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PERFORMANCE OF A POLYCLONAL SEEDLING POPULATION IN COMPARISON TO MONOCLONAL AND MULTICLONAL POPULATIONS OF *HEVEA* IN NORTHERN WEST BENGAL

Gitali Das, R. S. Singh* and D. Chaudhuri**

Rubber Research Institute of India, RES, Nagrakata, Jalpaiguri - 735 225, West Bengal, India
*Rajendra Prasad Agriculture University, Pusa, Samastipur, Bihar, India
**Rubber Research Institute of India, RRS, Guwahati – 781 006, Assam, India

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Two hundred and forty polyclonal rubber seedlings were planted in 1990 at Nagrakata, Jalpaiguri, West Bengal, in completely randomized design (single tree-single plot) at 5 x 5 m spacing and they were compared with a clonal composite population of 18 clones and a monoclonal block of clone RRIM 600 planted in the same year. Tappable girth was attained after nine years of growth. Early growth characters of this polyclonal seedling block were comparable with that of clonal composite block and monoclonal block of RRIM 600 in terms of percentage of healthy plants, wind damage, wintering-refoliation pattern, TPD and disease severity. The populations differed in average girth. Mean girth at initiation of tapping was only 43.9 cm in the polyclonal block compared to 55.9 cm in the clonal composite block and 53.8 cm in the RRIM 600 block. The percentage of plants that attained tappable girth by the eighth year of growth was similar in the polyclonal seedling and clonal composite blocks (65 and 60%, respectively) but was relatively high in RRIM 600 (70%). The average block yield of RRIM 600 was higher than that the polyclonal seedling and clonal composite blocks. The percentage of plants showing above-average block yield was similar in all the combinations. A total of 87 plants showed more than the average block yield every year over 10 years in the polyclonal seedling block. The mean yield of these 87 selected mother trees (40.5 g/t/t) was on par with the monoclonal block of RRIM 600 (39.0 g/t/t) and was higher than that of the clonal composite block (34.4 g/t/t). The trend of yield increase over years in the monoclonal block of RRIM 600 was better than that in the polyclonal and clonal composite blocks. Eighteen top ranking polyclonal seedling trees were found to show mean yield above 45 g/t/t over 10 years of tapping and had good bole volume, possessing the characters required for potential mother trees.

Keywords: Clonal composite, Growth, Polycross seedling, Selection, Yield

INTRODUCTION

Rubber (*Hevea brasiliensis*), being conventionally adapted to a tropical environment, needs to be tested in non-traditional environments prevailing in north-eastern India also, considering the limitation in area expansion in the traditional belt. Identification of planting materials suited to this region is of prime importance, and in this direction, selection from multiclonal populations would be an easy approach. However, no single clone can address the

Correspondence: Gitali Das (Email: gitalidas@rubberboard.org.in)

needs of all regions, where climate, topography and other environmental factors vary appreciably. Therefore, selections from polycross progenies offer possibilities in obtaining better genetic gain in terms of growth, yield, tolerance to biotic/abiotic stress, *etc.* (Varghese *et al.*, 2006). Selection of promising seedling mother trees from polycross progeny and development of primary clones were initiated in Sri Lanka (Fernando, 1974) and India (Marattukalam *et al.*, 1980). Some of these are still used as planting materials in different rubber growing countries (Tan *et al.*, 1996). Such attempts also facilitated selection of five high yielding clones and another six with high timber volume from 88688 seedling trees in *H. brasiliensis* in India (Mydin *et al.*, 2005). These 11 clones are in the pipeline. Preliminary selection of genotypes from polycross block of rubber in Tripura (Sasikumar *et al.*, 2001) and Assam (Mondal *et al.*, 2006) was done based on growth and yield performance. The present experiment on evaluation of polyclonal seedlings generated from rubber seeds was carried out at Nagrakata, Jalpaiguri, West Bengal.

MATERIALS AND METHODS

The Regional Experiment Station, Nagrakata in Jalpaiguri district of West Bengal is situated in the sub-Himalayan range (26°43'N; 88°26E; 69 m above msl; T_{max} 29.6 °C & T_{min} 17.2 °C; total rainfall 3699 mm per annum) and experiences stormy wind and high humidity. The experiment was started in 1990 with 240 seedling trees raised from seeds procured from the polyclonal seed garden in Kanyakumari, Tamil Nadu in the traditional belt. Completely randomized single tree-single plot design with a tree spacing of 5x5 m was adopted. A block of 18 clones planted adjacent to the polyclonal block in the same year and grown under similar agromanagement practices was considered as clonal composite block for comparison. The clones present in the clonal composite block were Haiken 1, SCATC 93-114, SCATC 88-13, PB 5/51, PB 235, PB 311, GT 1, RRII 300, RRII 203, RRII 118, Gl 1, RRIM 703, PR 107, RRIM 612, RRIM 605, RRII 105, PB 86 and RRII 208. The clonal blocks were laid out in RBD with three replicates and 16 plants in each replication. Another adjacent monoclonal block of RRIM 600 was considered as a control block. Yield (g/t/t) was recorded over a period of 10 years, in the two panels BO-1 and BO-2.

The peak yielding period in this region is from October to December, which coincides with temperatures beginning to fall below 25 °C (pre-winter). Actual winter yield (January-February) cannot be recorded as this is the period of tapping rest. Girth data was collected annually at the height of 110 cm for polyclonal seedling trees and at 125 cm for the clones. Clear bole volume was calculated using girth and first branch height following the true-volume method (Chaturvedi and Khanna, 1982). Bark thickness data was measured at panel opening (9th year) and in the 19th year of growth.

Monthly yield was collected as fresh cuplump which was transformed to dry weight using a correction factor $Y = 0.4355 X + 1.1428$ ($R^2 = 0.95$), where 'Y' was the dry weight and 'X' was the fresh cuplump weight (Das *et al.*, 2010). Coefficient of variation (%) was calculated on year-to-year basis. The trees in the polyclonal seedling block showing above average yield were designated as polyclonal above-average block and characterized separately. Pre-

winter yield was calculated considering the yield from October-December. The incidence of TPD was recorded in October every year (Das *et al.*, 2005) and powdery mildew disease was scored visually every year under sulphur dusted conditions following the method of Samaradeewa *et al.* (1985). Plants with 80-100% panel dryness incidence were considered as TPD affected trees for this experiment. Scoring for casualty, weaklings and healthy plants was done in the third year of growth. Wind damage data on branch snap or fully damaged tree (uprooting or trunk snap) was taken on a yearly-basis for the last three years. Visual scoring on wintering was conducted for three consecutive years from the eighth to the tenth year of tapping. Scoring was carried out on each tree at weekly intervals from the beginning of wintering till the commencement of refoliation. All the experimental plants were rainguarded and routine cultural practices were followed as per the recommendations.

RESULTS AND DISCUSSION

Growth in *Hevea* is considered as one of the important characters used for the selection of clones for timber and/or assessing the age of attaining tappability (Hashim and Aziz, 1994). A comparison of the attributes of polyclonal seedling block with that of clonal composite block and check clone RRIM 600 at the age of three years (Table 1) showed that the pattern was similar in terms of healthy plants (59.5, 58.2, 60.2%), weaklings (8.4, 5.5, 5.9%), casualty (17.2, 15.6, 15.6%), and severity in powdery mildew disease (moderately tolerant to tolerant). In the polyclonal seedling block, plants fully damaged by wind were less (3%) than in the cloal composite and RRIM 600 blocks (9.2 and 7.3% respectively), probably because of

Table 1. **Comparison of various attributes in polyclonal seedling, clonal composite and RRIM 600 blocks**

Attribute		Polyclonal seedling	Clonal composite	RRIM 600 block
Healthy plants (%)		59.5	58.2	60.2
Weaklings (%)		8.4	5.5	5.9
Casualty (%)		17.2	15.6	15.6
Wind damage (%) in the 19th year of growth	Branch snap	10.6	11.1	9.0
	Fully damaged	3.0	9.2	7.3
Wintering (%)		70-85	85-95	85-90
Mean girth at panel opening (cm)		43.9	55.9	53.8
Tappability in the 8th year (%)		65.0	60.0	70.0
Mean yield (g/t/t) over 10 years		26.5	34.4	39.0
Percentage of plants/clones showing above-average block yield every year over 10 years		49.0	50.0	50.00
Tapping panel dryness (%)		7.9	5.0	0.5
Severity of powdery mildew disease		Moderately resistant to susceptible	Moderately resistant to susceptible	Moderately resistant to susceptible

the undisturbed root system in polycross trees; number of plants showing branch snap was similar in all categories. Mean girth at panel opening in the ninth year of growth was lower in the polyclonal seedling block (43.9 cm) than that in the clonal composite block (55.9 cm) and the RRIM 600 block (53.8 cm). The block of RRIM 600 attained 70% tappability by eighth year whereas in the polyclonal block and the clonal composite block, it was less (65 and 60%, respectively). Similar results were reported when growth of seedling and clonal blocks growing under the climatic conditions of Tripura (Sasikumar *et al.*, 2001) and Assam (Mondal *et al.*, 2006) were compared. However, early attainment of tappability, high girth and girth increment in a seedling block compared to a clonal block was reported by Birari *et al.*, (1998) in Maharashtra. Average yield over 10 years was maximum in RRIM 600 (39 g/t/t) followed by the clonal composite block (34.4 g/t/t) and polyclonal seedling block (26.5 g/t/t). The percentage of plants showing above average yield in all the blocks was similar. Incidence of TPD was more in the polyclonal seedling (7.9%) than in the clonal composite block (5%) and RRIM 600 (0.5%).

The growth characteristics of trees in the three different groups are shown in Table 2. At the time of opening, the average girth of trees in clonal composite block was higher (55.9 cm) than that of the RRIM 600 (53.8 cm), polyclonal (43.9 cm) and polyclonal above-average blocks (50.2 cm). In the 19th year of growth, the mean girth of polyclonal above average block (73.5 cm) was higher than the rest of the blocks. Higher girth in selected polyclonal seedling trees than in the base polyclonal population was also observed in Assam (Mondal *et al.*, 2006). Better growth of selected polyclonal plants than the base clonal population was also reported by Sasikumar *et al.*, (2001) from Agartala, Tripura. Better growth of seedling plants than some of the primary clones in *Hevea* was also reported by Krishnankutty and Sreenivasan (1984). The annual average girth increment after tapping of RRIM 600 block was the lowest among all the groups. The bark thickness at opening of panel and in the 19th year after tapping, as well as the timber yield per unit area (bole volume) of all the groups in the 19th year were comparable.

Comparative study on yield (Table 3) of polyclonal above-average block with that of clonal composite and RRIM 600 blocks showed that the yield of RRIM 600 block (39.0 g/t/t) was on par with polyclonal above-average block (40.5 g/t/t), but in clonal composite block, it was lower (34.4 g/t/t). The coefficient of variation (CV) of polyclonal above-average block with respect to different years was very high (41.6%) indicating low stability in yield compared to the clonal composite and RRIM 600 blocks (27.5 and

Table 2. **Comparison of growth attributes in polyclonal, clonal composite and RRIM 600 blocks**

Block	Girth attributes (cm)		Bark thickness (mm)		Bole volume in 19th year (m^3)
	At opening	19th year	At opening	19th year	
Polyclonal seedling	43.9	61.0	5.1	6.1	0.09
Polyclonal seedling above average	50.2	73.5	5.9	7.3	0.14
Clonal composite	55.9	67.1	5.2	6.3	0.09
RRIM 600	53.8	65.3	5.3	6.3	0.07

Table 3. **Yielding pattern in different blocks**

Block	Annual average yield (g/t/t)	CV of average yield (%)	Linear regression between yield and year of tapping	BO-1 Panel over five years (g/t/t)	BO-2 Panel over five years (g/t/t)	Peak yield contribution (%)
Polyclonal seedling above- average	40.5	41.6	Y=2.59 X + 22.20	29.8	43.3	60.0
Clonal composite	34.4	27.5	Y=2.51 X + 20.62	27.9	40.4	62.2
RRIM 600	39.0	28.7	Y=3.58 X + 24.66	33.7	54.8	61.8

28.7%, respectively). The linear regression equation of yield for 10 years showed that in all groups, yield increased over time. However, the slope in RRIM 600 was high (3.58) compared to polyclonal above-average block and clonal composite block, which were 2.59 and 2.51 respectively, indicating that the increasing trend of yield over time was comparatively higher in RRIM 600. The mean yield of polyclonal above- average block in BO-1 and BO-2 panel was 29.8 and 43.3 g/t/t, respectively. The overall yield contribution of BO-2 panel was high compared to BO-1 panel in all groups. Peak season (pre-winter) yield contribution of all the blocks was high (above 60%) indicating high yield potential even though the temperature was low (below 25 ^{0}C).

The overall yield in the block of the polyclonal seedling trees was lower than that of RRIM 600 (Table 1), which may be due to the mixture of genotypes of different potential. However, 18 of the 178 polyclonal seedlings trees showed more than 45 g/t/t yield over 10 years (Table 4). Of these, seven trees showed 80-90% TPD. The best yielding tree NGK 203 showed 68 g/t/t followed by NGK 53 with 62 g/t/t. These were followed by NGK 42 and NGK 46 with 56 g/t/t. The final girth of these selections in the 19th year ranged from 73.5 to 105.7 cm. The bole volume of NGK 47 was the highest (0.32 m^3) followed by NGK 53 (0.28 m^3). Peak yield contribution was the highest for NGK 22 (72%) followed by NGK 55 and NGK 87 (70% each). However, NGK 53, NGK 87 and NGK 42 showed very high TPD. Ten trees out of 18 potential mother trees showed above 50 g/t/t yield. Reports on cultivation of polycross seedling populations in constrained climatic conditions, *viz.* drought (Dapchari, Maharashtra and Dhenkanal, Orissa) and cold (Tura, Meghalaya) showed high variability in growth and early mature yield of rubber, indicating scope for selecting potential genotypes (Varghese, 2002).

The present study to compare the growth and yield potential of polyclonal seedling trees with those in clonal composite and RRIM 600 blocks showed that the performance of polyclonal seedling trees was not as good as that of RRIM 600 in the climatic conditions of northern West Bengal. However, there were many polyclonal seedling trees with better growth attributes in terms of girth, bark thickness and bole volume and comparabale yield, qualifying them as potential mother trees.

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Table 4. **Potential mother trees showing high yield over 10 years of tapping**

Selection	Girth (cm)		Bole volume at 19th year (m^3)	Annual average yield over 10 years (g/t/t/)	Peak yield contribution (%)
	At panel opening	At 19th year of growth			
NGK 3	44.00	88.00	0.13	45.76	69.75
NGK 152*	42.80	58.10	0.07	45.92	56.14
NGK 136*	63.70	94.50	0.20	46.38	66.67
NGK 67*	37.80	73.20	0.09	46.40	65.31
NGK 146	53.80	77.80	0.13	46.53	56.98
NGK 224	49.20	73.00	0.12	46.67	66.68
NGK 22	58.20	90.30	0.15	47.63	72.02
NGK 69	53.20	72.10	0.10	49.87	64.78
NGK 70*	57.30	97.50	0.16	50.15	67.05
NGK 55	58.60	69.20	0.10	50.91	70.21
NGK 1	46.60	80.20	0.13	51.44	65.36
NGK 114	58.30	93.50	0.13	51.74	65.60
NGK 47	58.60	92.70	0.32	54.67	60.26
NGK 87*	55.70	86.60	0.15	55.67	70.08
NGK 46	51.70	82.50	0.11	55.69	66.36
NGK 42*	57.70	105.70	0.22	55.72	61.39
NGK 53*	64.00	92.60	0.28	61.83	59.77
NGK 203	56.10	73.50	0.13	68.19	57.32

* Trees showing 80-90% TPD

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