PROMISING RUBBER PLANTING MATERIALS WITH SPECIAL REFERENCE TO INDIAN CLONES

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Introduction

Performance of a plantation depends primarily on the genetic constitution of the materials planted and their interaction with the particular environment. Choice of the right planting material is of utmost importance in any crop species, particularly in a perennial crop like Hevea with a long economic life span.

Planting materials can generally be classified as seedlings and clones. Seedlings are resultant of generative (sexual) reproduction. Hevea is predominantly open pollinated and highly heterozygous. Seedlings are genetically heterogenous and do not result in uniform plantations. Seeds are either ordinary (unselected or selected), collected from seedling trees or clonal (monoclonal or polyclonal) obtained from clones. Clone, a group of plants produced by vegetative propagation from a single tree, is genetically homogenous and hence result in uniform plantations. Based on the method of development, clones are classified into primary, secondary and tertiary. In the case of primary clones, resultant of mother tree selection, the parentage is not known. A secondary clone has two primary clones as parents, and in the case of a tertiary clone, at least one parent is a secondary clone.

Tree improvement

Genetic improvement through breeding and selection has brought about significant improvement in productivity. With ordinary unselected seedlings as planting materials in the initial years of rubber cultivation, the productivity was only around 300 kg/ha/yr. Systematic breeding and selection, which followed subsequently resulted in the development of a good number of modern clones, some of which have a production potential of around 3000 kg/ha/yr.

The conventional methods of tree improvement adopted in Hevea are ortet selection and hybridisation.

(a) Ortet selection: In ortet selection or mother tree selection extensive seedling areas are systematically screened for elite mother trees, which are cloned and evaluated and the promising ones released as primary clones. Many of the earlier popular clones like Tjir 1, Gl 1, PB 86, PR 107, Hil 28, Mil 3/2, GT 1, etc. are mother tree selections, some of which are still widely used. In India, ortet selection programmes (till 1970) resulted in 43 primary clones of RRII 1 series

selected from over 100,000 seedlings. Among these, RRII 1, 2, 3, 5, 6 etc. appear promising selections for yield (Marattukalam et al. 1980) and RRII 33 shows resistance to abnormal leaf fall disease. Over 150 recent selections from about 290 ha. of seedling area (comprising around 120,000 seedlings) in different estates have been established in small scale trials. Currently over two lakhs seedling genotypes from an area of 605 ha. (in two large estates) are under preliminary screening. Selection from small holdings are also under way. Since the seedling areas are increasingly being replaced with modern clones, further extensive screening for yield, resistance to diseases, drought etc. in traditional as well as non-traditional areas is of significance.

(b) Hybridisation: Hybridisation, the most important conventional breeding method, involves artificial pollination between selected male and female clones, evaluation of the F1 hybrids and selection of promising recombinants. In Hevea, the early primary clones were used as parents for the first hybridisation series and resulted in clones like RRIM 500, 600 RRII 100 series. The best early secondary clones were used as parents for the next cycle and so on. This sort of cyclical generation-wise assortative mating (Simmonds 1986, 1989) over the past years in different rubber research institutes resulted in a series of secondary and tertiary clones of commercial significance.

Breeding and selection work in India resulted in a series of high yielding clones belonging to RRII 100, 200 and 300 series. Among the 100 series clones, RRII 105 is a promising selection for yield (Nair and George, 1969; Nazeer et al. 1986), popular in the plantation sector and RRII 118, a vigorous clone. RRII 203 and 208 (Saraswathy Amma et al. 1980), RRII 300 and 308 (Premakumari, et al. 1984) are the best selections of 200 and 300 series.

Clone evaluation: The experimental evaluation of clones is elaborate and involves three stages viz., small scale trial, large scale trials and block trials. The preliminary selections from hybridisation programmes, ortet selection as well as exotic clones are subjected to the second stage of evaluation viz., large scale trials. Promising selections are finally evaluated under block trials in commercial plantations. Conventionally evaluation of clones involving these three stages require 30-32 years from the nursery to the final release.

Year	Steps involved
0	Hand pollination, seedling nursery, insurance, budding
1	Small scale trial
8	Tapping small scale trial (3 years)
11	Selection, multiplication
12	Large scale trial

Year	Steps involved
19	Tapping large scale trial (3 years)
22	Selection, multiplication
23	Block wise trial - Recommended for limited planting
30	Tapping, block trials (3 years)
32	Final selection, recommendation and release

Studies on shortening the normal breeding and selection cycle, however, reveal that though identification of a few promising progenies at an earlier age is likely, many potential yielders may remain unidentified. Hence, such new approaches like promotion plot trials can be considered only as an adjunct to conventional methods. The elaborate field evaluation, a pre-requisite for final release of a clone, offers chances of identification of all promising clones with respect to yield and desirable secondary characters.

In RRII so far over 150,000 hand pollinations have been attempted and around 5400 hybrid seedlings produced. From these 2300 clones have been established in small scale trials in an area of 43 ha. This programme is continuous and annually over 10,000 artificial pollinations between selected parent clones are attempted. RRII also regularly imports promising clones from other rubber growing countries with a view to evaluating them under local agroclimatic conditions. So far, 114 clones have been introduced during different periods. A total of 105 clones of indigenous and exotic origin are being evaluated in 20 large scale trials covering an area of 28 ha. Similarly, a total of 44 clones in 153 blocks (153 ha.) in 25 different trials are under final evaluation. The RRII has a programme of supplying nucleus materials of selected promising clones to estates, for multiplication and laying out block trials. These clones will be coded and their identity will not be revealed during the period of experimentation. The choice of clones and estates will be made by RRII.

Approval of planting material

Depending on the stage of evaluation, the clones are included in three different groups viz., Category I, II and III. For planting in 1990, a total of 73 clones, three in Category I, 15 in Category II and 55 in Category III are recommended by the Rubber Board. The clones which emerge as promising in all the three stages of evaluation are finally recommended in Category I for planting on a wide scale. RRII 105, RRIM 600 and GT 1 are the clones included in this category. However, when planting of these clones is undertaken on a large scale it is advisable to use as many clones as practicable. In Category II a, older clones which are

still popular in certain locations as well as modern promising clones under evaluation are included. Limitating these clones within 20% of the total area in large estates is advised. In Category II b, polyclonal seedlings from selected polyclonal seed gardens are recommended, mainly for areas where establishment of clones is difficult. Production potential of polyclonal seedlings in general, though not as high as that of modern clones, seedling progenies arising from selected polycross combinations have adaptive value in problem areas, increase genetic diversity and also generate base materials for further tree improvement. Clones in Category III are purely experimental clones. Indigenous clones selected on the basis of their promising performance in India over limited periods are included under this category. Clones imported from other countries are also put in this category initially. Planting of these should be limited to small experimental or observational plots not exceeding 10% of the total area.

Short notes on some of the clones

RRII 5: This is a primary clone selected from Malankara estate. It is a vigorous clone with above average vigour during immaturity. The trees have straight terete trunk, low branching, prominent branch scars, several heavy to moderate branches arising at acute angles, heavy oval shaped canopy, dense foliage and pale green leaves. Thickness of virgin bark and renewed bark is above average. Initial and subsequent yield is very high and shows rising yield trend. Mean yield from small scale trial over 10 years was 89 g/t/t. Mean yield for the first five years (Panel A) was 67 g/t/t and that for six to ten years (Panel B) 111 g/t/t. Mean yield in large scale trial over ten years was 2942 kg/ha/yr. Over first five years (Panel A) the yield was 2352 kg/ha/yr and six to ten years (Panle B) it was 3532 kg/ha/yr. The clone has recorded above average summer yield also. The clone has below average resistance to Phytophthora leaf fall and Oidium, above average resistance to pink disease and wind damage, but susceptible to brown bast (Marattukalam et al. 1989).

RRII 105: This is a secondary clone developed by the Rubber Research Institute of India, currently enjoying maximum popularity in the country. This is a clone of the 1954 hybridisation programme. The parents are Tjir 1 and Gl 1.

The trees are sturdy with average vigour during immaturity period as well as after tapping. Stem is tall and straight, branching good with strong union. Canopy is dense with dark green glossy leaves. Thickness of virgin bark and renewed bark above average with high number of latex vessel rows.

The clone has recorded very high initial and subsequent yield giving consistant yield. Mean yield over 20 years in small scale trial was 81.38 g/t/t. Mean yield for the first five years (Panel A) was 60.61 g/t/t, for six to ten years (Panle B) was 89.29 g/t/t, for 11 to 15 years (Panel C) was 81.16 g/t/t and for 16 to 20 years (Panel D) was 76.25 g/t/t (Nazeer et al. 1990). Mean yield in large scale trial over

10 years was 2480 kg/ha/yr. Mean yield in large scale trial over first five years was 2439 kg/ha/yr and the mean yield over six to ten years was 2537 kg/ha/yr (Nazeer et al. 1986). Encouraging yield trend is recorded in commercial planting, showing an average yield of 1653 kg/ha/yr over the first seven years of tapping. This clone is fairly tolerant to yield depression during summer.

The clone has a fair degree of tolerance to abnormal leaf fall disease caused by Phytophthora species under normal prophylactic measures, but is susceptible to pink disease. Free from any serious wind damage if branch development is kept balanced. Trends indicate that this clone may not withstand high intensity of tapping and is susceptible to brown bast. Therefore, ½S d/3 system of tapping is preferable. Even occasional daily tapping should be avoided.

RRII 118: This is a vigorous secondary clone of the 100 series developed by the Rubber Research Institute of India. The parents are Mil 3/2 and Hil 28, two Sri Lankan primary clones.

Trees are vigorous, tall, trunk straight with prominent heavy branches. Secondary branches are long and slightly drooping in young stage. Several branches arise almost at the same level. Canopy dense and well balanced. The clone shows high vigour at opening and good girth increment on tapping. Thickness of virgin bark and renewed bark is average.

The clone is an average yielder. Mean yield over four years in small scale trial is 50 g/t/t. Average commercial yield for first six years is 1117 kg/ha/yr. The clone has average tolerance to all diseases, wind damage and brown bast.

RRII 203: This is a high yielding clone of the 200 series developed by the RRII. This clone is a product of 1956 hybridisation programme. Parents are PB 86 and Mil 3/2.

The clone has straight tall stem with above average vigour during immaturity and average girth increment on tapping. The trees are rather robust, canopy well distributed and balanced. Virgin bark thickness above average with high number of latex vessel rings. Renewed bark smooth with average thickness.

The clone shows above average initial and subsequent yield. The mean yield from the small scale trial during 15 years of tapping is 85 g/t/t. The mean yield for the first five years (Panel A) was 56.4 g/t/t; for 6 to 10 years (Panle B) 100.1 g/t/t and for 11 to 15 years(Panle C) 96.4 g/t/t, thus showing markedly rising yield trend from Panel A to B with only slight depression in Panel C (Saraswathy Amma et al. 1980). In the large scale trial, the mean estimated yield over 8 years was 2487 kg/ha/yr. In block wise trials an average yield of 1142 kg/ha/yr for the first five years of tapping was recorded (Saraswathy Amma et al. 1988). Summer yield is good.

The clone shows average tolerance to Phytophthora, pink, Oidium and also wind damage. Coagulam from latex and scrap shows discolouration. This, however, does not affect the quality of rubber.

RRII 208: This is another high yielder of the RRII 200 series clones, developed through artificial pollination between two primary clones viz., Mil 3/2, and AVROS 255.

The trees are straight, tall and main leader prominent with light secondaries. Canopy is light. The clone shows average vigour. Girth increment on tapping is also average. Virgin bark rough with prominent leaf scar. Thickness of virgin bark average and that of renewed bark below average. Number of latex vessel rings also average.

The mean yield from small scale trial over 15 years of tapping is 87 g/t/t. The yield in Panel A, B and C was 75.8, 86.4, 96.1 g/t/t respectively (Saraswathy Amma et al. 1980). In the large scale trial, the mean yield over 8 years was 2625 kg/ha/yr. Mean yield from commercial planting over six years of tapping is 1,226 kg/ha/yr. The clone is highly susceptible to Phytophthora causing shoot rot on young plants, and shows above average tolerance to other diseases.

RRII 300: This is a secondary clone of the 1958 HP series evolved by crossing between Tjir 1 and PR 107. The clone has a straight and cylindrical stem with open and distributed canopy. The clone is characterised by low branching with strong and spatulate branch union. Canopy is open and distributed. The clone shows average vigour with good girth increment on tapping. Virgin bark has average thickness and average number of latex vessel rows. The thickness of renewed bark is above average with very high number of latex vessel rows.

The clone has recorded moderately good yield in the virgin bark and very high yield in the renewed bark. The mean yield in small scale trial over 16 years of tapping was 105.35 g/t/t. The mean yield for the first three years (Panel A) was 56.29 g/t/t, four to six years (Panel B) 88.66 g/t/t, seven to eleven years (Panel C) 127.52 g/t/t and twelve to sixteen years (Panel D) 122.63 g/t/t. The rising yield trend is a specific character of this clone. Summer yield was recorded to be average.

The clone recorded average resistance to Oidium and above average resistance to Phytophthora leaf fall. Incidence of brown bast and wind damage below average (Premakumari et al. 1984).

RRII 308: This is another high yielding clone belonging to the RRII 300 series. This is a secondary clone with the parentage Gl 1 and PB 6/50. Trunk is slightly fluted with several medium to heavy branches. Canopy is heavy, distributed and broom shaped.

yield over 13 years in experiments in Malaysia was 1778 kg/ha/yr. Mean yield over 10 years in large scale trial in India was 2209 kg/ha/yr with a mean yield of 1590 kg/ha/yr. in Panel A and 2828 kg/ha/yr in Panel B. In India, the mean commercial yield over ten years was 1258 kg/ha/yr. Summer yield is very high. The clone is reported to be susceptible to Phytophthora leaf fall in Malaysia, but slightly tolerant in India. Resistance to pink and Oidium below average. Recorded above average resistance to wind and brown bast (RRIM 1989).

PB 235: This is a vigorous and high yielding clone developed in Malaysia by the Prang Bazar Research Station. The parents of this tertiary clone are PB 5/51 and PBS.78. Trees have straight stem, with good branching habit resembling that of PB 5/51. Foliage dense and crown fairly high. The clone has recorded very high vigour during immaturity and average girth increment on tapping. Thickness of virgin bark average and that of renewed bark below average. The clone is high yielding throughout with mean experimental yield over 15 years in Malaysia 2485 kg/ha/yr. In India, the mean commercial yield over 10 years was 1258 kg/ha/yr.

The clone is fairly tolerant to phytophthora, pink and wind damage but highly susceptible to Oidium. Resistance to brown bast below average and hence low intensity tapping is recommended (RRIM 1989).

PB 260: This is another high yielding clone of Prang Bazar series. Parentage is PB 5/51 and PB 49. The growth habit resembles that of PB 5/51, with prominent leader and light spreading, self shedding branches. Occasionally, the trees show late branching habit. Foliage is thick and dense, canopy balanced and rather high. Early vigour is high but subsequent vigour only average. Thickness of virgin bark and renewed bark below average. The clone has recorded very high initial and subsequent yield. In Malaysia, mean yield over 12 years in large scale trial was 2192 kg/ha/yr. Summer yield was below qaverage.

The clone shows average tolerance to Phytophthora and above average tolerance to pink and Oidium. Resistance to wind damage is average (RRIM 1989).

It may thus be seen that planting materials differ widely with reference to yield potential and other attributes. No single material will be ideally suited for all locations and variations in productivity could be expected in different locations. Monoclonal plantations have inherent risks and therefore, while choosing planting materials it will be ideal to include different materials approved for unrestricted planting. The estate sector could also go in for planting of experimental materials and those of local popularity to the extent specified so that performance of clones in different regions could be monitored.

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