INTRODUCTION AND PERFORMANCE OF EXOTIC CLONES IN INDIA

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Abstract

The most important single factor responsible for the advancement of rubber plantation industry is the contribution made by tree improvement research. Production and productivity index of rubber are the highest among the plantation crops in India. One of the important methods adopted by the Rubber Research Institute of India for obtaining improved planting material is the introduction of exotic modern clones of Hevea brasiliensis. Introduction of clones from their country of origin is being done prior to 1956. promising clones are being evaluated under different agroclimatic regions. The best among them is recommended for planting. So far a total of 119 clones were introduced from Malaysia, Indonesia, Liberia, South America, China, Thailand and Ivory Coast. Among these 21 clones are included in the recent planting recommendations.

The performance of promising clones in the large scale and commercial trials is discussed.

Introduction

Rubber plantation industry in India has been showing tremendous progress in increasing the productivity in recent years. Productivity of rubber which was only 788 Kg/ha. in 1980-81 has gone upto 1076 Kg. in 1990-91, an increase of 37% over a decade. Productivity index of natural rubber is 410 which s the highest among the commodity crops. The most important single factor responsible for this is the contributions made by the tree improvement research carried out by the Rubber search Institute of India.

Among the different methods adopted by the Rubber Research Institute of India for obtaining improved planting materials an important one is the introduction of modern clones of Hevea brasiliensis from other rubber growing countries. These materials selected, based on their reported performance in their country of origin, are then evaluated under different agro-climatic regions of our country to assess their adaptability to our conditions. Introduction of clones from other countries to India commenced before 1956.

Materials and Methods

Important countries from which the Rubber Research Institute of India has obtained clones are Malaysia, Indonesia, Liberia, South America, Sri Lanka, Thailand and Ivory Coast. So far 119 clones have been introduced from these countries. Majority of the clones recommended for planting in our country are exotic in origin. Many of these foreign clones were introduced on a bilateral clone-exchange programme between India and the donor country. RRII clones, developed by the Rubber Research Institute of India, were exchanged for getting the improved foreign clones.

Prior to 1956, 35 clones were introduced to India from Indonesia, Malaysia and Sri Lanka (1). These were earlier clones, primary in origin, ie., selected from the seedling population. Eventhough most of them are not popular at present, a few of them have proved to be good parental clones. They are Tjir 1, LCB 1320, PR 107, PB 5/51, PB 6/9 and Gl 1. A few others are showing better performance in certain locations as PB 86 in Kanyakumari Region. In early periods, these materials were incorporated in the breeding programmes.

During 1956, 20 clones belonging to the RRIM 500 and 600 series from Malaysia and three clones from South America were introduced to India. For evaluating their performance in our country two large scale trials were laid out in randomized block design with four replications at two locations experiencing different agroclimatic conditions (2), the central region and the southern region of the traditional rubber growing area. Mean yield over first

Table - 1

DETAILS OF CLONES INTRODUCED IN INDIA

Clone	Origin	Year of introduction	Country
Tjir 1, Tjir 16, AVROS 49, AVROS 255, AVROS 352, LCB 1320, PR 107, BD 5, BD 10	Primary clone	Pre 1956	Indonesia
PB 25, PB 86, PB 186, PB 5/60, PB 5/139, PB 6/9, PB 6/50, Pil B 84, Pil D 65, GL 1, Ch 2, Ch 4, Ch 8, Ch 26, Ch 29, Ch 30, Ch 31, Ch 32, CHM 3, Lun N	Primary clone	"	Malaysia
Mil 3/2, Hil 28, Hil 55, Wagga 6278, Waring 4	Primary clone	"	Sri Lanka
RRIM 501	Pil A 44 x Lun N	1956	Malaysia
RRIM 526	Pil B 84 x Pil D 65	"	"
RRIM 601	Tjir 1 x Gl 1	"	"
RRIM 602	Thir 1 x Gl 1	"	"
RRIM 603	PB 86 x Pil B 84	"	"
RRIM 604	Tjir 1 x PB 49	"	"
RRIM 605	Tjir 1 x PB 49	"	"
RRIM 607	Tjir 1 x PB 49	"	"
RRIM 608	AVROS 33 x Tjir 1	"	"
RRIM 609	AVROS 157 x BD 5	"	"
RRIM 610	RRIM 504 x Tjir 1	"	"
RRIM 611	RRIM 504 x Tjir 1	"	"
RRIM 612	AVROS 157 x PB 49	"	"
RRIM 615	RRIM 511 x Tjir 1	"	"
RRIM 617	BR 2 x RRIM 500	"	"
RRIM 618	Lun N x RRIM 501	"	"
RRIM 620	RRIM 501 x RRIM 511	"	"
RRIM 621	RRIM 504 x Tjir 1	"	"
RRIM 622	Tjir 1 x Pil B 84	"	"
RRIM 623	PB 49 x Pil B 84	"	"
IAN 45-717	PB 86 x F 4542	"	South America
Fx 516	F 4542 x AVROS 363	"	"
F 4542	Hevea benthamiana	"	"
RRIM 600	Tjir 1 x PB 86	1962	Malaysia
RRIM 628	Tjir 1 x RRIM 527	"	"
RRIM 513	Pil B 16 x Pil A 44	"	"
RRIM 519	Pil A 44 x Pil B 16	"	"
PB 213	PB 56 x PB 86	"	"
PB 217	PB 5/51 x PB 6/9	"	"
PB 206	Primary Clone	"	"
PB 5/76	PB 56 x PB 24	"	"
RRIM 632	--	1963	Malaysia
RRIM 636	--	"	"
RRIM 701	44/554 x RRIM 501	"	"
RRIM 707	RRIM 632 x RRIM 501	"	"
PB 5/51	PB 56 x PB 24	1963	Malaysia
PB 28/83	Primary clone	"	"

(Table - 1 Contd.)

Clone	Origin	Year of introduction	Country
PB 5/63	PB 56 x PB 24	"	"
PB 28/59	Primary clone	"	"
GT 1	Primary clone	"	Indonesia
PB 215	--	1964	Malaysia
PB 230	--	"	"
PB 235	PB 5/51 x PB 5/78	"	"
PB 240	"	"	"
PB 242	PB 5/51 x PB 32/36	"	"
PB 252	PB 86 x PB 32	"	"
PB 253	RRIM 501 near legitimate	"	"
RRIM 703	RRIM 600 x RRIM 500	1966	Malaysia
RRIM 704	RRIM 600 x RRIM 500	"	"
RRIM 705	RRIM 632 x RRIM 500	"	"
RRIM 706	RRIM 632 x RRIM 500	"	"
CH 153	Tjir 1 x Ch 5	"	"
Herbal 1	Primary clone	1969	Liberia
IAN 713	PB 86 x F 409	"	South America
IAN 873	PB 86 x F 1717	"	"
RRIC 7	Primary clone	1972	Sri Lanka
RRIC 36	PB 86 x PR 107	"	"
RRIC 45	RRIC 8 x Tjir 1	"	"
RRIC 52	Primary clone	"	"
RRIC 100	RRIC 52 x PB 83	"	"
RRIC 102	RRIC 52 x RRIC 7	"	"
RRIC 104	RRIC 52 x Thir 1	"	"
RRIC 105	RRIC 52 x Tjir 1	"	"
Nab 17	Primary clone		
PB 260	PB 5/51 x PB 49	1979	Malaysia
PB 310	PB 5/51 x RRIM 600	"	"
PB 311	RRIM 600 x PB 235	"	"
KRS 25	Primary clone	1984	Thailand
KRS 128	PB 5/63 x KRS 13	"	"
KRS 163	PB 6/63 x RRIM 501	"	"
SCATC 88-13	RRIM 600 x Pil B 84	"	China
SCATC 93-11	TR 31-45 x HK 3-11	"	"
Haiken 1	--	"	"
PB 255	PB 5/51 x PB 32/36	1985	Indonesia
PB 280	PBIG Seedling	"	"
PB 312	RRIM 600 x PB 235	"	"
PB 314	RRIM 600 x PB 235	"	"
PB 330	PB 5/51 x PB 32/36	"	"
IRCA 18	PB 5/51 x RRIM 605	1991	Ivory Coast
IRCA 109	PB 5/51 x RRIM 600	"	"
IRCA 111	PB 5/51 x RRIM 605	"	"
IRCA 130	PB 5/5' x IR 22	"	"
IRCA 230	GT 1 x PB 5/51	"	"

Table - 2
PERFORMANCE OF RRIM CLONES IN CENTRAL REGION

Clones	Mean yield over nine years of tapping g/tree/tap	Mean growth increment over nine years tapping (cm
RRIM 501	46.8	1.6
RRIM 526	37.0	3.0
RRIM 601	35.2	1.5
RRIM 602	37.6	2.2
RRIM 603	38.5	3.0
RRIM 607	35.4	1.8
RRIM 605	42.8	1.8
RRIM 608	41.0	2.0
RRIM 609	37.7	3.1
RRIM 610	34.1	1.7
RRIM 612	35.4	4.1
RRIM 615	34.4	1.7
RRIM 617	31.4	1.4
RRIM 618	35.2	1.5
RRIM 620	41.4	2.1
RRIM 621	38.6	4.9
RRIM 622	35.4	2.6
RRIM 623	37.5	2.2
Tjir 1	34.3	2.0
G. Mean	37.0	2.2
SE	1.6	0.2
CD 1%	6.0	0.9
CD 5%	4.5	0.7

nine years of tapping along with mean girth increment after tapping in the central region are furnished in table 2. The performance of 16 exotic clones in the southern region is given in Table 3.

During 1962, 8 clones were introduced from Malaysia (table 1) and these clones were evaluated in a large scale trial in the central region. Mean yield over first 15 years of tapping along with mean girth increment before and after tapping are furnished in table 4. The details of trials are reported earlier (3).

During 1963, 8 clones from Malaysia and one clone from Indonesia were introduced. This was followed by the introduction of seven and five Malaysian clones in 1964, and 1966 respectively. One Liberian clone and two South American clones were obtained in 1969. Selected clones from these introduction were incorporated into a large scale trial during 1971. Among these clones PB 5/51, GT 1, RRIM 701 etc., showed better growth performance while yield was more in RRIM 703, PB 5/51, RRIM 701 etc., during early stages.

Table - 3
PERFORMANCE OF RRIM CLONES IN SOUTHERN REGION

Clone	Mean yield over nine years of tapping g/tree/tap	Mean girth increment over nine years of tapping (cm)
RRIM 501	70.6	2.3
RRIM 526	53.7	2.4
RRIM 601	49.0	1.3
RRIM 605	68.0	2.7
RRIM 607	53.2	2.7
RRIM 608	72.5	2.5
RRIM 609	54.1	3.3
RRIM 610	59.1	2.5
RRIM 611	54.9	3.3
RRIM 612	41.6	3.7
RRIM 615	67.2	3.9
RRIM 618	66.1	2.8
RRIM 621	54.1	3.6
RRIM 622	67.0	3.3
RRIM 623	49.1	2.3
Tjir 1	53.4	3.0
G. Mean	58.3	2.8
SE	4.5	0.5

Table - 4
PERFORMANCE OF SOME EXOTIC CLONES IN CENTRAL REGION

Clone	Mean yield over 15 years	Mean girth increment before tapping (cm/year)	Mean girth increment on tapping (cm/year)
Tjir !	48.03	8.49	2.46
RRIM 513	38.42	8.04	1.81
RRIM 519	51.18	8.11	2.82
RRIM 600	52.59	8.52	2.60
RRIM 628	43.03	7.74	1.66
PB 206	46.58	8.03	3.02
PB 213	62.16	7.56	2.18
PB 217	65.99	8.35	3.44
PB 5/76	58.42	8.43	3.17
General Mean	55.08	8.26	2.66
S.E.	4.37	0.30	0.24
C.D.	12.85	0.88	0.71
C.D.*	14.52	0.99	0.80

* For comparing RRIM 513 with other clones.

During 1972, 10 RRIC clones were introduced from Sri Lanka and nine of them were incorporated in a large scale trial in 1976 (4). Performance of these materials are given in table 5.

During 1979-85 period eight Malaysian, three Thailand and three Chinese clones were imported to our country. In 1981 a large scale trial was laid

out using selected clones from 1964 and 1979 introductions from Malaysia. Another set of large scale trials were laid out during 1989 incorporating selected clones from 1979, 1984 and 1985 introductions from Malaysia, Thailand, China and Indonesia.

Table - 5
PERFORMANCE OF RRIC CLONES

Clones	Mean yield over three years (g/tree /tap)	Mean annual girth increment after opening (cm)
RRIC 7	28.79	4.42
RRIC 36	34.99	3.96
RRIC 45	29.32	4.06
RRIC 52	21.34	5.63
RRIC 100	37.41	3.85
RRIC 102	33.94	3.66
RRIC 104	32.05	4.52
RRIC 105	26.00	3.03
Nab 17	34.00	3.32
GT 1	28.12	3.74

In 1991, five clones were introduced from Ivory Coast on a bilateral exchange programme. These clones are being multiplied for taking up trials. Yield performance of various exotic planting materials in commercial practice along with total area planted by them, in India is furnished in Table 6. PB 28/59, GT 1, RRIM 600, PB 252, PB 5/139 and RRIM 605 are the most promising clones. Clonal differences were observed with regard to the major characters in different agro-climatic conditions (5).

Discussion

In the large scale trials the clones showing comparatively good performance are RRII 501, RRIM 605 (Table 2); RRIM 608, RRIM 501 (Table 3) and PB 217 and PB 213 (Table 4). A perusal of the girth increment on tapping of the exotic clones showed that RRIM 612, RRIM 621 (Table 2), RRIM 612, RRIM 615 and RRIM 621 (Table 3), PB 217, PB 5/76 (Table 4), RRIC 7, RRIC 52 and RRIC 104 (Table 5) were found to exhibit better girth increment on tapping. This is in agreement with the earlier reports of PB clones (6).

Incidence of brown bast was noticed in all the trials. Percentage of trees affected by this showed region wise as well as clone wise variations. RRIM 608, 609, 621, and 622 were found to be highly susceptible in both regions.

Among the Sri Lankan clones abnormal leaf fall due to *Phytophthora spp.* was high in a few clones like Nab 17, average in certain others such as RRIC 45 and RRIC 52 and comparatively low in the case of RRIC 100 and RRIC 105. Susceptibility of Nab 17 to this disease has been observed in other countries also (7). All the RRIC clones (Table 5) are susceptible to powdery mildew caused by *Oidium heveae* and pink disease by *Corticium salmonicolor*. But RRIC 52 and RRIC 102 are reported to be resistant to Oidium in Sri Lanka (8) (9).

Table - 6
YIELD PERFORMANCE OF VARIOUS PLANTING MATERIALS IN COMMERCIAL PRACTICE IN INDIA (KG/HA)

Planting material	Total area under observation (ha)	Mean Yield
PB 86	569	1127.06
PB 6/9	68	1150.73
PB 5/139	227	1229.26
RRIM 605	231	1225.93
RRIM 623	363	1178.13
GI 1	487	1144.86
LCB 1320	117	867.93
PR 107	68	1042.66
		Over 14 years
PB 5/51	232	1350.78
RRIM 600	888	1387.14
GT 1	992	1395.50
		Over 13 years
PB 28/59	556	1423.07
		Over 12 years
RRIM 628	100	1053.40
		Over 10 years
RRIM 701	32	1139.40
PB 217	125	1257.80
PB 252	18	1365.30
		Over 7 years
PB 235	41	1231.57

Among the Malaysian clones RRIM 600 and RRIM 628 are found to be susceptible to pink disease. This is in agreement with the reports from Malaysia (10). All the clones were found to be susceptible to abnormal leaf fall caused by *Phytophthora*, RRIM 600 being highly susceptible. Eventhough, PB 217 is reported to be highly susceptible to this disease in Malaysia (11), it is showing tolerance under Indian conditions. PB 217 is susceptible to *Oidium* where as RRIM 600 is tolerant to this malady.

Conclusion

The general performance of exotic clones in India is comparable to that in their countries of

origin. However, in certain specific characters some of the clones exhibited slight variations from their reported performance. Results obtained from these clonal evaluation studies showed that there can be marked variation in the performance of *Hevea* clones under different agro-climatic conditions.

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