlation with fruit and seed traits. Generally, large seeds have early, speed and uniform germination, due to more endosperm nutrient pool. The size and shape of seeds is variable depending on the structure and form of the ovary and environmental conditions under which plant is growing. The

Table 1. Fruit and seed traits among seven seed sources of *L. wightianum*

Seed sources	Fruit colour	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Seed length (cm)	Number of seeds per 10 g
Janmane	Dark brown	10.00	4.37	12.13	5.20	70.00
Katagal	Light brown	8.17	3.13	8.93	4.40	61.00
Gerusoppa	Light brown	8.70	3.27	7.67	4.70	60.67
Kumta	Light brown	8.83	3.43	10.17	4.77	68.00
Karwar	Dark brown	9.80	3.53	10.57	4.87	71.67
Banavasi	Light brown	8.77	3.20	9.07	4.10	63.33
Sirsi	Dark brown	11.17	4.90	13.53	6.00	72.00
Mean	-	9.35	3.69	10.30	4.86	66.67
S.Em±	-	0.55	0.38	1.06	0.24	0.89
C.D. (0.05)	-	1.71	1.19	3.30	0.76	2.78

Table 2. Effect of seed sources on seed germination attributes and seedling vigour of *L. wightianum*

Seed sources	Germination per cent	Meandaily germination	Peak valueo f germination	Germination value	Germination rate	Seedling vigour index
Janmane	75.34	1.83	2.40	4.39	3.89	1325
Katagal	54.30	0.70	1.74	1.21	1.59	734
Gerusoppa	54.00	0.67	1.75	1.17	1.76	714
Kumta	55.35	0.77	2.06	1.58	2.25	921
Karwar	65.33	1.10	2.06	2.26	2.23	1057
Banavasi	50.67	0.51	2.00	1.02	2.19	703
Sirsi	85.33	1.63	2.87	4.67	3.08	1470
Mean	62.86	1.03	2.15	2.21	2.43	989
S.Em±	5.92	0.04	0.12	0.21	0.40	83.74
C.D. (0.05)	18.44	0.13	0.36	0.66	1.26	256.48

differences for germination attributes are due to genetic in nature. The findings of present study are similar with the studies of Meena *et al.* (2016) who revealed maximum seed germination, mean daily germination, peak value for *Tecomella undulate* in Pali district and Arthanari *et al.* (2013) in *Caesalpinia sappan.*

Significantly higher seedling vigour index was observed in seed source of Sirsi (1470) followed by seed source of Janmane (1325), these two seed sources were on par with each other and significantly over other seed sources with respect to seedling vigour index (Table 2). While, least value for seedling vigour index was noticed in seed source of Banavasi (703). These significant difference may be due to the influence of superiority of fruit and seed traits which facilitates faster and vigorous growth of seedling in different seed source when compared to smaller sized fruit and seeds. The analysis of the data indicated inter source variations for the values of germination and seedling parameters. It is known that larger seeds results in taller and vigorous growth of the seedlings among different seed sources. These observations are similar with the findings of Reddy *et al*. (2007) in *Pongamia pinnata* from different seed sources of Karnataka and Batabyal *et al.* (2014) opined that effect of different seed sources on germination parameters by means of artificial seed germination of *Santalum album.*

Seedling height was recorded significantly higher in seed source of Sirsi (24.93 cm) which was significantly superior over other seed sources followed by Janmane (21.66 cm) and presented in Table 3. While, seedling length exhibited significantly lower values in seed sources of Katagal (18.70 cm) followed by Gerusoppa (18.87 cm) seed source (Table 3). This may be due to locational potentiality supported by agroclimatic and edaphic factors. These are in conformity with the study conducted by Bhat and Chauhan (2002) in *Albizia lebbeck.* Ginwal *et al. (*2005), who reported that the growth performance of seedlings of *Jatropha curcas* varied significantly across the seed sources.

Table 3. Effect of seed sources on seedling height, biomass and survival per cent of *L. wightianum*

Seed sources	Seedling height (cm)	Seedling biomass production (g)	Survival Per cent
Janmane	21.66	4.56	86.00
Katagal	18.70	3.23	67.90
Gerusoppa	18.87	3.47	81.20
Kumta	21.30	3.90	73.10
Karwar	20.27	4.14	81.62
Banavasi	20.57	4.00	72.40
Sirsi	24.93	6.56	89.08
Mean	21.00	4.27	78.76
S.Em±	0.88	0.26	2.20
C.D. (0.05)	2.74	0.81	6.85

Seedling biomass production among various seed sources showed significant difference (Table 3). Significantly highest total biomass was found in Sirsi (6.56 g) seed source followed by Janmane (4.56 g) and Karwar (4.14 g). However, least total biomass was found in Katagal (3.23 g) followed by Gerusoppa (3.47 g) and Kumta (3.90 g) seed sources and these seed sources were found to be on par with each other. These findings may be due to larger seeds contributed to the higher seedling growth and development which in turn results in higher biomass production than smaller seeds. This finding is similar with the investigation carried out by Bahru *et al.* (2014) who found significant variation for biomass in different seed sources of *Tamarindus indica* and Singh *et al.* (2010) in *Quercus glauca.*

The data revealed significant difference for survival per cent among seed sources (Table 3). Significantly higher survival per cent was recorded in Sirsi (89.08 %) seed source followed by Janmane (86.00 %). While least survival per cent was found in Katagal (67.90 %) seed source. This may be due to wider range of adaptability of seedling from Sirsi, Janmane and Karwar seed sources and narrow range of adaptability of seedling from Katagal and Banavasi seed sources. Survival of seedlings is an important factor to consider immediately after planting. At this time, the seedlings are highly susceptible to rapid changes in relative humidity, temperature and light levels. Seed source variation in survival percentage and related traits may be ascribed to the significant differences observed in seed dimensions and weight (Rawat *et al.,* 2006). Significant differences were noticed between seed sources of *L. wightianum* for seedling survival per cent. These results are in conformity with the following studies conducted by Abugre and Boateng (2011) in *Jatropha curcas* and Espahbodi *et al.* (2007) in *Sorbus torminalis.*

Conclusion

This study succeeded in identifying two best seed sources of *L. Wightianum* Arn. namely Sirsi and Janmane seed sources in order to conserve the threatened species of Western Ghats through mass multiplication. It is clear that considerable differences existed among seed sources for seed, fruit and seedling characters. Seed sources from Sirsi and Janmane were found to be best on the basis of seedling vigour index and survival per cent. These seed ousrce shoed promise in their further exploitation for plantation and selection for improvement. Further on a short term basis, breeding zones may be set up in these environmentally homogeneous areas. However, this may be preliminary as only seedling traits have been considered. Hence, seed source screening provides a great opportunity to the tree breeder to screen and capture natural variation for success of afforestation, besides providing information on the raw material for breeding and evolving improved planting stock within a seed source.

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