Research Article

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Performance of indigenous and exotic clones of rubber in india

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Abstract

Twelve clones of rubber (*Hevea brasiliensis*) (RRII 5, RRII 118, RRII 208, RRII 300, RRII 308, RRIM 600, RRIM 703, PR 255, PR 261, SCATC 88-13, SCATC 93-114 and Haiken 1) of which three are Chinese clones were evaluated in a large scale trial along with the control clone RRII 105. The trial was laid out in 1989 and the trees were opened for tapping during the 7th year after planting in 1996. The performance of these clones with respect to yield over a period of nine years, growth attributes, timber traits, incidence of tapping panel dryness, *Phytophthora*, pink and powdery mildew disease are presented. Significant clonal variations existed for all the characters. Clone RRII 5 (66.02 g/t/t) was the highest yielder over nine years of tapping followed by RRII 118 (54.55g/t/t), RRII 308 (47.27 g/t/t) and RRII 208 (46.77 g/t/t). Clone RRII 118 showed a rising yield trend. Among the cold tolerant Chinese clones evaluated SCATC 88-13 (45.00 g/t/t) showed comparable yield while SCATC 93-114 was the best in terms of growth and secondary attributes. Superiority of clones for specific traits is discussed.

Keywords: Clone evaluation, disease incidence, *Hevea brasiliensis*, secondary characters, yield

Introduction

Evaluation of exotic clones is one of the important methods of crop improvement in *Hevea*. In order to circumvent the breeding process, plant breeders in different rubber growing countries usually exchange potential clones among themselves. Evaluation and selection of clones for yield, girth and desirable secondary characters in the prevailing local agro climatic conditions assumes greater significance in choosing the right clones for large- scale planting. The present study reports the performance of certain selections of Indian, Malaysian, Indonesian and Chinese origin in comparison with the popular clone of India viz., RRII 105.

Materials and Methods

The materials comprised thirteen clones of *Hevea brasiliensis* (Willd. ex Adr. de Juss. Muell. Arg.) of which three are Chinese clones viz., SCATC 88-13, SCATC 93-114 and Haiken 1 introduced through bilateral clone exchange programme during 1984-85. The Malaysian clones (RRIM 600 and RRIM 703) and Indonesian clones (PR 255 and PR 261) were earlier introductions. Indian clones (RRII 5, RRII 105, RRII 118, RRII 208, RRII 308) constituted both primary and hybrid clones (Table 1). These clones were evaluated in a large scale trial employing randomised block design with seven replications and seven plants per plot at the research farm of the Rubber Research Institute of India, Kottayam. The trial was laid out in 1989 and the trees were opened for tapping during the 7th year after planting. The tapping system followed was 1/2S d/3.

Yield recording was done at fortnightly intervals by cup coagulation method and mean annual dry rubber

Table 1. Details of clones evaluated

Clone	Parentage	Country of origin
RRII 5	Primary	India
RRII 118	Mil 3/2 x Hil 28	- do -
RRII 208	Mil 3/2 x AVROS 255	- do -
RRII 300	Tjir 1 x PR 107	- do -
RRII 308	Gl 1 x PB 6/50	- do -
RRIM 600	Tjir 1 x PB 86	Malaysia
RRIM 703	RRIM 600 x RRIM 500	- do-
PR 255	Tjir 1 x PR 107	Indonesia
PR 261	Tjir 1 x PR 107	- do -
SCATC 88-13	RRIM 600 x Pil B 84	China
SCATC 93-114	TR 31-45 x HK 3-11	- do -
Haiken 1	Primary	- do -
RRII 105	Tjir 1 x Gl 1	India (Control)

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yield was computed. Girth of trees at a height of 150 cm from bud union was measured annually from three years after planting onwards. The annual girth data was used for computation of girth increment before tapping and girth increment on tapping. The height of branching was recorded and the timber yield in terms of clear bole volume was computed using the measurements of girth and branching height following the True volume method (Chathurvedi and Khanna 1982). Secondary characters like incidence of tapping panel dryness, incidence of *Pyhtophthora*, pink disease and powdery mildew disease were also recorded periodically. Data were statistically analysed as per the procedure given by Panse and Sukhatme (1985).

Results and Discussion

The performance of thirteen clones in respect of yield is presented in Table 2. There existed highly significant clonal variation for annual mean yield. The annual mean dry rubber yield over first five years ranged from 16.68 g/tree/tap (g/t/t) to 61.42 g/t/t with a general mean of 40.83 g/t/t. The clone RRII 5 showed the highest yield of 61.42 g/t/t followed by clones RRII 105 and RRII 118 with 47.11 and 46.00 g/t/t, respectively. Clones viz., RRII 308, SCATC 88-13 and RRII 208 showed yield on par while clone SCATC 93-114 exhibited the lowest yield of 16.68 g/t/t. Among the three introductions from China, SCATC 88-13 showed the best performance in terms of mean annual yield over first five years.

Table 2. Mean yield performance of clones

Clone	Mean dry rubber yield over first five years in A panel (g/t/t)	Mean dry rubber yield over first four years in B panel (g/t/t)	Mean dry rubber yield over 9 years (g/t/t)
RRII 5	61.42	71.77	66.02
RRII 118	46.00	65.28	54.55
RRII 208	43.04	51.43	46.77
RRII 300	37.22	43.09	39.83
RRII 308	45.20	49.86	47.27
RRIM 600	38.14	42.31	40.00
RRIM 703	42.86	38.00	40.66
PR 255	43.39	44.36	43.82
PR 261	36.33	40.30	38.10
SCATC 88-13	43.96	46.25	45.00
SCATC 93-114	16.68	24.52	20.16
Haiken 1	29.54	24.06	27.19
RRII 105	47.12	51.17	48.92
Mean	40.83	45.56	42.93
CD (P= 0.05)	6.52	9.63	7.39

g/t/t = g/tree/tap

The clones in general recorded a mean yield of 45.56 g/t/t for next four years in the B panel. Clone RRII 5 continued to show the best performance with an yield of 71.77 g/t/t followed by RRII 118, RRII 208, RRII 105 and RRII 308. Yield in the B panel ranged from 24.06 to 71.77 g/t/t. Chinese clones viz., Haiken 1 and SCATC 93-114 were the poor performers. The trend for yield performance in B panel was the same as that for the first five years.

Pooled analysis for yield over nine years of tapping showed significant variation for the character. RRII 5 was significantly superior in yield than the control clone RRII 105 and RRII 118 was the second best in this trial. Mean annual dry rubber yield over nine years ranged from 20.16 g/t/t to 66.02 g/t/t. Performance of RRII 308 and RRII 208 were on par with the control clone RRII 105. Among the Chinese clones evaluated, clone SCATC 88-13 showed comparable yield performance while clones SCATC 93-114 and Haiken 1 were poor in yield in this location. Good performance of SCATC 88- n terms of yield is reported from non traditional regions of Tripura and Nagrakatta (Varghese,2002 and Das *et al.*, 2005). The comparative yield performance of clones over nine years of tapping is depicted in Fig. 1. The rising yield trend in clone RRII 118 over the years is evident from the figure.

While yield of rubber is the major consideration in the breeding for improved clones, there are other characteristics that are equally important in ensuring the stability in yield and there by enhancing the value of the rubber tree. Characteristics such as girth and girth increment before and after tapping determine the age of attainment of tappability and the timber value (Othman and Aziz, 1994). The main growth characteristics of the clones studied are presented in the Table 3. Highly significant clonal variation was observed for the

Table 3. Important growth characters of the clones

Clone	Girth at opening (cm)	Tappability (%)	Mean girth increment before tapping (cm/yr)	Mean girth increment on tapping (cm/yr)
RRII 5	55.91	90.00	6.50	2.76
RRII 118	61.82	100.00	7.01	4.14
RRII 208	53.36	80.63	5.94	1.92
RRII 300	52.51	67.08	5.78	2.10
RRII 308	55.78	90.03	6.68	3.8
RRIM 600	49.72	49.02	5.67	2.91
RRIM 703	49.93	58.00	5.51	1.7
PR 255	50.54	55.44	5.98	2.15
PR 261	51.22	52.32	5.62	1.71
SCATC 88-13	49.95	52.14	5.72	2.41
SCATC93-114	50.44	61.02	6.30	3.06
Haiken 1	45.62	25.66	4.48	1.50
RRII 105	52.16	62.55	5.94	2.51
Mean	52.22	64.91	5.93	2.51
CD (P = 0 05)	5.12	-	1.08	1.06

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characters studied. According to Simmonds (1989), yield and vigour in the crop are hardly separable.

Growth vigour is genetically controlled and there is marked clonal variation with regard to girth increment under tapping and its effect on yield (Ferwerda, 1969).

The vigorous growth habit of clone RRII 118 was evident from its attaining 100 % tappability at the time of opening. The high vigour coupled with 100% tappability in the 7th year reflecting uniformity in growth has commercial significance. Two other clones viz., RRII 308 and RRII 5 also recorded very high tappability of 90.03 and 90 %, respectively. The girth at opening was the highest for clone RRII 118 (61.82 cm). The other vigorous clones in the trial include RRII 5 (55.91 cm), RRII 308 (55.78 cm), RRII 208 (53.36), RRII 300 (52.51 cm) and RRII 105 (52.16 cm), respectively. The Chinese clone Haiken 1 recorded the lowest girth at opening (45.62 cm) in this trial. The rate of girth increment (GI) before tapping ranged from 4.48 to 7.01 cm. Clone RRII 118 showed the highest GI rate of 7.01 cm followed by RRII 308 (6.68 cm), RRII 5 (6.50 cm) and SCATC 93-114 (6.3 cm).The trend for GI rate during tapping was the same with a range of 1.50 to 4.14 cm. The influence of GI rate on yield of clones was reported by Mydin *et al.* (1994). Table 4 shows the performance of clones with respect to forking height, girth and clear bole volume at the age of 12 years after planting. Girth in the 12th year after planting ranged from 51.63 to 78.38 cm with a general mean of 62.26 cm. There was significant variation for the girth among the clones. RRII 118, RRII 308 and RRII 5 were the vigorous clones in the 12th year after planting. There was significant clonal variation for clear bole volume which ranged from 0.08 to 0.17 m^3 /tree. Clone RRII 118 recorded the highest clear bole volume of 0.17 m^3 /tree followed by RRII 308 (0.13 m^3 /tree) and RRII 5 (0.12 m^3 /tree). The timber production potential along with yield assumes much significance for maximising the economic returns from rubber plantation. The yield of timber obtained from rubber tree comprises mainly of the clear bole volume (Najib *et al.*, 1995) which is dependent on the height at first forking and the girth of the tree which in turn is dependent on its growth rate. The growth attributes especially girth increment under tapping, thus have a bearing on the volume of timber (Mydin *et al.*, 2005). The clones with high clear bole volume viz., RRII 118, RRII 308, RRII 5 and RRII 208 were significantly high girthing clone which maintained a high growth rate in the tapping phase also, an indication of their timber yield potential in future years.

Resistance to various biotic and abiotic stresses is of greater significance in the performance of *Hevea* clones. Incidence of tapping panel dryness ranged from 0.00 to 10.2 % (Table 5). Clone SCATC 93- 114 was free from tapping panel dryness. Other clones which showed less occurrence of TPD were RRII 208 (2.04 %) and RRIM 703 (4.08 %). RRII 308 and RRII 105 were the most susceptible clones with 10.12 % each. All the clones were found to be affected by powdery mildew with varying intensity. Chinese clones viz., SCATC 93-114, RRIM 703, RRII 5 and Haiken 1 showed less disease intensity while others showed average to above average incidence of powdery mildew (Table 5). All the clones were affected by pink disease at the 3rd year after planting. The incidence varied from 12.25 % (RRII 208) to 44.39 % (PR 255) with a general mean of 28.27 %. Pink disease

Table 4. Important timber traits

Clone	Clear bole volume (m3/tree)	Branching height(m)	Girth 12th yr (cm)
RRII 5	0.12	3.49	66.91
RRII 118	0.17	3.44	78.38
RRII 208	0.11	3.76	61.02
RRII 300	0.10	3.5	60.89
RRII 308	0.13	3.10	70.88
RRIM 600	0.09	3.14	61.36
RRIM 703	0.09	3.42	56.64
PR 255	0.08	3.02	59.15
PR 261	0.08	3.14	58.04
SCATC 88-13	0.10	3.49	59.57
SCATC 93-114	0.10	3.18	62.67
Haiken 1	0.08	3.81	51.63
RRII 105	0.10	3.18	62.18
Mean	0.10	3.36	62.26
CD(P= 0.05)	0.03	NS	4.63

NS = Not Significant

Table 5. Important secondary characters

Clone	Brown bast (%)	Incidence of *Phytophthora* (Leaf retention %)	Incidence of powdery mildew (PDI)	Incidence of pink disease (PDI)
RRII 5	8.16	79.11	25.45	27.30
RRII 118	6.12	73.01	32.97	23.47
RRII 208	2.04	59.79	34.48	12.25
RRII 300	6.12	59.91	51.91	27.55
RRII 308	10.2	73.33	46.12	25.51
RRIM 600	6.12	47.00	40.88	35.72
RRIM 703	4.08	34.36	20.82	18.62
PR 255	6.12	63.66	38.95	44.39
PR 261	6.12	53.43	42.28	23.98
SCATC 88-13	6.12	59.66	52.60	34.69
SCATC 93-114	0.00	48.66	15.32	14.97
Haiken 1	6.12	43.76	29.14	36.40
RRII 105	10.2	85.15	50.38	40.82
Mean	5.96	60.06	37.02	28.27

** Source of data on powdery mildew: Rajalakshmy *et al.* (1997)

** Source of data on pink disease: Rajalakshmy *et al.* (1994)

predominant in young rubber trees is the most serious among the stem diseases (Kothandaraman and Idiculla 2000). Occurrence of high incidence of pink disease of these clones during the 2nd and 3rd year and subsequent reduction thereafter was already reported by Rajalakshmy *et al.*(1994).

Abnormal leaf fall caused by *Phytophthora* spp. is the most destructive disease of rubber in India (Edathil *et al.*, 2000). The intensity of abnormal leaf fall varied significantly among clones with leaf retention ranging from 34.36 to 85.15 %. High leaf retention was noticed in the control clone RRII 105 followed by RRII 5, RRII 118 and RRII 308. Clones RRIM 703 and Haiken 1 recorded low leaf retention. High level of tolerance of clone RRII 105 to *Phytophthora* is already reported (Pillay *et al.*, 1980; Mushrif *et al.*, 2004).

Rubber yield in *Hevea brasiliensis* is a manifestation of various morphological, anatomical, physiological and biochemical characters of the tree (Pollinere,1966). A superior clone is expected to exhibit higher yield and other secondary attributes. From the comprehensive study of various parameters of clones, it emerges that RRII 5 is the high latex yielder among the clones evaluated. Superiority of clone RRII 5 in terms of yield and vigour combined with satisfactory secondary characters has already been reported (Marattukalam *et al.*, 1989, 1990 and 1992). Clone RRII 118 performed well in terms of yield, growth and timber attributes and resistance to biotic and abiotic stresses which could be recommended for commercial planting after examining its performance in on farm trials. Superiority of this clone in terms of growth vigour in the early growth phase is reported by Varghese *et al.* (1996). Clone RRII 118 exhibited a rising yield trend and showed good performance in B panel. The yield superiority of a clone is judged by its capacity to maintain considerable yield levels during stress. Supremacy of clone RRII 118 in terms of growth and yield is reported from the non-traditional regions also (Priyadarshan *et al.*, 2000 and Reju *et al.*, 2002). Another clone found to be promising was RRII 308. However the merit of this clone needs to be examined in different locations.

Among the cold tolerant Chinese clones evaluated, SCATC 88-13 showed comparable performance for yield. This clone is also reported as a potential clone for non-traditional regions of Tripura and Nagrakatta. Clone SCATC 93-114 was the best in terms of growth attributes and secondary characters. It is worthwhile to note that this clone exhibited complete tolerance to tapping panel dryness and low incidence to *Phytophthora*, pink disease and powdery mildew. This clone could be incorporated in the future hybridisation programmes.

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References

Chathurvedi, A.N and Khanna, L.S. 1982. *Forest mensuration*; International Book Distributors, Dehradun. p. 310.

Das, G., Singh, R.S., Satisha, G.C. and Chaudhuri, D. 2005. Performance of rubber clones in Dooars area of West Bengal. pp. 103-107. In: *Preprints of Papers. International Natural Rubber Conf.*, 6-8 November 2005 (Eds). Mathew, N.M., Jacob, C.K., Nair, M.G.S., Srinivas, P., Korah, A.C., Ajitha, A.S. and Joseph, L. Rubber Research Institute of India, Kottayam, Kerala, India.

Edathil, T.E., Jacob, C.K. and Joseph, A. 2000. Leaf diseases pp. 273-296. In: *Natural Rubber- Agromanagement and Crop Processing* (Eds). George, P.J. and Jacob, C.K. Rubber Research Institute of India, Kottayam, Kerala, India.

Ferwerda, F.P. 1969. Rubber. pp. 427-458. In: *Outlines of Perennial Crop Breeding in the Tropics* (Eds) Ferwerda, F.P. and WIT. F. Veenmanen Zonen, Wageningen, Netherlands.

Kothandaraman, R. and Idiculla, S.P. 2000. Stem diseases. pp. 297-308. In: *Natural Rubber - Agromanagement and Crop Processing* (Eds). George, P.J. and Jacob, C.K. Rubber Research Institute of India, Kottayam, Kerala, India.

Marattukalam, J.G., Panikkar, A.O.N and Saraswathyamma, C.K. 1989. Early performance of a few *Hevea* clones in large scale trials. Placrosym VII, 1986, Coonoor, India. *J. Plantn. Crops* **16** (Supplement): 377-381.

Marattukalam, J.G., Saraswathyamma, C.K and George, P.J. 1990. Crop improvement of *Hevea* through ortet selection in India. *Rubber Reporter* (Annual Number), May/June 1990: 5-8.

Marattukalam, J.G., Panikkar, A.O.N. and Saraswathyamma, C.K. 1992. Long term performance of a few clones of *Hevea brasiliensis* in large scale trial. Placrosym IX, 1990, Bangalore, India. *J. Plantn. Crops* **20** (Supplement): 170-174.

Mushrif, S.K., Joseph, A., John, A and Jacob, C.K. 2004. Evaluation of *Hevea* clones against abnormal leaf fall disease caused by *Phytophthora* spp. *Journal of Rubber Research* **17**(1): 74-78.

Mydin, K.K., Nazeer, M.A., George, P.J. and Panikkar, A.O.N. 1994. Long term performance of some hybrid clones of rubber with special reference to clonal composites. *J. Plantn. Crops* **22**(1): 19-24.

Mydin, K.K., John, A., Nazeer, M.A., Prem, E.E., Thomas, V. and Saraswathyamma, C.K. 2005. Promising *Hevea brasiliensis* clones evolved by ortet selection with emphasis on latex

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timber traits and response to stimulation. *J. Plantn Crops* 33(1): 18-28.

Najib Lotty bin Arshad., Ramli bin Othman and Abdul Rahman bin Wan Yaacob. 1995. *Hevea* wood availability in Peninsular Malaysia. *Planters Bulletin*, **224-225**, 73-83.

Othman, H and Aziz, M.Z.A. 1994. Performance of potential clones in Block planting trial. *RRIM Planters Bullettin* **218-219**: 12-20.

Panse, V.G and Sukhatme, P.V. 1985. Statistical methods for Agricultural Workers 4th ed. ICAR, New Delhi.347 p.

Pillay, P.N.R., George, M..K. and Rajalakshmy, V.K. 1980. Leaf and shoot diseases. pp.249-278. In: *Hand book of Natural Rubber Production in India.* (Eds). P.N Radhakrishnan Pillay. Rubber Research Institute of India, Kottayam, Kerala, India.

Pollinere, J.P. 1966. Introduction to the study of genetical selection of *Hevea brasiliensis Trop. Abstr.* **21**: 6.

adarshan, P.M., Sudhasowmyalatha, M.K., Sasikumar, S., Dey, S.K and Varghese, Y.A. 2000. Evaluation of *Hevea brasiliensis* clones for yielding trends in Tripura. *Indian Journal of Natural Rubber Research* **13** (1&2): 56-63.

Rajalakshmy, V.K., Joseph, A., Varghese, Y.A., Vanitha, S., Jayarathnam, K. and Sethuraj, M.R. 1994. Evaluation of *Hevea* clones against diseases. 1. Susceptibility to pink disease caused by *Carticium salmonicolor*. pp. 102–104. In: *Proceedings of IRRDB Symposium on diseases of Hevea.* November 21-22, Cochin, India.

Rajalakshmy, V.K., Joseph, A., Annamma, Y.A. and Kothandaraman, R. 1997. Evaluation of *Hevea* clones against powdery mildew caused by *Oidium heveae* Steinm. *Indian Journal of Natural Rubber Rresearch* **10** (1&2): 110-112.

Reju, M.J., Thapiliyal, A.P., Gopalakrishnan, J., Deka, H.K. and Soman, T.A. 2002. First panel yield of eight Hevea clones in sub-tropical Meghalaya. *Indian Journal of Natural Rubber Research* **15** (2): 190-193.

Simmonds, N.W. (1989). Rubber Breeding. pp. 85-124. In: *Rubber* (Eds). Webster, C.C. and Baulkwill, Longman Scientific and Technical, U.S.A.

Varghese, Y.A., John, A., Saraswathyamma, C.K., Panikkar, A.O.N. and Sethuraj, M.R. 1996. Performance of indigenous and exotic clones of rubber. 1. Early growth performance of 13 clones. pp. 396-402. In: *J. Plantn Crops* 24 (Supplement) (Eds). Peter, K.V., Sarma, Y.R., Rajagopal, V., Ramana, K.V., Devasahayam, S and Krishnamurthy, K.S. Indian Society for Plantation Crops, Kasaragod, India.

Varghese, Y.A. 2002. Crop improvement in the non traditional rubber growing areas in India. pp. 117-131. In: *Global competitiveness of Indian Rubber Plantation Industry Rubber Planters' Conference*, November 21-22, Kottayam. (Ed). Jacob, C.K. Rubber Research Institute of India, Kottayam, Kerala, India.