J. Rubb. Res., **11(1)**, 52–58

*Latex as Yield may be Better than Rubber Yield in Juvenile Screening for Selection in Rubber (*Hevea brasiliensis *Muell. Arg.)*

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The usefulness of collecting latex as yield in test-tapping of Hevea *seedlings for juvenile selection was assessed. Latex volume was recorded as yield instead of dry rubber. Data were recorded from each tapping for each of the test-tapped seedlings using graduated microcentrifuge/ centrifuge tubes. Dry rubber content (DRC) of top selections was determined for calculation of rubber yield. Mean range in latex yields among the tapped seedlings was 0.07 mL t^{-1} t^{-1} to 16.46 mL t^{-1} t^{-1} (mL per tree per tapping). Mean rubber yields in the top 20% selections from 10 tappings varied from 4.25 g t^{-1} $10t^{-1}$ to 41.37 g t^{-1} $10t^{-1}$ (grams per tree per 10 tappings). DRC among the top 20% selections varied from 14.3% to 38%. It was concluded that in juvenile selection of* Hevea *seedlings, yields determined as latex volume could result in more accurate yield recordings. Furthermore, the latex could be used to determine rubber content for eliminating the very low DRC seedlings. Information on biochemical and physiological determinants of yield could also be extracted in an effort to enhance probability of potential selections.*

Key words: *Hevea brasiliensis*; juvenile screening; test-tapping; nursery selection; seedling evaluation

In *Hevea* breeding, evaluation and recommendation of clones is long, laborious and time consuming like in other tree crops[1–3]. In its breeding programme, each cycle of hand pollination activity produces few hundred to several thousand new genotypes. Nursery evaluation of these is the first major step in selection of potential seedlings that are carried forward for further evaluation. The method of evaluation currently practiced in the nurseries for selection is test-tapping of seedlings at two to two and a half years of age[3–7]. In India, seedlings are tapped mostly on 1/2S d/2 6d/7 system of tapping with yield recordings from 10 tappings[8,9] while in Malaysia 1/2S d/3 6d/7 is the standard system adopted with yield data collected in cycles of 10 tappings for three times (three months) and presented as the mean of 3 values, each of 10 tappings[4–7]. This method of yield recording has the disadvantage of not providing the information on the progress in yield over different tappings and the data of individual seedlings cannot be subjected to statistical treatment to extract simple statistical measures like standard deviation and coefficient of variation. In addition, accuracy of yield

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data suffers because of external contamination as the latex collection cups are left in the field till the completion of fixed number of tappings. The disadvantages associated with the collection of dry rubber yield data after a fixed number of tappings can be overcome if yield from each tapping is collected. It is extremely difficult to obtain dry rubber yield data from each tapping as the yield is utterly low. This problem can be addressed if latex volume can be measured directly. So far no attempt has been made to collect latex volume as yield and determine rubber content in latex of tapped seedlings from nursery experiments. Therefore, for the first time, this paper reports collection of latex as yield in each tapping from each of the test-tapped seedlings and its importance in juvenile screening for selection in breeding of *Hevea brasiliensis*.

MATERIALS AND METHODS

Plant Material and Seedling Nursery

Seedling materials used in this study were the products of a hand pollination programme implemented in 2002 and established in a nursery at the Rubber Research Institute of India at Kottayam (9º 32' N, 76º 36' E, altitude 73 m ASL), Kerala, South India. Crosses made, progenies obtained and their establishment are detailed elsewhere[10]. A nursery of the seedlings was established during August/ September 2002 following a spacing of 60 cm × 60 cm. In the first year of planting, during November 2002 to March 2003, the seedlings were maintained under irrigation twice a week to prevent casualties due to moisture and heat stress.

Test Tapping of Seedlings

Test tapping was carried out on three-year-old seedlings at a height of 30 cm from the ground. Only the seedlings with a girth of 10 cm and above at a height of 30 cm from the ground were selected for test tapping. This cut-off girth was chosen because in the earlier programmes, high yielding selections were very rarely spotted from such saplings. Half circumference panel was marked using a miniature template and the tapping knife used was a miniature Mitchie-Goledge knife with only the longitudinal half forming the knife (*Figure 1*). Both the template and knife were specially made for this purpose. The tapping system followed was 1/2S d/2 6d/7.

Collection of Yield Data

Yield data was collected in terms of latex volume instead of dry rubber. For this purpose, graduated microcentrifuge/centrifuge tubes were used (*Figure 2*). In order to collect latex, it was not possible to use spouts for directing the latex into the tubes and hence the tubes were directly fixed on to the stem by cutting off a small portion of the open end at a slanting of 60º to 70º (*Figure 2*). The tubes were fastened to the stem below the tapping cut on the previous day of tapping using a 12 mm width cello tape that was wound round the stem with the slanting cut of the tubes firmly pressed against the stem to keep it in its place (*Figure 3*). Latex volume yield was directly read from the tube after detaching the tubes by cutting the cello tape. Used tubes were reused after washing and drying. As the tapping progressed, higher yielding seedlings were fixed with higher capacity tubes depending on the previous yield. After a few tappings, the seedlings that were giving noticeably high yield were tapped first on each tapping day. Upon completion of 22 tappings, all the seedlings that were giving a latex yield of less than 1.0 mL per tapping were excluded from further tapping as they were not likely to increase their yield any more. Unit of yield for the latex volume was mL t^{-1} t^{-1} (mL per tree

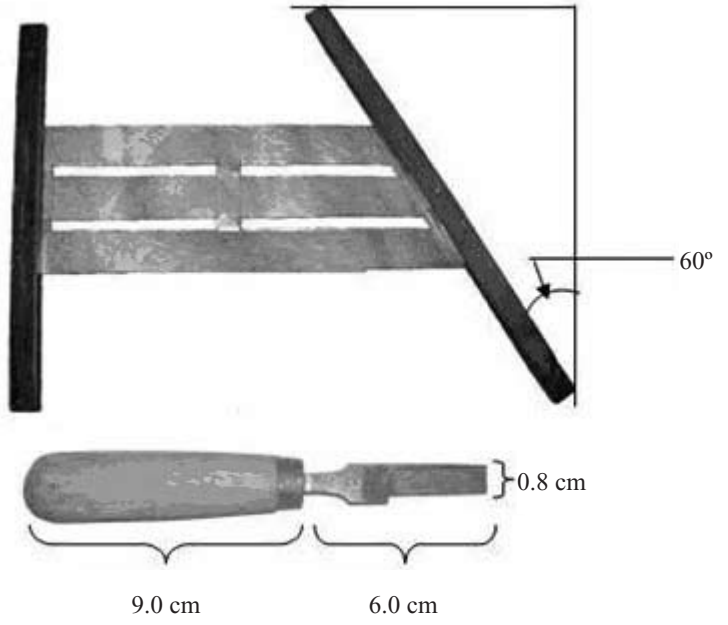

Figure 1. Miniature template and test tapping knife used in test-tapping.

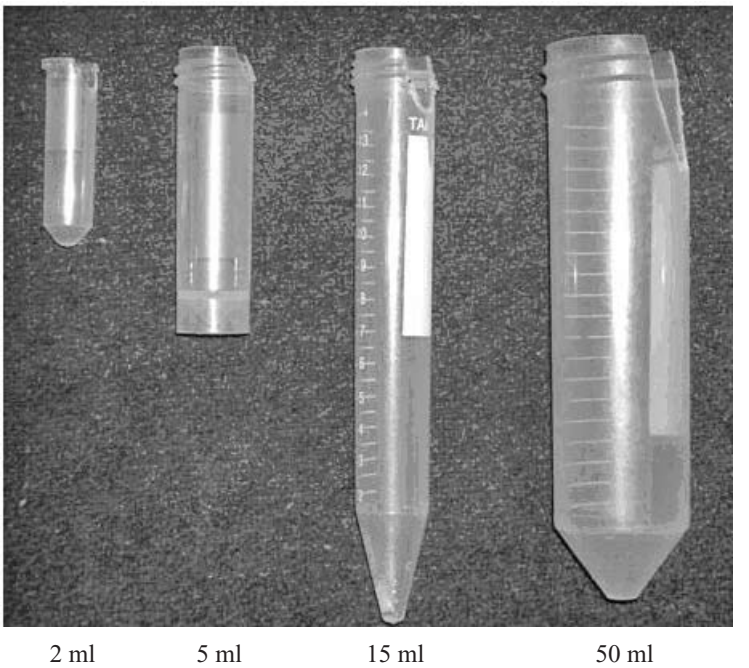

Figure 2. Different capacity graduated centrifuge tubes used in test-tapping.

Figure 3. General view of the tapped seedlings with different capacity graduated centrifuge tubes fixed on the stems (background) and a close-up view of a single seedling in the foreground.

per tapping) and that of rubber yield was g t^{-1} t^{-1} (grams per tree per tapping) and g t^{-1} $10t^{-1}$ (grams per tree per 10 tappings).

Data on Dry Rubber Content

Dry rubber content (DRC) only in latex samples of high yielding selections was determined. Top performers were identified based on latex yield upon completion of 22 tappings. Selections were restricted to 20 percent only[3]. DRC was estimated by a gravimetric method using 5.5 mm diameter Petri plates. Two to three mL of latex (and in some cases the available yield) was taken in, cleaned, dried on pre-weighed Petri plates and weighed again to get the weight of latex. The Petri plates with latex samples were dried overnight at 60ºC in an oven to obtain the total solids content (TSC) in a known weight of latex which was then converted to a percentage value. TSC was taken as DRC as there is negligible difference between them. Five

determinations were done for each selection and the mean was taken as the typical DRC for the selection.

RESULTS AND DISCUSSION

Mean girth of the tapped seedlings was 15.28 cm and the maximum girth was 34.2 cm (*Table 1*). Mean latex yield noted was 1.32 mL t^{-1} t^{-1} with a minimum of 0.07 mL t^{-1} t^{-1} and a maximum of 16.46 mL t^{-1} t^{-1}. Coefficient of variation was 27.2% in girth while in latex yield it was about 132.0%. Girth of the seedlings in the top 20% selections varied from 13.0 cm to 34.2 cm with a mean of 14.6 cm (*Table 2*). Latex yield in this group varied from 2.05 mL t^{-1} t^{-1} to 19.61 mL t^{-1} t^{-1}. Rubber yield varied from 0.42 g t^{-1} t^{-1} to 4.14 g t^{-1} t^{-1}. Mean rubber yield from 10 tappings varied from 4.25 g t^{-1} t^{-1} to 41.37 g t^{-1} t^{-1} with a mean of 11.63 g t^{-1} t^{-1}. Dry rubber content among the top 20 % selections varied from 14.3% to 38%. Girth, latex yield, rubber content and rubber yield characteristics in the top 5 percent selections indicated that the majority of high yielding seedlings were of high girth (*Table 3*). Mean maximum latex yield observed was 19.6 mL t^{-1} t^{-1} while that of rubber yield was 4.1 g t^{-1} t^{-1}. Mean rubber content in the top yielding seedlings was around 20%. Variability observed in yield of the individual seedlings was high in most of the cases.

As the results reported in this study on yield both in terms of latex yield and rubber yield for each tapping are the first reports, comparative analysis is not possible. However, with regards to the yield in terms of 10 tappings, much lower values have been reported[4,8,9]. The differences could be due to the age and genetic potential of the seedlings. Lower values reported were for two-year-old seedlings while in the present study the values are for three-year-old seedlings. Much higher values ranging from 21.8 g t^{-1} $10t^{-1}$ to 58.9 g t^{-1} $10t^{-1}$ for two and half year old seedlings wherein the tapping system was 1/2S d/3 6d/7 and spacing of 1.8 m × 1.8 m was also reported[7]. The reported higher values could be attributed to the higher spacing and lower tapping frequency.

From the study, it could be concluded that collecting yield data in terms of latex volume in juvenile selection of *Hevea* seedlings appears to be highly advantageous because of better accuracy in yield recordings. Additionally, the latex can be used for determining rubber content as well as

TABLE 1. STATISTICAL FEATURES IN GIRTH AND LATEX YIELD OF ALL THE TAPPED SEEDLINGS

Statistic	Girth (cm)	Latex yield* (mL t^{-1} t^{-1})
Mean	15.28	1.32
Minimum	10.00	0.07
Maximum	34.20	16.46
S.D. (±)	4.15	1.74
C.V. (%)	27.20	131.96

*Based on 22 tappings

TABLE 2. STATISTICAL FEATURES IN GIRTH, RUBBER CONTENT, LATEX YIELD AND RUBBER YIELD IN THE TOP 20 PERCENT SELECTIONS

Character	Mean	Mean minimum	Mean maximum	SD (±)	CV (%)
Girth (cm)	14.58	13.00	34.20	2.08	14.27
Latex yield (mL t^{-1} t^{-1})*	4.52	2.05	19.61	3.05	67.44
Rubber content (%)	27.53	14.30	38.00	5.49	19.93
Rubber yield (g t^{-1} t^{-1})*	1.16	0.42	4.14	0.61	52.47
Rubber yield (g t^{-1} $10t^{-1}$)*	11.63	4.25	41.37	0.61	52.47

*Based on 35 tappings

TABLE 3. GIRTH, YIELD AND RUBBER CONTENT IN THE TOP 5 PERCENT SELECTIONS

Seedling parentage	Seedling No.	Girth (cm)	Mean latex yield* (mL t^{-1} t^{-1})	Rubber content (%)	Mean rubber yield*		CV (%)
					g t^{-1} t^{-1}	g t^{-1} $10t^{-1}$	
PB 330 × RRII 414	704	34.2	19.6	21.1	4.1	41.4	43.1
PB 330 × RRII 414	514	27.0	17.9	22.4	4.0	40.1	51.1
PB 330 × RRII 414	683	25.0	11.5	20.7	2.4	23.7	49.7
PB 330 × RRII 414	690	25.5	11.4	18.4	2.1	21.0	34.6
RRII 429 HS	445	26.0	11.4	20.0	2.3	22.8	50.7
PB 330 × RRII 414	701	22.4	11.1	17.8	2.0	19.8	50.3
RRII 414 HS	335	19.8	9.0	16.6	1.5	15.0	30.5
RRII 414 HS	342	20.0	8.4	24.5	2.1	20.6	24.2
RRII 414 × PB 330	477	24.3	6.9	22.3	1.5	15.5	50.4
RRII 414 HS	575	21.1	6.6	30.2	2.0	19.9	24.6
PB 330 HS	844	25.0	6.6	24.3	1.6	16.0	35.0
PB 330 × RRII 414	638	23.0	6.6	22.5	1.5	14.7	55.4
PB 330 × RRII 414	712	27.0	6.2	30.4	1.9	18.9	58.7
PB 330 × RRII 414	512	23.2	6.0	29.5	1.8	17.7	39.0
PB 330 × RRII 414	522	20.0	5.9	18.0	1.1	10.6	36.5
PB 330 × RRII 429	726	21.2	5.8	19.8	1.2	11.5	48.7
RRII 105 HS	309	20.8	5.8	21.8	1.3	12.7	37.1
RRII 105 HS	91	18.7	5.8	22.7	1.3	13.1	41.4
RRII 414 × PB 330	869	18.5	5.6	20.3	1.1	11.4	42.9
PB 330 HS	822	19.2	5.3	29.2	1.5	15.4	58.4
RRII 414 HS	1021	16.5	5.3	18.4	1.0	9.7	55.0
PB 330 × RRII 429	881	21.5	4.9	27.4	1.4	13.5	56.5

*On completion of 35 tappings; HS= Half sib

biochemical and physiological determinants of yield for enhancing the probability of potential selections. Furthermore, selection can be practiced by giving weightage to DRC so that very low DRC seedlings can be eliminated in the juvenile stage itself.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. K. U. Thomas, Senior Scientist, exploitation studies for the idea on the test-tapping knife. Help rendered by Mr. Joy P. Edakkara, Field Assistant and the two tappers is thankfully acknowledged.

Date of receipt: May 2007
Date of acceptance: January 2008

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