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GERMINATION BEHAVIOUR AND OCCURRENCE OF ALBINO SEEDLINGS IN *SAPINDUS EMARGINATUS* VAHL.

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ABSTRACT

Soapnut being one of the largely traded non timber forest product (NTFP) of Tamil Nadu, work on germplasm assemblage of *Sapindus emarginatus* was undertaken to conserve and domesticate the species for sustainable use. Candidate plus trees (CPTs) were identified based on their fruit yield from four locations in Tamil Nadu. Fruits from selected 55 CPTs were collected and studied for seed germination and seedling vigour index. Out of four populations viz. Thengumarada, Pillur, Mettupalayam and Palani, albino seedlings were noticed in half-sib progenies of two CPTs of Pillur. The germination and seedling vigour index were found to be statistically significant in these populations as compared to Pillur indicating the need for concerted efforts to conserve the Pillur population.

Key words : Candidate plus trees, *Sapindus emarginatus*, Fruit yield, Albino seedlings.

Introduction

Sapindus emarginatus Vahl, commonly referred as soap nut tree belongs to the family Sapindaceae. It is a medium-sized deciduous tree native to South India and found upto an elevation of 850 m. Soapnut is one of the major NTFP of Tamil Nadu sold at a cost of ` 90/- per kg in local market. The pericarp of fruit contains saponins (10 to 18%) which possess detergent property (The Wealth of India, 1972). The saponins are used in soaps, shampoos, textiles, foods, pharmaceuticals and photo film industry. Traditionally, *Sapindus emarginatus* has been used to purify blood (Srikanth and Muralidharan, 2010) and also showed strong antibacterial activity (Nair *et al.*, 2005). The soap nut solution is a good repellent and used to prevent a wide variety of agricultural pests and also finds use in the remediation of contaminated soil.

With increasing population and demand for forest products, it is essential to maximize its usefulness to people while minimizing environmental damage. Under the given circumstances, the best possible option is to enhance productivity of trees outside the forest areas by raising improved planting stock and maximize returns per unit area. Consequently, for sustainable use and conservation of tree species like *S. emarginatus* in a long term perspective, *ex-situ* conservation in the form of germplasm banks finds significance. Taking into consideration the importance of the species, an attempt was made to assemble the germplasm of *S. emarginatus* so that the wide base population would serve as a bioresource for sustainable utilization in the future.

Material and Methods

A reconnaissance survey was conducted in the deciduous and scrub forests of Tamil Nadu to identify high fruit yielders of *S. emarginatus.* The candidate plus trees (CPTs) were selected from four locations namely, Thengumarada (11.30 ^{0} N; 77.03 ^{0} E) (308 msl; 729.9 mm rainfall), Pillur (11.12 ^{0}N; 76.47 ^{0}E) (532 msl; 639.9 mm rainfall), Mettupalayam (11.21 ^{0} N; 76.56 ^{0} E) (370 msl; 704.7 mm rainfall) and Palani (10.22 ^{0} N; 77.22 ^{0} E) (401 msl; 639.9 mm rainfall).

Selection of CPTs

The CPTs were identified based on their fruit yield by comparison tree method. The criteria for an individual tree to qualify as a CPT was derived based on field observations. The selection criteria included (i) a minimum of fifty fruits per metre length of the fruiting branch and (ii) a minimum of ten such high fruiting branches to be present in a tree. Table 1 shows the mean fruit yield for check tree, CPT and the superiority % of CPT over the check tree.

Fruit processing

Individual tree-wise fruit collections were made from the CPTs in the natural populations during March 2011. Fruits were collected at fully mature stage as indicated by the brownish-yellow gummy pericarp. The fruits were brought to the laboratory, spread on tarpaulins to dissipate the heat developed while transporting. The next day, the seeds were extracted manually by peeling off the fruit pericarp.

Germination Test

Seeds were sown without any pretreatment to determine the germination percentage in sand beds under the nursery shade net (32 ± 2°C; RH: 65 ±2 %) (ISTA,

Germination and seedling vigour index of *Sapindus emarginatus* were found statistically significant in 3 selected locations of Tamil Nadu except Pillur which requires conservation efforts.

Table 1 : Superiority of CPT over check tree at four study locations

Area	Mean fruit yield for check tree (Kg)	Mean fruit yield for CPT (Kg)	Superiority %
Thengumarada	1.95	5.71	65.92
Pillur	2.08	5.42	61.56
Mettupalayam	1.56	5.84	73.27
Palani	3.39	6.37	46.77

1993). The experiments were carried out in completely randomized design. Four replications with 50 seeds each for each CPT were maintained. The germination count was recorded daily and the final count of germination as taken after 30 days of first emergence. The germination was expressed in percentage.

Seedling Vigour Index (SVI)

The seedling vigour index was computed as per the method suggested by Abdul Baki and Anderson (1973) based on seedling height and germination percentage.

SVI = [seedling length (cm) × germination percentage]

The average seedling length for seedlings germinated in each replication was multiplied with the average germination percentage of that replication to obtain SVI. This study was carried out on completion of the germination test.

Transplanting

The root elongation was very significant compared to the shoot growth. As a result the germinated seedlings at two leaf stage were transplanted immediately after the germination test and recording SVI. Delay in transplanting increased the causality. The seedlings were transplanted to sand: red earth: FYM (2:1:1) media filled in 13 x 25 cm black poly bags. The transplanted seedlings were kept under shade upto 3 months and then hardened under open sun light in the nursery for 6 to 12 months before outplanting.

Statistical Analysis

The germination percentage data were transformed to arc sine values, and applied ANOVA to test the significance at 5% level of confidence ($\alpha = 0.05$) (Panse and Sukhatme, 1995).

Results

The mean fruit yield for check trees at Thengumarada, Pillur, Mettupalayam and Palani were found to be 1.95, 2.08, 1.56 and 3.39 kg respectively while the mean for CPTs was found to be 5.71, 5.42, 5.84 and 6.37 respectively. The location-wise superiority per cent varied from 46.77 to 73.27 with Mettupalayam ranking the highest in superiority followed by Thengumarada, Pillur and Palani.

The seeds did not require any pretreatment to induce germination. It showed epigeal germination with the first appearance of seedlings on the 12th day, which however, extended upto 15th day. The mean germination percentage and mean seedling vigour index recorded are presented in Table 2. Germination percentage for the populations from three locations were appreciably high with 56.96, 56.89 and 54.77 for Thengumarada, Mettupalayam and Palani respectively when compared to Pillur which recorded only 32.68.

Table 2 : Germination percentage and Seedling vigour index of *Sapindus emarginatus* populations

Area	Mean Germination percentage	Seedling Vigour Index
Thengumarada	56.96 (48.50)	1316
Pillur	32.68 (34.75)	577
Mettupalayam	56.89 (48.75)	910
Palani	54.77 (47.75)	1321
S.e.d.	1.066	21.82
L.S.D.	2.322	47.54

Value in parantheses are arc sine values

Albino seedlings were noticed only in Pillur population. Two CPTs from Pillur expressed albinism which is a rare occurrence (Table 3). The albino seedlings produced two pairs of trifoliate leaves, pale white in colour and showed stunted growth as compared to normal seedlings (Fig. 1). These albinos shriveled to death after 16 days of germination. The results also showed significant variation for seedling vigour index similar to germination percentage with values of 1316, 577, 910 and 1321 for Thengumarada, Pillur, Mettupalayam and Palani respectively.

Discussion

The low superiority per cent of CPTs of Palani indicates that most of the *S. emarginatus* trees in this location are good fruit yielders. This in turn implies that the species is well adapted to this locality and the factors influencing reproductive success in terms of soil, climate, rainfall, topography, population density, availability of pollinators, etc. are conducive in this region. At the same time CPTs of Mettupalayam having 73.27% superiority indicates that environmental influence is higher in this

Fig. 1 : Albino seedlings of *Sapindus emarginatus*

Table 3 : Frequency of albino seedlings of *Sapindus emarginatus*

Area	No. of CPTs selected	No. of CPTs expressed albinism	No. of Albino seedlings
Thengumarada	14	0	0
Pillur	15	2	6
Mettupalayam	11	0	0
Palani	15	0	0

locality reflecting on wide variation in fruiting. It could be expected that the effect of genotype on fruiting behaviour could for significant for CPTs in Palani when compared to that of Mettupalayam.

With regard to germination percentage except Pillur, all the three populations were at par indicating that the proportion of viable seed production is higher in these locations. However, the seedling vigour index was significantly very low for Pillur compared to Mettupalayam, Thengumarada and Palani. From this study it could be inferred that the CPTs found in Pillur must have less genetic divergence. Genetic divergence studies in Neem and Pungam has been reported by Kumaran (1991) based on seedling traits. Variability between different populations of *Dalbergia sisoo* for seed characters and germination percentage is due to strong genetic influence (Vakshasya *et al.,* 1992)

Albinism in plants is caused by lack of the pigment chlorophyll and is fatal because the albino plants have no means to manufacture food needed for survival and growth to maturity and are therefore short lived. Albinos were reported earlier in tropical species, namely, *Tectona grandis* (Bagchi and Emmanuel, 1983), *Bambusa bambos* (Indira, 1988; Indira and Koshy, 1986 and Adarsh Kumar *et al*., 1995), *Artocarpus hirsuta* (Kader *et al.*, 1999) and *Aegle marmelos* (Anandalakshmi *et al.,* 2005). Albino seedlings probably result from the combination in the genes that were recessive in the parent plants. It occurs when heterozygous albino carriers are self fertilized (Dhiman and Sharma, 1997). Although there are chlorophyll lethals, a mutation type is frequent in higher plants, there are only few cases known in tropical forest tree species (Venkatesh and Emmanuel, 1976) as reported in *Pterocarpus santalinus* by Vakshasya (1981).

In the present study as none of the trees selected were isolated ones, the chances of out crossing remains high. However, the occurrence of albinos suggests prevalence of albino gene carriers in natural populations of *S. emarginatus.* This implies the tendency of the species for selfing and the resulting inbreeding depression (Kraus and Squillace, 1964). Inbreeding depression has been reported for many pine species (Squillace and Kraus, 1963). The other possibility could be due to crossing between individuals which are heterozygous carriers for recessive albino genes. It is also suggestive that the Pillur population must have originated from very few families and therefore the diversity of natural population of *S. emarginatus* could be low. Besides, low seedling vigour index seen in Pillur certifies the poor quality of its progenies compared to other sources. Selfed or inbred offspring can also be characterized by reduced fitness (higher mortality and lower reproductive success), ultimately causing local extinction (Frankham *et al*., 2004).

Further, reasons for poor out crossing could also be due to asynchrony in flowering. However, through this study, details about flowering synchrony could not be explained expect for the information that irregular and prolonged flowering period was noticed in *S. emarginatus*. Even though albino plants do not have practical value, their occurrence is useful to study forest genetics. The genes that create albinism can be used as markers to examine the rates and patterns of seed dispersal from those trees which carry those particular genes (Zasada, 1980).

Conclusion

As seen from the results that both germination percentage and vigour index were higher in populations such as Thengumarada, Palani and Mettupalayam unlike Pillur, it could be understood that inherent genetic problems exist in Pillur population of *S. emarginatus. Sapindus emarginatus* is known to exhibit entomophilly and therefore the results of the present study calls for indepth study on reproductive biology involving mating pattern and pollination biology of soapnut with respect to Pillur area. The need to adopt appropriate strategies to conserve the soapnut germplasm is therefore felt essential.

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सेपिंडस इमर्जीनेटस वीएएचएल में अल्बीनों पौधों की प्राप्ति तथा अंकुरण व्यवहार

आर. आनन्द लक्ष्मी, एस. सुजा, टी. वामदेवन, के.एस. रथनम तथा के. सुरेश कुमार

सारांश

सोपनट तमिलनाडु का मुख्य व्यापारिक अकाष्ठीय वन उत्पाद है। इस प्रजाति को सतत् उपयोजन हेतु संरक्षित करने के लिए *सेपिन्डस इमर्जीनेटस* के जन जर्मप्लाज्म संचयन पर कार्य किया गया। तमिलनाडु की चार अवस्थितियों में फल उत्पाद के आधार पर कन्डीडेट धन वृक्षों का पता लगाया गया। चयनित 55 धन वृक्षों से फलों को एकत्र किया गया और उनकी बीज अंकुरण तथा पौध क्षमता सूची का अध्ययन किया गया। चार आबादियों अर्थात् थेंयूमराडा, पिल्लूर, मेट्टू-पलायम और पालानी से अल्बीनियों पौधों को पिल्लूर के दो कंडीडेट धन वृक्षों में अवधीकुलीय पाया गया। इन आबादियों में पिल्लूर की तुलना में अंकुरण और पौध क्षमता सूची को संतोषजनक पाया गया और पिल्लूर की आबादी को संरक्षित करने के हेतु संयुक्त प्रयास करने योग्य पाया गया।

References

Abdul Baki, A.A. and Anderson, J.D. (1973). Vigour determination in soybean seeds by multiple criteria. *Crop Science*, 13: 630-633.

Adarsh Kumar, V.K. Sharma, and Dhiman, R.C. (1995). Natural selfing in *Bambusa bambos* (L.) Voss, Besch. (Syn. *Bambusa arundinacea* (Retz.) Willd. as estimated from albino frequencies. *Indian Forester*, 121 (2): 156-158.

Anandalakshmi, R., Gurudev Singh, B., Parimalam, R., Warrier, R.R. and Sivakumar, V. (2005). Occurrence of albino seedlings in *Aegle marmelos* Correa. *Indian Forester*, 131(7): 964-966.

Bagchi, S. and Emmanuel, C.J.S.K. (1983). Germination studies in *Tectona grandis* L. *My Forest*, 19(4): 209-213.

Dhiman, R.C. and Sharma, V.K. (1997). Occurrence of albino and other chlorophyll deficient seedlings in *Dendrocalamus giganteus* Munro. *Indian Forester*, 123 (5): 435-437.

Frankham, R., Ballou, J.D., Briscoe, A.D. (2004). *A Primer of Conservation Genetics*. Cambridge University Press, Cambridge, UK.

Indira, E.P. (1988). Short Note: Albino Gene Carriers and Mating System in *Bambusa arundinacea* (Retz.) Willd. *Silvae Genetica*, 37(5-6): 249-250

Indira, E.P. and Koshy, M.P. (1986). A report on monohybrid ratio for albino expression in *Bambusa arundinacea* (Retz.) Willd. *Current Science*, 55: 993-994.

ISTA. (1993). International rules for seed testing. Supplement, Rules. *Seed Science and Technology,* 21: 157.

Kader, S.A., Bindu, K.R. and Chacko K.C. (1999). Occurrence of mono and polyembryonic albino seedlings in *Artocarpus hirsuta*, HK.F. *Indian Forester*, 125 (11): 1167-1168.

Kraus, J.F. and Squillace, A.E. (1964). Selfing vs. outcrossing under artificial conditions in *Pinus elliottii* Engelm. *Silvae Genetica,* 13:72-76.

Kumaran, K. (1991). *Genetic analysis of seed and juvenile seedling attributes in neem* (*Azadirachta indica* A. Juss.) *and pungam* (*Pongamia pinnata* Linn. Pierre). M.Sc. thesis, TNAU, Coimbatore, 181 p.

Nair, R., Kalariya, T. and Chanda, S. (2005). Antibacterial activity of some selected Indian Medicinal flora. *Turk J Biol*., 29:410-18.

Panse, V.G. and Sukhatme, P.V. (1995). *Statistical methods for agricultural workers*. Published by Indian Council of Agricultural Research, New Delhi, 359 pp.

Squillace, A.E. and Kraus, J.F. (1963). The degree of natural selfing in slash pine as estimated from albino frequencies. *Silvae Genetica*, 12: 46-50.

Srikanth, J. and Muralidharan, P. (2010). Evaluation of antioxidant properties of *Sapindus emarginatus* Vahl. *Asian J. Exp. Biol. Sci.,* 1 (3) : 693-699.

The Wealth of India. (1972). A dictionary of Indian raw materials and industrial products. *Raw Materials*, vol. IX, CSIR, pp 227.

Vakshasya, R.K. (1981). Mutant albino in Red Sanders. *Silvae Genetica*, 30:163.

Vakshasya, R.K., Rajora, O.P. and Rawat, M.S. (1992). Seed and seedling traits of *Dalbergia sissoo* Roxb. Seed source variation studies among ten sources in India. *For. Ecol. Manage.,* 48: 265-275.

Venkatesh, C.S. and Emmanuel, C.J.S.K. (1976). Spontaneous chlorophyll mutations in Bombax L. *Silvae Genetica*, 25: 137-139.

*Zasada, J. (*1980). *Albino Plants*. Geophysical Institute, University of Alaska Fairbanks, in cooperation with the UAF research community Alaska Science Forum, October, 1980, Article #433.