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Effect of provenance and progeny selection in *Calamus andamanicus* Kurz for fast growth

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Abstract: *Calamus andamanicus* is a large diameter cane preferred for furniture frame work. This species was found to be promising in a species trial conducted in Kerala, India. Hence, a provenance-cum-progeny trial was carried out to select the best provenance or family for fast growth and other desirable characters. Eight families belonging to four provenances of the Andaman and Nicobar Islands were tested for superiority with respect to growth in an evergreen forest area with 3000 mm rainfall at 300 m asl. Analysis of growth data in nursery and field revealed no significant difference between provenances. However, the difference between families was highly significant. The phenotypic and genotypic coefficients of variation were high for basal diameter, whereas they were low for height. The family heritability was found to be high and single tree heritability to be moderate which indicate the influence of additive as well as non-additive genes on growth characters. Hence, family selection will be desirable for enhancing productivity rather than provenance selection.

Key words: Calamus andamanicus, provenance trial, progeny trial, heritability.

INTRODUCTION

Rattan or cane is an important non-timber forest product which has received little attention till recently. The small-scale rattan industries in the southern states of India are not getting enough raw material and they depend on the northeastern region and the Andaman Islands. Fast depletion of rattan resources in the natural habitat has triggered a series of research activities like, taxonomic survey and identification, phenological and ecological studies, silvicultural practices, anatomical studies, *etc.* Since rattan has not been domesticated, not much work has been done on genetic improvement. It is exclusively extracted from forest, and plantations have been established only recently. Sustainable management of wild rattan resources also presents great challenges. Bringing it into cultivation may assist in better conservation of the meager rattan resources in forest.

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Studies conducted so far have revealed that wild rattan populations in their natural habitat have much lower growth rates when compared to that of plantations. However, large-scale cultivation would require good quality planting material. Screening of genetic variability is the first step in any genetic improvement programme. The variability in a given population can be manipulated and directed through selection (Rao, 1988). Exploration of the genetic diversity of commercially important species is essential to conserve those species and to provide rattan cultivators with improved plant material (Bacilieri and Appanah, 1998). Rattans are dioecious, thus they are out-crossing species. However, this does not exclude the possibility of inbreeding due to mating among relatives in natural populations (Finkeldey, 1995).

Even though many countries have established provenance trials, progeny trials and germplasm banks, genetic evaluation of these trials is yet to be done. Innoprise Corporation Sendirian Berhad, Indonesia (ICSB) has established 33 genetic trials with 478 different seed lots (progenies and provenances) of four major commercial rattan species. Forest Research Centre, Sabah (FRC) has established a network of progeny and provenance trials including 160 accessions of *C. subinermis*. Forest Research Institute Malaysia (FRIM) has established several progeny trials of *C. manan* and *C. palustris* (Bacilieri and Appanah, 1998). Provenance and progeny trials have been carried out in Sabah, Malaysia on several species including *C. subinermis* and *C. manan* and the preliminary analysis shows large morphological and genetic variation in *C. subinermis* (Lee, 1999).

A survey among the industrial units in India revealed that *C. andamanicus* Kurz, a large diameter cane, is one of the most preferred canes for making furniture frames. The anatomical studies conducted at the Kerala Forest Research Institute (KFRI) also prove this to be a good quality cane for furniture (Bhat *et al.*, 1996). Hence, a provenance-cum-progeny trial was conducted in Kerala, India to conserve and encourage cultivation of the species by selecting the best provenances and families for future planting.

MATERIALS AND METHODS

Four provenances, Tarmugali (in South Andamans at 11°30′N and 92°15′E), Baratang (in Middle Andamans at 12°15′N and 92°50′E), Smith Island (in North Andamans at 13° N and 93° E) and Campbell Bay (in Great Nicobar Islands at 7°N and 93° 55′E), which are completely isolated from each other, were selected for the study.

C. andamanicus is dioecious and insect pollinated and hence, it must be highly out crossing in nature. It flowers annually and the period from inflorescence to fruit maturation is about 10 months (Renuka *et al.*, 1998). In *C. andamanicus* there are two phenotypes, one with long inflorescences that could bear large number of fruits and the other with short inflorescences with low fruiting potential (Renuka, 1995). Good

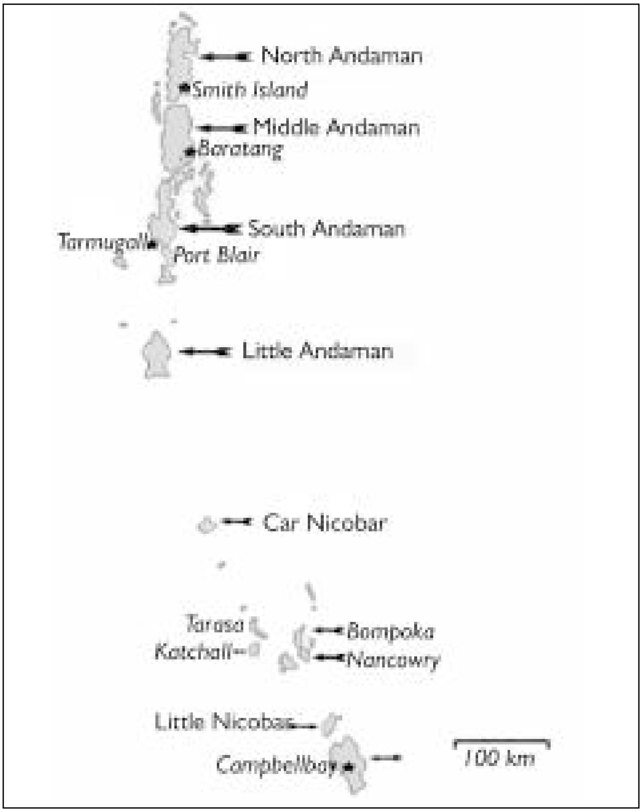

Figure 1. Map showing seed collection areas in the Andaman and Nicobar Islands, India.

fruit bearing clumps of this species growing in these four different geographical areas were selected during April and May 1995 (Fig. 1). Fruits were collected, de-pulped, cleaned and stored in moist sawdust before they were transported to KFRI, Kerala. Seeds were sown in nursery beds adopting a Randomized Block Design (RBD) with three blocks. The seeds were found to be dormant for one year. Seedlings were transplanted to polythene bags and after two years of hardening, eight families were

Table 1. Mean performance of the families/ progenies for growth

Family	Height at 6 months (cm)	Height at 5 years (cm)	Basal diameter at 5 years (cm)
Smith Island 1	6.31[a]	25.3[a]	2.4[a]
Smith Island 2	5.05[b]	19.9[ab]	1.8[b]
Smith Island 3	4.78[bc]	17.6[ab]	1.7[b]
Tarmugali 1	3.79[c]	15.4[b]	1.5[b]
Tarmugali 2	4.35[bc]	11.1[b]	1.3[b]
Baratang 1	4.64[bc]	17.4[ab]	1.6[b]
Baratang 2	4.25[c]	14.2[b]	1.4[b]
Campbell Bay 1	6.87[a]	11.2[b]	1.5[b]

[*] Mean values superscribed with different letters are significantly different.

Table 2. Coefficient of variation, heritability and genetic gain

Genetic parameter (%)	For 6 months height	For 5 years height	For 5 years basal diameter
PCV	6.54	9.13	59.99
GCV	5.75	8.10	54.39
Family heritability (%)	77.35	78.69	82.20
Single tree heritability(%)	17.38	40.56	46.30
Genetic gain possible by selecting the best family(%)	1.22*	6.94	0.62

* Two best families were selected.

found to have enough seedlings, which were field planted in an evergreen forest area in Thrissur Forest Division, Kerala at 300 m asl. On an average, this area gets 3000 mm annual rainfall and temperature ranges from 18-40°C. Field planting was done in the rainy season following a Randomized Block Design with a spacing of 2 m x 2 m. There were three blocks with unequal number of plants, since the availability of seedlings in each family varied. In each block, there were 6 to 16 plants per family.

The plant height measurement was recorded at the age of six months in the nursery. After field planting the rattan plants remain in the rosette stage for a long time. Hence, plant height and basal diameter were recorded only at the age of five years (3 years after transplanting). The height was measured from the base of the plant to the tip of the petiole of the youngest leaf. The data were analysed for the variation using nested seed lot structure. Analysis of variance (ANOVA) was done using the statistical package SAS. Mean comparison test was also carried out and the families were grouped into clusters. Both family and single tree heritability were estimated following Wright

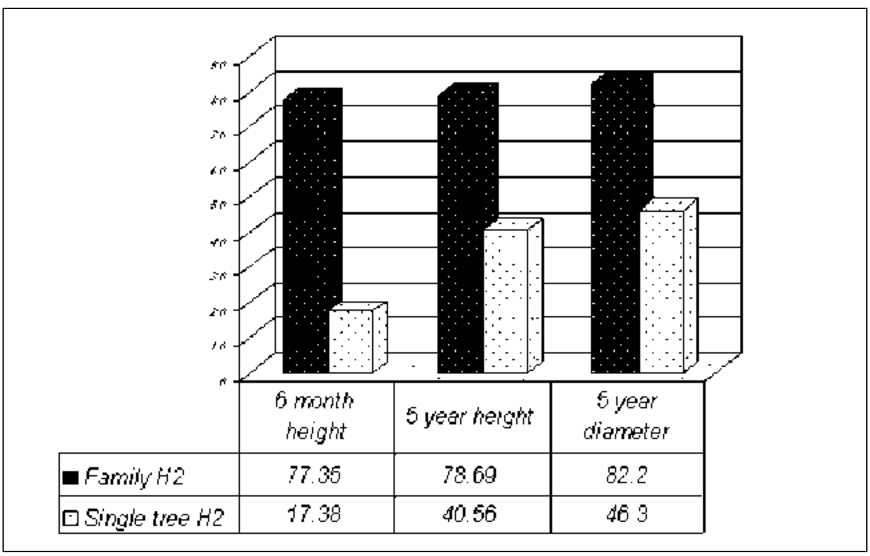

Figure 2. Changes in family and single tree heritability over a period of 5 years.

(1976). The phenotypic and genotypic coefficients of variation were also estimated following Singh and Chaudhary (1985). Genetic gain was worked out by selecting the best family at the age of five years, whereas two families showing very good performance were taken into consideration for estimating the gain at the age of six months.

RESULTS AND DISCUSSION

Significant difference in height growth could be seen between provenances as well as between families at the age of six months. At the age of five years, there was highly significant difference ($P = 0.01$) between families for both height and basal diameter though there was no significant difference between provenances. The result indicates that family selection has remarkable influence on growth performance. However, families from Smith Island have shown good performance.

The mean performance of each family with regard to growth at the age of six months and five years is given in Table 1. The mean comparison test reveals that, at the age of six months, Campbell Bay 1 and Smith Island 1 were the best families, all others being in the second cluster. At the age of five years, Smith Island 1 was again the best and the only one family in the first cluster superior for both height and basal diameter. For basal diameter all the others were in the second group. Campbell Bay 1, which had the best performance in the nursery showed poor performance in the field. From the result it can be seen that Smith Island 1 is the best among all the eight families. Family Smith Island 2 has also shown good performance.

Both phenotypic and genotypic coefficients of variation (PCV and GCV) were low for height, whereas they were high for basal diameter (Table 2). However, a large part of the variation that existed is genotypic and heritable (Fig. 2). Very high family heritability (H^2) was estimated for both the characters. Single tree heritability (h^2) was found to be low for height at six months. It was moderate for both the characters at the age of five years (Fig. 2). In *C. caesius*, a moderate heritability was found for agronomic traits such as length and number of suckers (Bacilieri and Appanah, 1998). Lee (1999) has reported high levels of genetic variation both in morphological and agronomic traits of *C. subinermis*, indicating the possibility of marked improvement through family selection.

Bon (1997) investigated genetic variability using isozyme studies in *C. subinermis* and found considerable variability in wild populations of this species in Sabah. The experiment also showed that the variability had some correlations with geographical distribution, where nearby populations were genetically more closely related than those occurring further apart. Biochemical marker studies in 13 populations of *C. palustris* from seven provinces in Thailand showed that approximately 18 per cent of total diversity resulted from difference among populations (Hong *et al.*, 2001).

Our experiment showed a significant positive correlation ($r = 0.70$) between height and diameter. High correlation between these two traits simplifies the selection procedure. Bacilieri and Appanah (1998) reported significant correlation between number of suckers and total length. The genetic gain possible by selecting the best family is given in Table 2. It shows that by selecting the family Smith Island 1, a remarkable genetic gain is possible over the general average. As a whole, the result gives an indication that family selection after genetic evaluation of plus clumps will be suitable for higher productivity in *C. andamanicus*.

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