Evaluation of Some Rubber (*Hevea brasiliensis*) Clones Selected from 1975 Hand Pollination Program

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ABSTRACT

A study was conducted to evaluate the performance of 25 *Hevea* clones selected from a seedling population derived from 1975 hand pollination program. Clones RRIC100, RRIC121, RRIC130 and RRIM600 were used as control clones. Girth and yield data were collected over 10 years and 5 years respectively. Pre and post tapping growth rates of clones were found to be significantly different indicating genetic differences between clones. growth rates of clones slowed down after the commencement of tapping. The reduction of growth rates differed among clones indicating that the response to tapping varied among the genotypes. Results of Duncan Multiple Range Tests performed on mean yield of 29 clones showed that RRIC121 and the new selection, 75-143 were significantly better than rest of the clones. Considering the performance of new selections with respect to yield and ability to maintain the vigour after tapping, two new selections, 75-143 and 75-33 were identified to be promoted to the next stage of evaluation.

KEY WORDS: *Hevea brasiliensis*, Clone, Evaluation, Genotype, Post Tapping, Pre Tapping.

INTRODUCTION

Rubber (*Hevea brasiliensis*) is the second largest plantation crop in Sri Lanka next to tea and Sri Lanka is the 6th largest natural rubber producer in the world. Also the rubber industry plays a vital role in the national economy and provides employment, both directly and indirectly to about 600000 persons. Its production in 2003 was 92 million kg. In terms of export earnings and value addition as percentage of GDP, rubber contributed about Rs million 37.18 and 0.5 respectively in 2003 (Anon, 2003). Latex is the most economically important component of the rubber plant and vigour in terms of girth increment is considered as an important secondary character. In view of current surge of interest in rubber wood by timber industry, the rubber tree has now gained recognition as a dual purpose tree providing both rubber and timber. The domestic consumption of natural rubber has increased over the years. In 1980 it was about 14.9 MT and in 2004 it reached 56.8 million kg. This indicates nearly a four fold increase in domestic consumption but the production in Sri Lanka had been static. Poor crop management, poor usage of high yielding clones as well as shrinking rubber hacterage are the main reasons for the low production and productivity. Use of genetically improved high yielding clones possessing important secondary characters is the easiest and cheapest way to increase the production and productivity.

In *Heave* breeding current superior clones are used as parents to produce the seedling progenies for the next cycle of selection. This process is generally referred to as generation wise assortive mating (GAM) because the best is crossed with the best in each cycle (Simmonds, 1986).

The seedling progenies derived by GAM are then selected in the nursery, cloned and evaluated in small scale clone trials (SSCTs) and large scale clone trials (LSCTs) to identify the superior clones. The main objective of this study is to evaluate the performance of clones initially selected from a seedling population derived as a result of 1975 hand pollination program.

MATERIALS AND METHODS

The experimental material consisted of 25 new selections made from 1975 hand pollination or artificial crossing program and four control clones (RRIC100, RRIC121, RRIC130, and RRIM600). Details of the crosses made and the number of seedlings derived from each cross are given in Table 1.

Out of these 255 seedlings 25 promising seedlings (genotypes) were selected on their micro tapping yield (Waidyanatha and Fernando, 1972) and vigour as measured by girth. These selections were then cloned and planted in a clone trial, along with the four control clones. Trial was established on Clyde estate in Kalutara district in 1982.

Table 1: Details of the hand pollination program;

Cross	No. of Seedlings derived
Selfs	
82 * 82	40
RRIC100 * RRIC100	22
82 * RRIC101	106
RRIC 100* RRIC101	108
1458 * RRIC101	3
Total	**255**

A completely randomized design with 15 single tree plots per clone was used. Thus the clone trial at the beginning consisted of 435 plants. Spacing of 3.5 m within rows and 5.5m between rows was adopted. Cultural practices recommended by the rubber research institute of Sri Lanka (RRISL) were followed in the maintenance of the trial.

MEASUREMENTS AND ANALYSIS

Girth (circumference in cm), considered to be a measure of vigour was recorded annually from the date of planting. During the first two years diameter

measurements were recorded, because plants were too small to measure the girth and these diameter measurements were converted to girth assuming that the stem was cylindrical using the following formula:
Girth= 22/7 * Diameter

Pre and post tapping girth measurements were taken at 91.4cm and 152.4 cm above the highest point of bud union respectively. Tapping started in the year of 1989, at the end of 6th year after planting, on reaching the recommended girth for commencement of tapping. Yield was recorded in grams per tree per tapping (g/t/t) and an attempt was made to record one yield measurement per month from each tree on a normal tapping day.

ANALYSIS

1. Growth Rates

Pre and post tapping linear growth rates were calculated by regressing girth on to the year of measurement (Winitha Margret etal, 1998). Regression was done using individual tree girth measurements.

2. Yield

Yield data were subjected to analysis of variance and the Duncan Multiple Range Test (DMRT) was performed on mean yields of clones. When computing mean yields only those years with 5 or more test tapping yield data were included. Analyses were done using the statistical analysis system (SAS, 1998) procedure.

RESULTS AND DISCUSSION

1. Girth

Regression of girth on year of measurements showed a significant linear component of growth for two periods. Winitha Margret etal, (1989) also reported a significant linear growth in some rubber clones during the first five years.

Therefore linear growth rates of clones as measured by regression co- efficients were subjected to an analysis of variance and results are presented in Table 2a and 2b for pre and post tapping periods. Highly significant differences between clones for linear growth rates indicated presence of genetic differences among the clones for this character for both periods.

Pre and post tapping growth rates of clones are presented in Figure 1. Comparison of growth rates for the two periods in Figure 1 clearly showed that all the clones under consideration had reduced growth after tapping.

Response to tapping by clones was not same and indicated that some initially fast growing clones grew slowly, relative to others, after the commencement of tapping (Figure 1).

New selection 75-240 had the highest pre tapping growth rate (11.11cm) followed by 75-141 (10.92cm) which is also a new selection. Among control clones RRIC121 had the highest pre tapping growth rate of 9.47cm followed by RRIC100 (9.32cm).

Table 2. analysis of variance;

2a. Pre tapping

Source	Mean Square	F value	Pr > F
Clones	8.47407	6.13	<.0001
Error	1.38262		

2b. Post tapping

Source	Mean Square	F value	Pr > F
Clones	22.27274	21.77	<.0001
Error	1.023020		

Reduction of growth as a result of tapping could be due to competition for food assimilates between vegetative growth and synthesis of extra latex to replace what was extracted during tapping. Post tapping growth reduction as a percentage of pre tapping growth is shown in Figure 2.

Figure 2 clearly showed that with the commencement of tapping, growth rates went down by more than 90% in some clones (75-17 and 75-41). On the other hand clones that can withstand the effect of tapping can be selected from the clonal population. It was also evident that, majority of clones showed more than a 50% reduction in growth rate after tapping when compared to pre tapping growth rate. New clones 75-143 and 75-33 showed only 45% and 48% reduction in growth rate while the best control clone, RRIC121, showed a reduction of 47% indicating that they can withstand tapping and maintain fairly good growth relative to other clones.

1. Yield

Results of the analysis of variance (Table 3) of yield showed significant differences among clones indicating genetic differences among clones for this character. Thus it may be possible to select high yielding clones among these clones.

Table 3. Results of analysis of variance;

Source	Mean Square	F Value	Pr > F
Clones	226.3289	3.76	< .0001
Error	60.136786		

Duncan Multiple Range Test (DMRT) performed on mean yield, averaged over 5 years, showed that RRIC121 and 75-143 were significantly different from rest but there was no significant difference between RRIC121 and 75-143. Thus these two clones were superior to the rest of the clones when yield was considered. The mean yields of clones were plotted against their pre tapping growth rates (Figure 3).

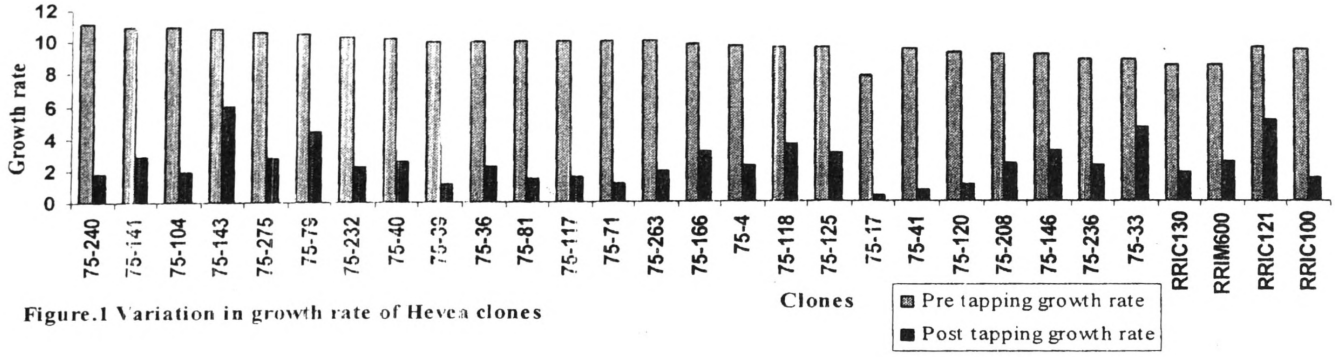

Figure.1 Variation in growth rate of Hevea clones

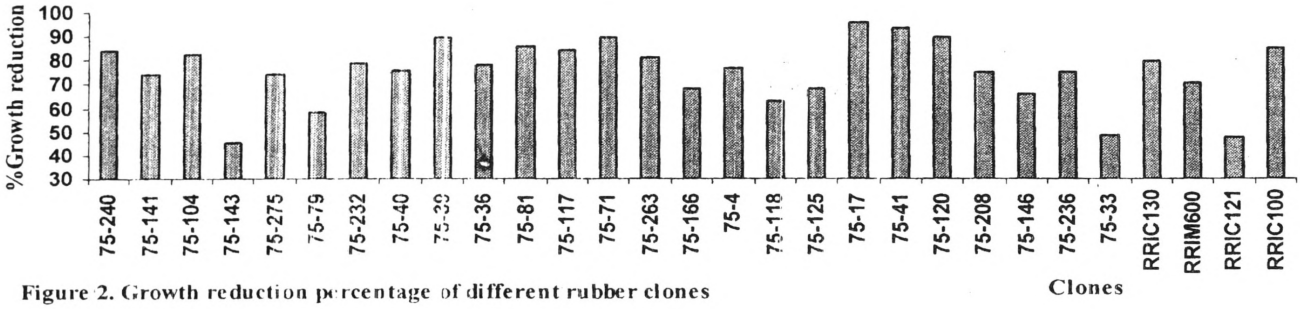

Figure 2. Growth reduction percentage of different rubber clones

It's clear from this figure that clones occupying B quarter had above average growth rates and above average yield when compared to population means. Eight new selections (75-143, 75-104, 75-275, 75-240, 75-232, 75-4, 75-71 and 75-36) occupied the B quarter of the Figure 3. None of the control clones fell into this category. But RRIC121 with very high above average yield had marginally below average pre tapping growth rate. High yielding clones with good pre tapping vigour should also have a good post tapping vigour .To check whether clones with above average yield and above average of pre tapping girth can stand the effect of tapping, a scatter diagram was obtained by plotting mean yield of clones against percentage post tapping girth reduction (Figure 4).

It can be seen from Figure 4 that the control clones RRIC121 and two new selections (75-143 and 75-33) had above average yield and below 50% post tapping growth reduction. This means that these clones had good yields and low post tapping growth reduction when compared to other clones.

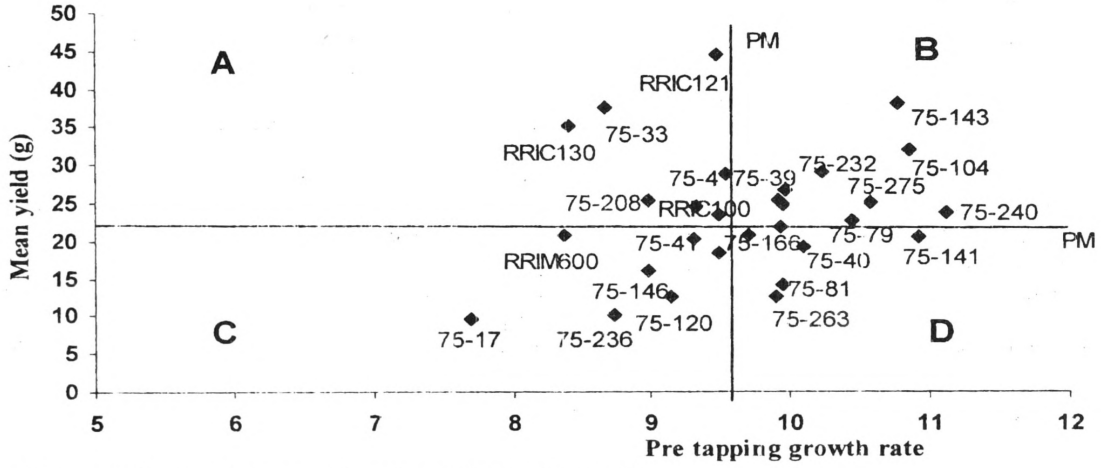

Figure 3. Pre tapping growth rate vs Mean yield of clones

PM = Population Mean

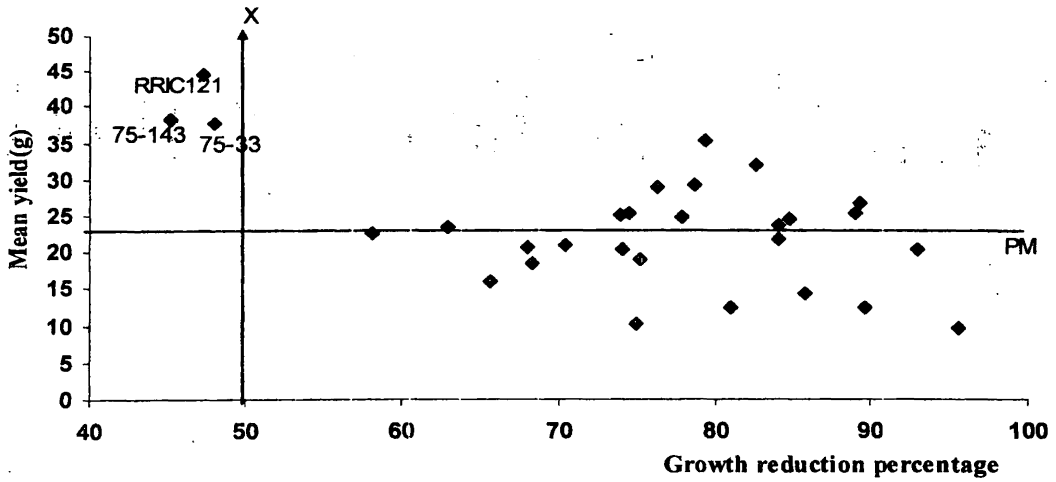

Figure 4. Mean yield variation of clones against the pre tapping growth reduction percentage(%)

PM = Population Mean
X = 50% Post tapping growth reduction

CONCLUSIONS

The new clones 75-143 and 75-33 performed well with respect to yield and vigour. Yield of 75-143 was not significantly different from that of the best control clone. According to DMRT, yield of 75-33 was significantly lower than RRIC121, but comparable to other control clones. Both new selections showed that their pre tapping growth was high and reduction of growth as response to tapping was low and comparable to RRIC121. These characteristics, high yield, high pre tapping growth and low post tapping growth reduction of the two new selections were much better than the other three control clones. Therefore these two selections can be promoted to the next stage of evaluation.

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