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EVALUATION OF POLYCLONAL SEEDLING POPULATION OF *HEVEA BRASILIENSIS* (WILLD. EX ADR. DE JUSS.) MUELL. ARG. IN TRIPURA

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The performance of a seedling population of polyclonal origin was evaluated under the agro-climatic conditions of Tripura. Comparison of the characters of the polyclonal seedling population with a multiclonal population of the same age revealed that the seedling population is highly heterogeneous with respect to growth, yield and other useful secondary characters. Yield evaluation of the seedling population over the initial three years revealed that some genotypes are outstanding performers which recorded two to three times higher yield than the mean of the multiclonal population. In addition to growth and yield, the population was assessed for incidence of powdery mildew, wind damage and wintering pattern. Ten genotypes with high yield and useful secondary attributes were selected for further evaluation. This report, which is the first of its kind from North East India, reveals the scope for selection of promising genotypes from polycross progeny.

Key words : Breeding, *Hevea brasiliensis*, Polycross seedlings, Selection, Stress, Yield.

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INTRODUCTION

Rubber, being a cross-pollinated plant, heterogeneous seeds are produced in specially designed polycross seed gardens. Compared to clonal populations, the progeny of polycross breeding, popularly known as polyclonal seedling populations may be the ideal material to circumvent biotic and abiotic stresses. The evaluation of polyclonal seedling population for selection of outstanding genotypes in any new environment, therefore, has significance. Selection of outstanding seedling trees from rubber estates followed by their multiplication through budding and use as primary clones has been practised since the early years of rubber breeding and such clones are still under cultivation in different rubber growing countries (Fernando, 1974).

The region between 10^0 north and south of the equator offers the ideal environment congenial for rubber cultivation and any deviation from this latitude range is a non-traditional environment (Pushparajah, 1983). The state of Tripura (22^0 56′ – 24^0 32′N and 91^0 10′ – 92^0 21′E) in North East India thus represents a non-traditional environment for rubber cultivation. Tripura has a sub-tropical warm humid climate with a conspicuous winter season limiting the growth and yield of rubber. Strong wind accompanied by thunder showers, hailstorm and incidence of powdery mildew disease are the other stress factors affecting rubber cultivation in the region. Climatic adaptation involves the genetic adaptation of populations through the ability of individuals to buffer environmental changes by modifying their phenotypic response. Scientific information on the performance of polyclonal seedlings in Tripura is lacking. The present study attempts to compare the performance of the polyclonal seedling population and a multiclonal population grown in Tripura.

MATERIALS AND METHODS

The polyclonal population of *Hevea* raised from seeds collected from polyclonal seed gardens in Kanyakumari district of Tamil Nadu in South India was utilized for the study. The seedling stumps were planted in 1987 at the experimental farm of the Regional Research Station of the Rubber Research Institute of India at Taranagar (23^0 53′ N - 91^0 15′E, 30 m MSL). Single tree single plot completely randomized design was used with a spacing of 4.9 x 4.9 m.

Girth and dry rubber yield of individual trees were recorded from 361 trees. The trees were tapped on $^1/_2$S d/2 system. Growth, yield and secondary attributes for the initial three years of tapping were utilised for evaluating the performance of genotypes in the present study. Visual scoring for the incidence of powdery mildew, tapping panel dryness (TPD), wintering and refoliation pattern were undertaken for three consecutive years. Secondary characters like branching pattern, canopy stature and wind tolerance were also considered while selecting the outstanding performers. Ten genotypes were selected as potential mother trees. Seedling establishment and other parameters like uprooting due to wind and casualty were recorded up to October 1998.

The seedling population was compared with a nearby multiclonal population planted with budded stumps of 12 clones in 1987 employing completely randomised design with 50 trees per clone and a spacing of 4.9 x 4.9 m. The clones selected for yield comparison in the present study were RRIM 600, RRII 208, Haiken 1, SCATC 88/13, SCATC 93/114 and PR 107 and data for the first two years from the multiclonal population was utilised. Girth increment for two years and length of tapping panel recorded during October 1998 were also compared. June-September was considered as Regime 1 and October-January as Regime 2 for dry rubber yield. Crop efficiency (Tan, 1998) was calculated using the formula :

$$\frac{\text{Annual mean yield (g/tree/tap)}}{\text{Length of tapping panel (cm)}}$$

RESULTS AND DISCUSSION

A comparison of the polyclonal seedling trees and multiclonal budgrafted population during the early mature phase revealed that the seedling population was more heterogeneous with respect to girth, yield and other secondary characters of importance. An assessment of the seedling population after 10 years revealed that out of a total of 591 seedling stumps planted, 361 trees (61.08%) established well whereas in the multiclonal population only 333 trees (55.5%) survived out of 600 budded stumps planted. Though both the plantations were raised in the same year by stump planting, the seedling plantation attained tappable girth by the eighth year, while the clonal plantation could be opened only by the ninth year. Girth was comparatively higher in the seedlings than the multiclonal population (Table 1). Further, the annual girth increment on tapping was also higher in the seedling population (Table 2).

Dry rubber yield of polyclonal seedling trees for the initial three years and selected multiclonal budgrafted trees for the first two years were analysed. The mean yield of the seedling population was 21.11 g per tree per tap over the initial three years, while that of the multiclonal population was 21.35 g per tree per tap over two years (Table 1). However, the individual genotypes exhibited seasonal variability in yield ranging from 2.6 to 70.30 g per tree per tap.

Table 1. **Comparison of seedling population with multiclonal population (10 years after field planting)**

Character	Polyclonal seedlings	Multiclonal population
Healthy trees (%)	61.08	55.50
Immature trees (%)	2.03	2.77
Casualty (%)	15.2	11.00
Wind damage (%)	19.11	25.63
Uprooting (%)	Nil	1.33
Panel dryness (%)	2.53	3.83
Defoliation pattern (%)	70 (30-100)	90 (70-100)
Powdery mildew (%)	65 (20-100)	90 (75-100)
Girth* (cm)	68.70 (30.5-100.6)	63.10 (38.5-89.5)
Mean annual yield (g/tree/tap)	21.11 (2.6-70.30)	21.35 (9.3-35.5)
Mean yield (g/tree/tap)		
Regime 1	16.13	11.18
Regime 2	26.09	31.52

The figures in parentheses are the ranges
* Girth at 110 cm for polyclonal seedlings and 150 cm for multiclonal population

Yielding trend of the early phase revealed that the seedling population has a stable yield, since the contribution is almost equal in both the regimes, while the yield of the multiclone population was low in Regime 1 and higher in Regime 2. The mean dry rubber yield in both the populations was almost equal. Some of the seedling trees with good yield during July have contributed to a peak in Regime 1. However, in both the populations the highest yield was observed in November (Fig. 1).

Wintering and refoliation pattern of the seedlings and the clonal population varied from year to year possibly due to environmental factors such as rainfall pattern, irradiance, soil moisture, etc. Scoring of wintering pattern of the seedling population over three years showed a mean

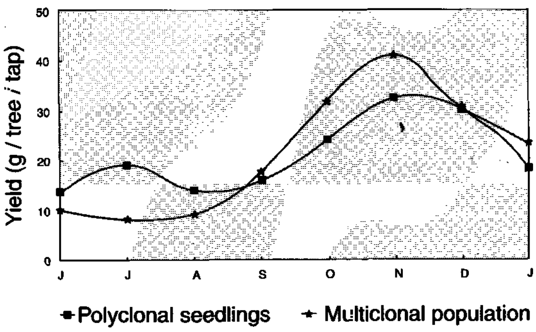

Fig. 1. Yielding patterns of polyclonal seedlings and multiclonal population.

Table 2. **Growth and yield of 10 seedling selections in comparison to polyclonal seedlings and multiclonal population**

Selection (Code No.)	Girth (cm)	Annual girth increment (cm)	Yield (g/tree/tap)	Length of tapping panel (cm)	Crop efficiency (g/cm)
S1	87.5	9.9	70.30 (26.3)	47.00	1.49
S2	67.4	5.3	55.72(25.8)	38.50	1.45
S3	93.1	7.8	54.53 (23.9)	60.00	0.91
S4	72.8	8.1	53.28 (40.4)	47.00	1.13
S5	78.5	6.0	51.59 (33.7)	44.50	1.16
S6	82.2	7.7	48.30 (24.6)	43.50	1.11
S7	70.4	5.3	44.08 (24.1)	43.50	1.01
S8	74.1	5.3	41.56 (36.7)	46.50	0.89
S9	75.3	7.9	40.52 (30.3)	47.50	0.85
S10	75.6	6.5	40.46 (26.3)	46.00	0.87
Mean*	68.7	4.8	21.11 (31.2)	39.60	0.53
Mean**	63.1	4.3	21.35 (53.3)	34.50	0.62

*Polyclonal seedlings **Multiclonal population
The figures in parentheses are the coefficient of variation (CV) of yield over months

of 70 per cent leaf fall ranging from 30 to 100 per cent in individual genotypes. However, in the multiclonal population it ranged from 70 to 100 per cent in different clones with a mean of 90 per cent.

Disease scores of the seedlings over three consecutive years differed from year to year due to genotype, pathogen and environment interaction. The leaf fall due to *Oidium* in individual genotypes ranged from 20 to 100 per cent with a mean of 65 per cent. Disease incidence in the multiclonal population was higher (90%) ranging from 75 to 100 per cent. The damage due to wind was low (19.1%) in the seedling population compared to the multiclone population (25.6%). No uprooting of seedling trees was recorded which indicates a stronger tap root system for the seedling trees. The panel dryness in the population fell into two categories, (1) simple cessation of latex flow and (2) rupture of the bark below the tapping panel following the arrest of latex flow. In budded trees, cessation of latex flow followed by bulging of the tapping panel due to irregular growth was observed. Percentage of trees affected by panel dryness was less in the seedling population than in the multiclonal population (Table 1). In both the cases dryness was preceded by prolonged latex flow with low dry rubber content during the peak yielding period.

Selection of putative clones

Yield evaluation of the seedling population over the years revealed that certain genotypes are good performers. Such seedling trees were closely monitored for growth, yield and secondary attributes. The criteria for selection were consistent yield over months and years, good girth increment on tapping as well as secondary attributes *viz.*, branching, canopy architecture and disease tolerance. The mean dry rubber yield of the 10 selected trees over the three years was comparatively high and ranged from 40.46 to 70.30 g per tree per tap (Table 2). Girth, girth increment on tapping and yield per unit length of tapping cut of the selected trees also showed higher values as against the base seedling population as well as the multiclonal population. Significant positive correlation for nursery seedling yield and nursery yield per cm girth with mature yield of corresponding clones over five years has been reported (Tan, 1998). It is also interesting that most high yielding clones have this value above 1 g dry rubber per cm tapping cut. In most of the present selections the value is above 1 g.

Comparison of the monthly yielding pattern of the seedling population with a popular clone RRIM 600 and mean values of the selections are depicted in Figure 2. The mean performance of these selections was better than that of RRIM 600 with almost equal contribution in both the regimes similar to the mean performance of the base population. The dry rubber yield contribution of the 10 selections in both the regimes (Fig. 3) shows that there is scope for selection of promising genotypes. The selections S1, S2, S3, S6, S7 and S10 with low coefficients of variation indicate their stability over the months (Table 2).

Polyclonal seedlings are expected to adapt well to new areas due to their genetic heterogeneity. The original narrow genetic

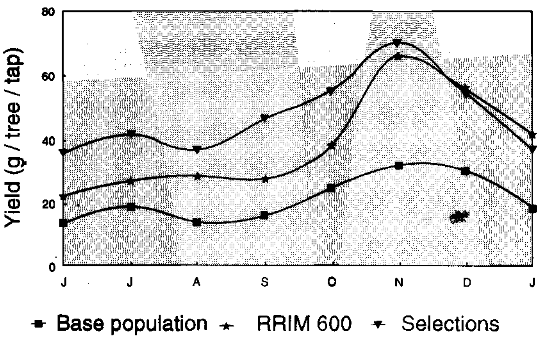

Fig. 2. Yielding pattern of base population, selections and the popular clone.

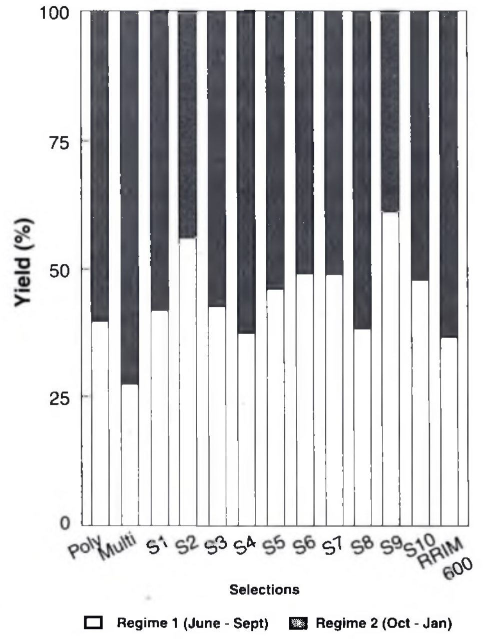

Fig. 3. Yield contribution during the two regimes

base of *Hevea* (Wycherley, 1968; Schultes, 1977) has been further narrowed down through a directional selection for yield, a cyclical breeding pattern and wide adoption of vegetative propagation. This resulted in the erosion of valuable genes for adaptability thus diminishing the returns from breeding in the recent years than in the early phase (Simmonds, 1989). Also, the predominance of monoclonal plantations are dangerous due to their susceptibility to diseases (Chee and Holliday, 1986; Liyanage, 1987). Selection of advanced polycross progenies can be a useful complement to the normal hand pollination programme (Tan *et al.*, 1996). Clones RRII 5 and RRII 51 are two such primary clones evolved and released in India (Marattukalam *et al.*, 1980; 1990). Multiparent first generation synthetic varieties of rubber also have been economically successful for many decades and are recommended under category I in Malaysia (Simmonds, 1986).

Commercial plantations in Kerala, the traditional rubber growing state of India, are reported to be confined to a limited number of clones and the share of seedling plantations has been reduced considerably (Joseph and Haridasan, 1990; 1991). An earlier evaluation of planting materials under commercial plantings in Kerala revealed that some of the primary clones and seedling plantations performed better than hybrid clones (Krishnankutty and Sreenivasan, 1984).

In the present study the polyclonal seedlings exhibited early attainment of tappability, high girth and girth increment on tapping in comparison to the clonal population. Similar performance of seedlings has also been reported from the Konkan region of Maharashtra (Birari *et al.*, 1998), a non-traditional region in the Western India, where the plantations are under drought stress. Although some of the selections from the present study appear to yield higher than the popular clone RRIM 600, more detailed studies may be required to draw conclusions as the yield may stabilise only over a longer period of tapping.

This study reveals the importance of maintenance of genetic variability through planting of polyclonal seedlings in stress-prone areas. The selections identified in this study can be used as components in clonal composites for this region as has been suggested for the traditional rubber growing region of India (Mydin *et al.*, 1994; Varghese *et al.*, 1996).

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