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PREPOTENCY IN RUBBER
I. EARLY ESTIMATION THROUGH JUVENILE TRAITS

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Abstract

The predominant outbreeding nature of Hevea brasiliensis offers scope for the identification and utilisation of prepotents. Seedling progeny analysis of twenty clones was conducted in an attempt to identify likely prepotents. Polycross progeny of the clones were planted in a randomized block design with four replications. Vegetative growth and juvenile yield were assessed at the age of 12 months.

There was considerable variation among progenies for foliar traits and juvenile yield. However, genotypic differences for plant height and girth were not expressed at this stage. Vegetative traits showed positive association with juvenile yield as evidenced by correlation estimates. Likely prepotents were identified on the basis of a performance index.

Introduction

Prepotency is the capacity of a parent to impress characteristics on its offspring so that they resemble that parent and each other more closely than usual (Allard, 1960). As expressed by Harland (1957) for coconut, a prepotent palm is one where the gene combinations tend to cohere but do not recombine resulting in the 'enbloc' transmission of parental characters to the progeny even under random mating leading to some sort of functional homozygosity. The concept of prepotency has been further elucidated with investigations on several cross

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pollinated perennial species like coconut, arecanut and cashew. Identification of prepotent palms and their utilization have become established as the most viable means of ensuring a regular supply of elite planting material in coconut.

Rubber is another cross pollinated perennial tree crop in which also the identification of prepotent clones assumes much significance. Though scattered reports on general combining ability (GCA) estimates from diallel matings (Tan and Subramaniam, 1976) and vigour of seedling progeny (Alika, 1980; Saraswathyamma et al., 1984; Markose, 1984) are available, no study conducted to date has indicated the scope of exploitation of prepotency in rubber. An attempt was therefore made to evaluate certain clones for prepotency through morphological traits and latex yield at the juvenile phase.

Materials and Methods

Twenty promising clones of rubber were selected on the basis of their early yields from a small scale evaluation of 51 clones. Open pollinated seedling progenies of these clones were raised in a randomized block design with four replications at the RRII, Kottayam. The progeny of the male sterile clone Ch 2 was used as the control. A plot size of 21 plants per progeny and a spacing of 60 x 60 cm were adopted. Following a stratified sampling procedure, 15 plants per plot were selected for observations.

Five morphological traits (plant height, girth at 10 cm from ground level, total number of leaf flushes produced in 12 months, number of flushes retained at the 12th month and number of leaves per plant) and juvenile yield of rubber at the 12th month were studied for variability within and among the 20 progenies. Juvenile yield was determined by the test incision method (Annamma et al., 1989). Correlations among juvenile traits were also worked out.

A performance index for each of the 20 progenies was computed based on vegetative vigour and juvenile yield. Considering the variables plant height (X_1), girth (X_2), number of leaf whorls retained at the 12th month (X_3), number of leaves (X_4) and juvenile rubber yield (X_5):

$$\text{Performance Index} = W_1x_1 + W_2x_2 + W_3x_3 + W_4x_4 + W_5x_5$$

Where, W_1, W_2, W_3, W_4 and $W_5 = \frac{1}{\sigma_1^2}, \frac{1}{\sigma_2^2}, \frac{1}{\sigma_3^2}, \frac{1}{\sigma_4^2}$ and $\frac{1}{\sigma_5^2}$

denote weights attached to the traits X_1, X_2, X_3, X_4 and X_5 respectively and provide information on each trait. x_1, x_2, x_3, x_4 and x_5 stand for the mean values of the traits X_1, X_2, X_3, X_4 and X_5 respectively.

The progenies were then ranked on the basis of their performance indices.

Results and discussion

Polycrosses from specially designed seed gardens have not been exploited to any significant extent in rubber. They offer an attractive means of utilizing advanced clones. The choice of parents should be based on GCA estimates (Simmonds, 1989). Prepotency, being comparable to GCA (Liyanage, 1972) provides the Hevea breeder with a simpler method of assessing the ability of each clone to produce superior seedling progeny under open pollination. Early results from the present investigation gave indications of likely prepotents among the 20 clones studied.

The mean values for plant height, girth, number of leaf flushes produced, number of flushes retained, number of leaves and juvenile yield of rubber in respect of the 20 progenies are presented in Table 1. Analysis of variance revealed the progenies to be uniform with respect to plant height, there being little variation both within and among the progenies. The same trend was reflected for girth at the 12th month, conforming to an earlier report based on 10 months' growth of clonal seedlings (Markose, 1984). This indicates that the age of 12 months is likely to be too early for expression of genotypic differences among progenies for height and girth. Contrary to this, significant variability

Table 1. Performance of progenies for juvenile traits and yield.

Clones	Plant height cm	Girth cm	No. of flushes** produced	No. of flushes** retained	No. of** leaves	Juvenile yield** mg
Ch 2 (control)	268	10.3	9.1	4.2	42	63
RRII 105	249	11.0	8.5	3.9	41	116
PB 242	242	10.1	8.5	3.9	48	87
AVT 73	295	11.6	9.3	4.2	47	128
PB 252	259	11.1	9.0	4.0	48	82
PB 235	249	10.5	9.1	3.7	38	62
LCB 1320	272	10.6	9.7	4.3	47	65
Ch 32	250	10.0	9.1	4.2	53	88
PB 217	245	9.6	8.9	4.0	45	78
PB 28/83	239	10.0	8.4	3.7	45	92
PB 5/51	252	9.7	8.3	3.8	46	59
PB 215	289	10.8	9.1	4.2	54	88
Ch 26	234	9.8	8.7	3.8	43	77
PB 230	244	9.5	8.7	3.5	41	76
PB 5/76	232	9.4	8.7	3.4	37	51
PB 206	236	9.9	8.8	4.2	46	63
Gl 1	230	9.5	8.1	3.4	37	59
PB 86	258	9.8	8.9	3.7	43	95
Ch 153	254	10.2	9.3	4.2	47	70
BD 5	260	10.5	8.7	3.7	40	87
General mean	251.2	10.27	8.80	3.86	43.7	79.3
CD (0.05)	43.0	1.41	0.80	0.50	7.8	30.0

** Progeny differences significant at 0.01 level.

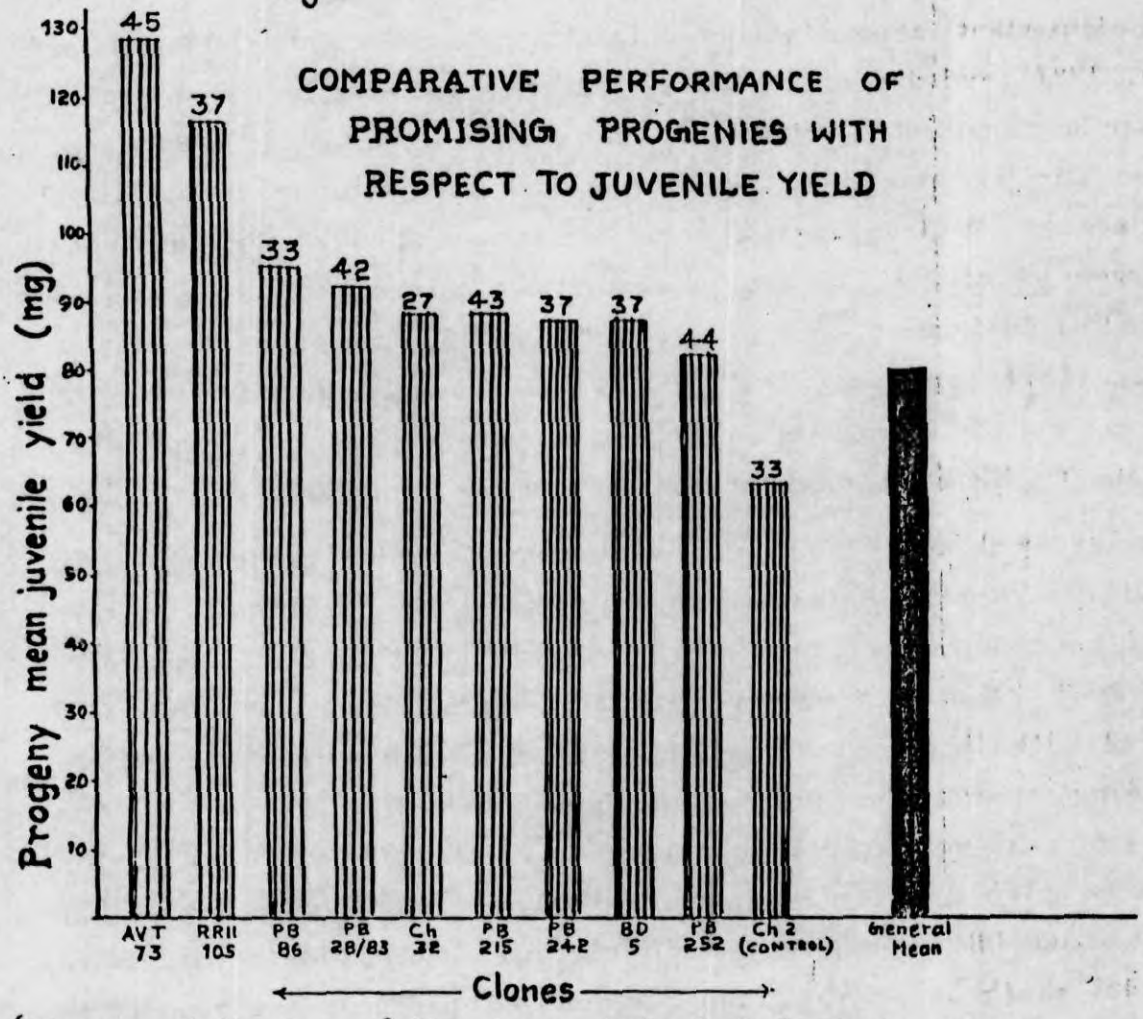
within and among progenies was observed for the three foliar traits studied. Significant differences between progenies were also observed for juvenile yield of rubber.

Seedling morphology is very important in the improvement of perennial crops and seedling vigour indicates the vigour of clones after budding (Haskell, 1961). Good immature vigour is one of the most important attributes associated with yield potential in rubber (Tan, 1987) and is one of the early selection criteria in Hevea breeding programmes. Test incision of one year old seedlings was found to be equally effective as the conventional test tapping of seedlings at the age of two years for early detection of superior genotypes (Annamma et al., 1989). In the present study, progeny of clone AVT 73 gave the highest mean dry rubber yield of 128 mg on test incision (Table 1). Three progenies, AVT 73, RRII 105 and PB 86 were superior to the control in terms of juvenile rubber yield. Two progenies, PB 215 and Ch 32 were superior for the number of leaves.

Figure 1 depicts the yield performance of nine progenies which exhibited dry rubber yields greater than the general mean of the 1200 seedlings belonging to 20 progenies along with that of Ch 2 (control). Clone AVT 73 produced progeny with the highest mean juvenile yield coupled with the highest proportion (45%) of plants with yields above the progeny mean. The progeny derived from clone RRII 105 also gave a mean yield comparable to that of AVT 73 but only 37% of the plants were high yielders. Progenies derived from clones PB 28/83, PB 215 and PB 252 also gave reasonably high mean yields with more than 40% of the plants being high yielders compared to the respective progeny means.

Correlations among plant height, girth, number of leaf flushes produced, number of flushes retained, number of leaves and yield on test incision are presented in Table 2. Highly significant positive correlations were observed among all the traits except in two cases. Between the number of flushes retained and yield, the correlation

Fig. 1.



(Figures at the top of the bars indicate % of plants with juvenile yield above the progeny mean)

Table 2. Correlations among juvenile traits and yield.

	Plant height	Girth	Flushes produced	Flushes retained	Number of leaves
Girth	0.8102**				
Flushes produced	0.4525**	0.3804**			
Flushes retained	0.5129**	0.4833**	0.6064**		
Number of leaves	0.6374**	0.4761**	0.3234**	0.5836**	
Juvenile yield	0.5562**	0.6289**	0.0913	0.2641*	0.4661**

* Significant at 0.05 level.

** Significant at 0.01 level.

was significant only at 5% level and was comparatively lower (r = 0.2641) and in the case of the number of flushes produced and yield, the association was not at all significant. The magnitude of correlation estimates revealed that girth contributes most towards juvenile yield (r = 0.6289) followed by plant height (r = 0.5562), number of leaves (r = 0.4461) and the number of flushes retained (r = 0.2641). Positive correlations of plant height and girth with juvenile yield of seedlings have previously been reported (Licy and Premakumari, 1988; Annamma et al., 1989). The results imply that height, girth, number of flushes and number of leaves contribute to juvenile vegetative vigour which in turn determine the yield potential.

The morphological traits and juvenile yield were utilised simultaneously to determine the relative merit of progenies by estimating their performance indices. As established by Liyanage (1967), prepotent coconut palms combined high yield and superiority of progeny characteristics. The open pollinated progeny of such palms were consistently high yielding with low coefficient of variation. The

performance index computed in the present study (Table 3) takes into account the performance of each progeny along with their variation for the trait. In terms of the performance index, fifteen progenies

Table 3. Progenies ranked on the basis of performance indices.

Ranks	Clones	Performances Index
1	AVT 73	321
2	RRII 105	292
3	PB 86	245
4	PB 28/83	237
5	PB 215	235
6	Ch 32	234
7	PB 242	229
8	BD 5	227
9	PB 252	220
10	PB 217	210
11	Ch 26	206
12	PB 230	201
13	Ch 153	195
14	LCB 1320	187
15	PB 206	180
16	Ch 2 (control)	179
17	PB 235	174
18	PB 5/51	167
19	Gl 1	164
20	PB 5/76	148

were superior to the progeny of the control (Ch 2). Of these, twelve progenies exhibited performance indices greater than 200 and could be considered as likely prepotents. Progenies derived from clones AVT 73 and RRI 105 with performance indices 321 and 292 respectively

stand up as better performers. In terms of juvenile yield and girth also these two progenies were superior.

The present results imply scope for identification of prepotents among Hevea clones. Clones AVT 73 and RRII 105 deserve special mention for high juvenile vigour and yield in their seedling progeny. The study, however, has to be continued for obtaining confirmatory results.

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