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RESEARCH PAPER

Influence of seed source variations for seed morphometric traits in *Sapindus emarginatus* Vahl.

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Abstract: *Sapindus emarginatus* is an important non-timber forest product (NTFP) tree species of central and southern states of India, that has saponin and fatty oil content in its pericarp and seed respectively. Ecologically species distribution is random pattern in natural habitat contributing for green cover and tree outside the forests. In the present context of the study, was performed with selected ten different locations seed sources of *S. emarginatus* covering its entire natural population distribution of central western ghat of Karnataka *viz.,* (T1) Athani, (T2) Kalghatgi, (T3) Dandeli, (T4) Hangal, (T5) Sagara, (T6) Mudigere, (T7) Putturu, (T8) Madikeri, (T9) Saraguru, (T10) Gundlupete.Coefficient of variation (C.V.) between seed sources shown 18.82 per cent for tree mean girth and 11.40 per cent for tree height. Seed morphometric traits was assessed by collected different seed source'sgeographical locations indicated significant variation. (T5) Sagara source was found to be superior with respect to seed morphometric traits *viz.,*Seed length (13.70 mm), seed diameter (12.10 mm), 100 seed weight (159.50 g) and 100 kernel weight (94.40 g). In nutshell, seed sources of *Sapindus emarginatus* collected from (T5) Sagara and (T1) Athani performed well in morphometric traits to facilitate for future breeding and tree improvement programme.

Key words: Coefficient, Morphometric traits, Non-timber forest product (NTFP)**,** Seed source

Introduction

Sapindus emarginatus Vahl., also known as Indian soapberry, is a medium-sized deciduous tree native to South Asia and ecologically its distributed randomly. It is commonly found in tropical and subtropical regions, growing in dry and deciduous forests, scrublands, home gardens and along roadsides. This species is adaptable to various soil types, including sandy, loamy and rocky soils. Although not considered globally threatened, it may face habitat loss and degradation due to deforestation, urbanization and agricultural expansion (Mahar *et al.,* 2011; Anandalakshmi *et al.,* 2013). The fruits of *S. emarginatus* are natural surfactants, producing a lathering effect when mixed with water. Traditionally, the fruits have been used in India as a natural soap alternative. In Ayurvedic medicine, various parts of the plant are used for their medicinal properties, believed to have anti-inflammatory, antimicrobial and insecticidal properties. The wood is used for furniture, agricultural implements and traditional handicrafts. The tree also provides shade and serves as a food source for wildlife. In some cultures, it holds cultural significance and is associated with various rituals and beliefs (Deepa *et al.,* 2012).

Seed source variation in *S. emarginatus* has been a subject of investigation due to its implications for conservation and cultivation practices. Research indicates that seed characteristics, including size and germination rates, can vary significantly depending on the source of the seeds. For instance, studies highlight that seeds from different geographical locations exhibit distinct morphological traits, which can influence their viability and growth potential in various environments (Wang *et al*., 2022). Additionally, environmental factors such as soil type and climate conditions at the seed source can further contribute to this variation, affecting the overall adaptability of the species (Kumar *et al.*, 2022). Importance of genetic diversity among seed sources, suggesting that this diversity is crucial for the resilience of *S. emarginatus* populations in changing environments (Chandipriya *et al.,* 2014). A systematic evaluation of seed sources from the central western ghats locations, along, is crucial for screening of superior sources. This targeted breeding program aims to develop superior genotypes that can be propagated and mass-produced by farmers, forest departments and research institutes for agroforestry and forest biodiversity improvement.

Material and methods

Investigation of predominant *Sapindus emarginatus* population growing areas of Karnataka were identified consulting Karnataka Forest Department and matured fruits from 10 central western ghats districts of Karnataka population were collected during March-April 2023. Total of 10 seed sources lots were collected for experiment. Selected seeds sources were recorded latitude, longitude and altitude of the location. Average girth, height of seed sources tree was recorded (Table 1). The fruits collected from each population were kept in separate open gunny bags and labelled with the date of collection, locality and information about the seed sources. Study was conducted at College of Forestry, Sirsi, Uttara Kannada, Karnataka. For seed morphometric traits measurements digital vernier calliper was used to measure seed length, seed diameter. Further, electronic weighing balance was used to measure 100 seed weight and 100 kernel weight. Finally, fruit to seed ratio and seed to kernel ratio was derived. Complete randomized design (CRD) statistical design was adopted with three replications

Table 1. Geographical location and mean growth attributes of seed sources in *S. emarginatus* population

Location	Districts	Latitude	Longitude	Altitude	Mean GBH (m)	Mean Height (m)
Athani	Belagavi	16°35'21.7"N	74°56'19.8"E	590.00	1.35	12.00
Kalghatgi	Dharwad	15°10'37.3"N	74°47'13.7"E	536.00	1.15	10.50
Dandeli	Uttara Kannada	15°12'12.3"N	74°36'43.2"E	472.00	1.05	9.50
Hanagal	Haveri	14°48'57.0"N	75°01'16.3"E	555.00	1.10	10.00
Sagara	Shivamogga	14°07'05.3"N	74°58'38.9"E	579.00	1.60	11.50
Mudigere	Chikkamagaluru	13°11'22.9"N	75°33'55.7"E	990.00	1.10	10.20
Puttur	Dakshina Kannada	12°45'32.0"N	75°10'23.6"E	87.00	1.80	10.50
Madikeri	Kodagu	12°25'09.9"N	75°38'56.5"E	1170.00	1.20	11.00
Saraguru	Mysore	11°59'58.9"N	76°21'47.3"E	686.00	1.44	8.50
Gundlupete	Chamarajanagar	11°48'01.7"N	76°31'01.1"E	816.00	1.65	13.00
Mean					1.33	10.67
S.Em(±)					3.10	0.78
C.D@5%					9.43	2.35
C.V. (%)						

and data was analysed using MS-Excel to study the influence of different seed source variations for seed morphometric traits in *Sapindus emarginatus.*

Results and discussion

Variation in mean growth attributes among seed sources trees of *S. emarginatus*

The wide distributions and genetic diversity present promising opportunities for genetic improvement of the tree species. Numerous seed sources have been identified across different regions of Karnataka state; however, their genetic potential remains largely untapped. The selection of superior seed sources from natural forests is imperative to enhance the genetic foundation. Growth differences were observed among these selected sources for mean growth parameters in *S. emarginatus*. Among the ten selected seed sources, (T7) Puttur recorded the highest mean girth of 1.80 m, while (T3) Dandeli had the lowest 1.05 m. In terms of total tree height, (T10) Gundlupet exhibited the highest at 13.00 m, whereas (T9) Saraguru had the lowest at 8.50 m. Maximum variation was recorded for mean GBH (C.V. of 18.82%), followed by mean height (C.V. of 11.40%) (Table 1). These differences may be attributed to provenance factors such as altitude, rainfall, soil characteristics and the genetic makeup of the selected seed sources trees. It could be stated that variations in girth and height of tree might have resulted due to the genotypic differences resulting in different growth forms of trees and varied growth stages and rates of the trees along with contribution of different genotype-environmental interactions (Rao *et al.,* 2008). Similar findings have been reported in prominent studies revealed significant variation, Manish (2020) studied the provenance effect on 36 plus trees of *Butea monosperma* and similarly, Abhijith (2018) evaluated twelve *Ailanthus triphysa* plus trees for high lighting significant variations in height and tree girth from three agroecological zones in Thrissur, Kerala.

Influence of seed sources variation for seed morphometric traits in *S. emarginatus*

Significant variation with respect to seed traits *i.e*., seed length, seed diameter, 100 seed weight,100 kernel weight, fruit to seed ratio and seed to kernel ratio was documented across seed sources (Table 2). (T5) Sagara sources found to be superior in seed length (13.70 mm), seed diameter (12.10 mm), 100 seed weight (159.50 g) and 100 pericarp weight (94.40 g) than other sources and (T6) Mudigere source was poor in all seed traits. The variation in fruit size was attributed by genetic influences and environmental factors. Selection of heavier seed-producing sources will result in healthy and vigour seedlings. Correlation coefficient of seed length, seed diameter, seed weight and kernel weight were strong positively correlated with each other. The characters considered were allometrically associated with each other, therefore there was a good significant association. Maheshnaik and Chavan (2023) reported variation for different seed sources on morpho-chemical traits of *S. emarginatus* fruits and concluded that variation in environmental parameters like, rainfall, mean annual temperature and genetic makeup of trees responsible for fruits morpho-chemical traits. Pranali, (2022) reported for *S. emarginatus* with highest length, diameter and hundred seed weight differed significantly among the plus trees of Tamil Nadu source. The results are in accordance with Khan (2018) observed that in *S. trifoliatus*, the average seed weight of the three-seeded fruit was 0.6298 ± 0.01437 g, ranging

Table 2. Influence of seed sources variation for seed morphometric traits in *S. emarginatus*

Sees sources	Seed length (mm)	Seed diameter (mm)	100 seed weight (g)	100 kernel weight (g)	Fruit to Seed ratio	Seed to kernel ratio
(T1) Athani	12.54	10.85	152.59	92.33	1.84	1.65
(T2) Kalghatgi	12.59	11.10	154.45	88.20	1.78	1.75
(T3) Dandeli	13.50	11.90	129.48	76.13	2.07	1.70
(T4) Hanagal	10.45	8.80	117.92	62.60	1.95	1.88
(T5) Sagara	13.70	12.10	159.50	94.40	1.91	1.69
(T6) Mudigere	9.67	8.15	115.90	73.52	1.97	1.58
(T7) Puttur	10.45	8.90	119.59	76.49	2.09	1.56
(T8) Madikeri	11.25	10.10	113.16	70.14	2.08	1.61
(T9) Saraguru	11.78	10.21	114.46	68.40	2.14	1.67
(T10) Gundlupete	13.20	11.60	127.30	74.82	2.04	1.70
Mean	11.91	10.37	130.44	77.70	1.99	1.68
S Em(±)	0.57	0.55	2.88	1.44	0.04	0.05
C D@5%	1.71	1.68	8.57	4.28	0.12	0.16
C.V. (%)	11.26	12.66	13.19	12.89	5.74	8.05

Table 3. Correlation matrix (Pearson) for seed traits of *S. emarginatus*

Seed traits	Seed length	Seed diameter	Seed weight	Kernel weight
Seed length	1.00			
Seed diameter	0.99	1.00		
Seed weight	0.68	0.66	1.00	
Kernel weight	0.59	0.58	0.94	1.00

from 0.60 to 0.66 g. Similarly, results are in agreement with geographic variability in seed weight within *S. mukorossi* has noted by Khairon and Sankhyan (2017) across different localities in Himachal Pradesh. These results are consistent with the findings of Kumar and Chavan (2018), opined seeds of various source exhibited significant variability in size, weight, germination and growth characters. Seed length, seed width and seed weight were positively correlated to each other but seed size had positive effect on germination per cent in *Dalbergia latifolia*. Similar results of variations in seed morphometrics have been documented in *Neolamarckia cadamba* (Parthiban *et al.,* 2019).

Positive and significant correlations observed for all seed traits considered in the experiment (Table 3)**.** The correlation coefficients for seed length, seed diameter, seed weight, and kernel weight showed strong positive correlations with each other. These characters were allometrically associated, indicating a significant association. Notably, kernel weight exhibited a strong correlation with all other parameters, suggesting that kernel weight can be a good predictor for variations in morphological seed parameters.

Conclusion

Sapindus emarginatus species reveals that strong potential as industrial raw materials for saponin production, as well as promising biodiesel feedstock due to their monounsaturated fatty acid composition. Although independent populations tend to exhibit a higher likelihood of unique saponin and fatty acid compositions, the overall saponin and fatty acid profiles of *S. emarginatus* seed kernel oil demonstrate continuous variation in response to broad-scale environmental factors. It is anticipated that large-scale industrial demand for saponin and biodiesel feedstocks will enhance the economic well-being of forest workers and farmers by empowering them through the cultivation of high-yielding *S. emarginatus* genotypes, fostering sustainable utilization of forest plant bio-resources.

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