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AN INCISION METHOD FOR EARLY SELECTION OF *HEVEA* SEEDLINGS

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Four hundred and forty nine seedlings belonging to fourteen cross combinations were evaluated at an age of one year by an incision test method. A special knife was designed for this purpose. Normal test tapping was adopted when the seedlings attained an age of two years. The yield at one year by test incision method showed a highly significant positive correlation ($P < 0.01$) with the test tap yield. Hence the comparatively simpler and rapid incision test method is suggested as an alternative for the more elaborate and time consuming test tap methods.

Girth of one year old seedlings was positively correlated with that at two years ($r = 0.81^{**}$) and also with yield at the age of one year ($r = 0.76^{**}$)

Among the 14 families, the cross combinations PB 242 x RRII 105, PB 242 x PB 86 and PB 5/51 x RRII 208 recorded higher girth and juvenile yield at one year as well as at two years. A similar trend was noticed for plant height at one year age. The families RRII 105 x PR 107, RRIM 600 x G1 1 and RRIM 600 x RRII 203 recorded higher number of leaf flushes. Test of significance for the different characters revealed no significant difference between families but there were significant differences within the families for girth, incision test yield and test tap yield.

Key words -- *Hevea*, Early selection, Incision test, Test tapping.

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INTRODUCTION

The elaborate three phase evaluation of progenies resulting from hybridization in the conventional breeding and selection programmes of *Hevea* is a limiting factor for the quick identification of promising genotypes. Any reliable early prediction method would help to reduce the population size and enable preliminary evaluation of large populations through small scale trials. Realising the significance of juvenile selection in *Hevea*, a number of early prediction parameters in relation to yield of mature plants was suggested (Summers, 1930 and Gunnery, 1935). The parameters like girth, height, bark thickness, latex vessel number, diameter of latex vessel and sieve tube and rubber hydrocarbon in bark and petiole showed very poor and/or inconsistent relationship (Tan, 1987). Cramer (1938) developed the 'testatex' method using a special knife consisting of four 'V' shaped blades, set one below the other. Using this knife, incisions could be made on one to two year old plants for making qualitative assessment of the latex oozing out. However, this method was found useful only for culling (Cramer, 1938 and Dijkman, 1951). The modified Hamaker Morris Mann method (Tan and Subramaniam, 1976), the one widely adopted by many, consists of successive tappings of 2–3 year old plants and quantifying the latex yield. Girth, bark thickness, number of latex vessel rings, latex vessel density and one to three years yield, were correlated with yield potential (Premakumari *et al.* 1989, Goncalves, 1982 and Paiva, 1982) and are used by breeders for preliminary selection in small scale trials. But these parameters or the test tap yield cannot be used for screening when the budded plants are only one year old (Paardekooper, 1956). With a view to identifying alternative methods which could help in preliminary selection at an early stage of growth, an attempt was made to design a simple method which is reliable and fairly easy to screen large populations.

EXPERIMENTAL

The experimental materials comprised 449 seedlings belonging to 14 cross combinations of the 1986 hybridization programme, established in a seedling nursery at RRII at a spacing of 60 cm x 60 cm, employing a randomised design with two replications of 20 plants each (Table 1). Open pollinated seedlings of RRII 105 were used as control.

Juvenile yield of the seedlings was recorded at an age of one year by making incisions on the seedling bark using a specially designed knife. The device had two blades, fixed parallel to each other 10 cm apart, on a rigid metallic bar (Fig. 1). The blades were fixed in such a way that the incisions made on the seedlings are at an angle of 25° to the horizontal. By applying this device twice, one each on opposite sides on a seedling stem, four incisions of 1.5 cm each were made, two each at 5 cm and 15 cm height from the base of the seedling. The latex oozing out was collected on oven dried preweighed blotting paper clipped to the seedling stem below the incisions. The blotting paper with latex was again oven dried, weighed and the dry rubber yield quantified.

Table 1. **Seedling progenies evaluated**

Parentage	Number of progenies
RRII 105 x RRII 118	34
RRII 105 x RRII 208	32
RRII 105 x PB 86	35
RRII 105 x PR 107	36
RRII 105 x PB 217	32
RRII 105 x PB 5/51	31
RRIM 600 x RRII 33	35
RRIM 600 x RRII 203	36
RRIM 600 x PB 235	30
RRIM 600 x Gl 1	31
PB 5/51 x RRII 208	34
PB 242 x RRII 105	30
PB 242 x PB 86	30
IAN 45–873 x RRII 105	23
RRII 105 (control)	33

In addition, plant height, girth at a height of 10 cm from the base of the seedlings and number of flushes per seedling were also recorded at one year age. When the plants attained two years growth, they were test tapped for 15 days on alternate daily half spiral system. The latex was collected in cups and weight of dry rubber determined. Girth was also recorded just before test tapping. Simple correlations between the girth (X_1) and the yield (X_2) at the age of one year, the girth (X_3) and the test tap yield (X_4) at the age of two years were computed following Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Simple correlations for the juvenile yield by the incision test method and that by test tapping showed significant positive correlation (r = 0.51**, Table 2). Similarly

Fig. 1. Incision test knife in use.

the girth at one year was significantly correlated with the yield at one year (r = 0.58**), the yield at two years (r = 0.76**) and with the girth at two years (r = 0.81**). Thus the potential juvenile yielders could be identified at the age of one year by the incision test method. This method is, therefore, as effective as test tapping at an age of 2–3 years and hence a saving of 1–2 years in evaluation can reasonably be achieved. This method of incision test is quite simple and comparatively easy. The injury caused by the incisions is relatively less, heals quickly and does not apparently affect growth of the seedlings. The angle of inclination of the incisions is fixed to cut the maximum number of latex vessels. Latex yield from the four incisions at four different points can be quantified and will reflect the yield potential of the genotypes. Thus the juvenile yield and the girth at one year can be used as parameters for early selection.

Table 2. **Correlations of nursery characters at the age of one year and two years.**

Characters	X_2	X_3	X_4
Girth at one year (X_1)	0.58**	0.81**	0.76**
Yield at one year (X_2)	..	0.50**	0.51**
Girth at two years (X_3)	..	..	0.74**
Yield at two years (X_4)	..	..	..

**P < 0.01

Several early workers have suggested different methods of yield prediction of young *Hevea* plants. Fernando and De Silva (1971) reported an inverse relationship between oil content of cotyledons and latex yield in some clones and suggested the possibilities of early selection of *Hevea* seedlings for growth and yield. Similarly characters like latex constituents such as N, P, K etc., (Ho, 1976), number of stomata (Senanayake and Samaranayake, 1970) and gas exchange parameters (Nugawela and Aluthewage, 1985) were also considered as criteria for early yield prediction. Huang *et al.*, (1981) reported significant association between latex vessel number of lateral veins and petioles of young clones with mature yield. Zhou *et al.*, (1982) suggested petiolule latex method and lateral vein latex method for predicting rubber yield at nursery stage. However, Samsuddin and Mohd. Noor (1988) did not find the ratio of the petiolule rubber content to dry weight of the middle leaflet to be a perfect method for early selection.

A family wise evaluation of the progenies revealed that the families PB 242 x RRII 105, PB 242 x PB 86 and PB 5/51 x RRII 208 are among the higher yielders with respect to juvenile yield both at the age of one and two

Table 3. **Mean girth and juvenile yield at the age of one and two years.**

Family	Characters at one year		Characters at two years	
	Girth (cm)	Yield (g/four incisions)	Girth (cm)	Test tap yield (g/15 tappings)
	X̄ ± SE	X̄ ± SE	X̄ ± SE	X̄ ± SE
RRII 105 x RRII 118	7.48 ± 0.37	0.09 ± 0.01	16.4 ± 0.63	6.5 ± 0.70
RRII 105 x RRII 208	7.00 ± 0.49	0.11 ± 0.02	14.59 ± 0.60	7.03 ± 0.77
RRII 105 x PB 86	5.85 ± 0.40	0.07 ± 0.01	14.64 ± 0.66	5.33 ± 0.83
RRII 105 x PR 107	8.36 ± 0.52	0.10 ± 0.01	14.07 ± 0.76	6.83 ± 0.78
RRII 105 x PB 217	6.9 ± 0.35	0.08 ± 0.01	15.21 ± 0.69	5.96 ± 0.84
RRII 105 x PB 5/51	5.82 ± 0.43	0.09 ± 0.01	14.59 ± 0.76	6.95 ± 1.34
RRIM 600 x RRII 33	6.39 ± 0.32	0.07 ± 0.006	13.21 ± 0.48	4.23 ± 0.60
RRIM 600 x RRII 203	6.47 ± 0.38	0.12 ± 0.02	14.46 ± 0.64	6.5 ± 1.25
RRIM 600 x PB 235	6.00 ± 0.47	0.07 ± 0.01	12.96 ± 0.67	6.02 ± 0.90
RRIM 600 x G1 1	7.10 ± 0.37	0.08 ± 0.01	15.11 ± 0.47	6.5 ± 0.57
PB 5/51 x RRII 208	8.16 ± 0.68	0.11 ± 0.01	16.4 ± 0.97	11.13 ± 1.65
PB 242 x RRII 105	8.71 ± 0.38	0.12 ± 0.01	17.7 ± 0.96	10.44 ± 1.39
PB 242 x PB 86	8.08 ± 0.39	0.13 ± 0.01	16.5 ± 0.92	9.82 ± 1.39
IAN 45–873 x RRII 105	6.47 ± 0.36	0.08 ± 0.007	14.23 ± 0.79	5.47 ± 0.63
Population Mean	7.06 ± 0.42	0.09 ± 0.01	15.01 ± 0.71	7.05 ± 0.97
RRII 105 (Control)	6.50 ± 0.50	0.12 ± 0.04	13.48 ± 0.69	8.2 ± 1.24
	CV : 13.6	CV : 34.34	CV : 19.52	CV : 42.11

Table 4. **Juvenile growth characters at the age of one year.**

Family	Plant height (cm) Mean ± SE	No. of flushes Mean ± SE
RRII 105 x RRII 118	268.46 ± 11.87	9.15 ± 0.22
RRII 105 x RRII 208	268.09 ± 11.12	9.26 ± 0.19
RRII 105 x PB 86	245.69 ± 9.50	9.03 ± 0.24
RRII 105 x PR 107	256.30 ± 9.40	8.94 ± 0.19
RRII 105 x PB 217	254.42 ± 10.42	9.21 ± 0.15
RRII 105 x PB 5/51	262.46 ± 7.82	8.73 ± 0.16
RRIM 600 x RRII 33	249.05 ± 9.33	8.80 ± 0.22
RRIM 600 x RRII 203	245.47 ± 9.69	9.53 ± 0.18
RRIM 600 x PB 235	229.84 ± 11.85	8.47 ± 0.22
RRIM 600 x G1 1	264.81 ± 9.62	9.56 ± 0.18
PB 5/51 x RRII 208	294.61 ± 10.77	9.36 ± 0.17
PB 242 x RRII 105	281.84 ± 9.05	8.48 ± 0.21
IAN 45–873 x RRII 105	236.50 ± 10.65	5.62 ± 0.25
PB 242 x PB 86	306.80 ± 13.48	8.50 ± 0.07
RRII 105 (Control)	228.87 ± 10.60	8.84 ± 0.25
	CV : 13.44	CV : 5.25

years (Table 3). A similar trend was also observed for girth at the age of one and two years. The same families recorded higher plant height also (Table 4). Number of flushes of leaves was higher in the families RRIM 600 x G1 1, RRIM 600 x RRII 203 and PB 5/51 x RRII 208. However, no significant differences were noticed between the families. But within the families, significant differences at 5 per cent level were obtained for girth, juvenile yield and test tap yield. In *Hevea*, within family genetic differences between individuals are expected and in breeding programmes what requires more attention is identification of the superior genotypes, as early as practicable.

Out of a total of 449 seedlings evaluated for juvenile growth and yield, 29 per cent was selected, multiplied and a small scale trial laid out (Table 5). These seedlings recorded a test tap yield above the population mean (7 g per plant per 15 tappings; Table 3). All the selected seedlings also recorded high juvenile yield at the age of one year.

Table 5. **Details of selections based on juvenile yield**

Family	No. of selections with test tap yield > 7 g
RRII 105 x RRII 118	13 (9.92)
RRII 105 x RRII 208	12 (9.16)
RRII 105 x PB 86	6 (4.58)
RRII 105 x PR 107	7 (5.34)
RRII 105 x PB 217	9 (6.87)
RRII 105 x PB 5/51	7 (5.34)
RRIM 600 x RRII 33	2 (1.53)
RRIM 600 x RRII 203	7 (5.34)
RRIM 600 x PB 235	5 (3.82)
RRIM 600 x G1 1	7 (5.34)
PB 5/51 x RRJI 208	16 (12.21)
PB 242 x RRII 105	15 (11.45)
PB 242 x PB 86	19 (14.50)
IAN 45 – 873 x RRII 105	6 (4.58)
Total	131 (100)

(Figures in parenthesis indicate the percentage of progeny over the total selected).

However, various reports on relationship of juvenile yield and growth characters with mature yield reveal only low to moderate correlations between nursery yield and mature yield and the precision of nursery yield predictor is relatively low (Ong *et al.*, 1986). Therefore, breeders should not aim at a drastic reduction of population size based on available nursery yield predictor, but only a rather mild selection. For such preliminary screening at an early growth phase, the incision test method appears promising.

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