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Sankariammal, L and

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HETEROSIS FOR GROWTH AND TEST TAP YIELD IN WICKHAM x AMAZONIAN HYBRIDS OF *HEVEA BRASILIENSIS*

L. Sankariammal and Kavitha K. Mydin

Rubber Research Institute of India, Kottayam, Kerala, India, 686 009.

ABSTRACT

Rubber cultivation in South-East Asia began after the introduction of rubber from Brazil through Kew Gardens in 1876. Commercial cultivation in India was started in 1902 and systematic crop improvement programmes were initiated with the inception of Rubber Research Institute of India (RRII) in 1955. RRII maintains a large collection of germplasm consisting of domesticated (Wickham clones) and wild accessions (Amazonian germplasm) received from the 1981 IRRDB expedition to Brazil. They are being conserved for characterization, evaluation and utilization in a phased manner. Accessions showing potential for important secondary traits such as girth and tolerance to biotic and abiotic stresses were identified and incorporated in crossing with popular clones in 1997 with the intention of broadening the narrow genetic base of cultivated rubber and also for developing improved clones for cultivation.

This paper summarizes the performance of 27 hybrid clones of *Hevea brasiliensis* resulting from the 1997 hybridization programme, incorporating two popular Wickham clones *viz.*, RRII 105 and RRIM 600 as females and seven accessions from wild germplasm (MT 1014, MT 1027, MT 1005, MT 1021, MT 999, RO 380 and AC 495) as males. The clones were evaluated in a clonal nursery trial laid out at the Central Experiment Station of RRII at Chethackal, Ranni in Central Kerala in 2003 employing randomized block design with three replications and plot size of four plants. The high yielding clone RRII 105 was

planted as control. The characters studied were yield performance of the clones over a period of three years by test tapping, girth up to five years and incidence of diseases. Mean test tap yield ranged from 4.9 to 29.32 g/t/10t (gm/tree/10taps). Five hybrids *viz.*, 97/4, 97/47, 97/182, 97/213, and 97/300, showed higher yield than the control and the yield of these hybrids ranged from 18.33 to 29.32 g/t/10t. The high yielding control clone RRII 105 gave 16.08 g/t/10t. Hybrid 97/300 recorded the highest yield of 29.32 g/t/10t followed by hybrid 97/213 (28.83 g/t/10t) and yield of these two clones were significantly superior to the check clone. Mean girth at the age of five years ranged from 12.30 to 25.25cm. Standard heterosis was worked out in respect of the hybrid clones and this ranged from 14.00 to 82.34 percent for yield with the hybrid 97/300 being the highest followed by 97/213. Standard heterosis for girth ranged from 7.14 to 110 percent, hybrid 97/300 exhibiting the highest heterosis. Five hybrids *viz.*, 97/4, 97/47, 97/182, 97/213 and 97/300 which showed better yield and other secondary attributes were selected for the next phase of evaluation in participatory trials.

Key words: Biotic/Abiotic stresses, Evaluation, Heterosis, *Hevea brasiliensis*, Utilization, Wild germplasm.

INTRODUCTION

The Rubber Research Institute of India has been evolving new clones of rubber through breeding and selection from 1955 onwards. Over 127 clones evolved by other rubber producing countries like Malaysia, Indonesia, Sri Lanka, Thailand, Ivory Coast and China have been introduced to India and selected clones from this collection were used in hybridization programmes which led to the release of some very successful cultivars as RRII 105, RRII 414, RRII 417, RRII 422 and RRII 430 (Nair and Panikkar, 1966; Nair and George, 1968; Nazeer *et al.*, 1986; Licy *et al.*, 1992; Mydin *et al.*, 2005). In addition to this, RRII introduced 4548 wild germplasm accessions, received from the 1981 IRRDB expedition to Brazil. They were collected from three provenances in Brazil viz. Acre (AC), Rondonia (RO) and Mato Grosso (MT) and are being conserved for characterization, evaluation and utilization in a phased manner. Even though wild accessions are generally low rubber yielders, accessions with desirable agro morphological traits were selected (Abraham *et al.*, 2000; Mercy *et al.*, 1995; Madhavan *et al.*, 1993; Rao *et al.*, 1996, 2008) and used in crossing with popular Wickham clones with the intention of broadening the narrow genetic base of cultivated rubber and also developing improved clones for cultivation. The progenies of Wickham x Amazonian crosses were first evaluated in a seedling nursery (Sankariammal *et al.*, 2010) following which the selections were multiplied and planted in this clonal nursery. This paper summarises the performance of 27 hybrid clones selected from the progeny of the 1997 hybridization programme, incorporating wild germplasm in breeding in India. The results of the clonal nursery evaluation are discussed.

MATERIALS AND METHODS

The materials used in this study included 27 hybrid clones, the selected progenies of Wickham x Amazonian hybridization programme done in 1997. The parents used in this study were the most popular Wickham clones *viz.*, RRII 105 and RRIM 600 as females and seven accessions from wild germplasm(MT 1014, MT 1027, MT 1005, MT 1021, MT 999, RO 380 and AC 495) as males. The hybrid progenies that showed yield above the general mean were selected and multiplied. The clones and their parentage are given in Table 1. The clones were evaluated in a clonal nursery trial laid out at the Central Experiment Station of RRII at Chethackal, Ranni in Central Kerala in 2003 employing randomized block design with three replications and plot size of four plants. The high yielding clone RRII 105 was planted as control. The characters studied were yield performance of the clones over a period of three years by test tapping, girth up to five years, height and number of leaf whorls in the third year and incidence of diseases. Test tapping was conducted in three year old plants at a height of 20cm from the base in the month of November in three consecutive years from 2005 to 2007. Tin spouts were attached to the stem bark with the collection cup placed on the ground. Latex from the first five tappings was discarded. Thereafter, latex from 10 consecutive tappings was collected, sun dried for a day and the cup lumps were extracted for oven drying. Oven drying at 55^{o} C was done for 10 days. The dried cup lumps were then weighed to record the dry rubber yield per plant for ten tappings.

RESULTS AND DISCUSSION

Yield of clones

Performance of clones with respect to yield is given in Table 2. Mean test tap yield over three years ranged from 4.9 to 29.32 g/ t/ 10t (gram/tree/10taps). Among the 27 hybrids, five of them viz., 97/4, 97/47, 97/182, 97/213 and 97/300 showed higher yield than the

control and the yield of these hybrids were 18.33, 19.56, 18.82, 28.83 and 29.32 g/t/10t respectively. The high yielding control clone RRII 105 gave 16.08 g/t/10t. The hybrid clone 97/300 recorded the highest yield of 29.32 g/t/10t followed by 97/213 (28.83 g/t/10t) and the yield of these two clones were significantly superior to the check clone RRII 105.

Growth parameters

Mean girth over five years ranged from 12.3 to 25.25 cm (Table 2). The highest girth was exhibited by 97/300 followed by 97/170 (22cm). Other high yielding clones viz., 97/4, 94/47, 97/182 and 97/213 also showed good girth (20.92, 20.13, 21.93 and 21.17 cm respectively). Mean height of the hybrids in the third year ranged from 2.06 to 4.70 m, the highest was in 97/300. The number of leaf whorls ranged from 3 to 6, the highest was in 97/63.

Standard heterosis indicates the improvement of hybrids over the standard clone RRII 105. Based on yield it ranged from 14 percent in 97/4 to 82.34 percent in 97/300. Other high yielders *viz.,* 97/213, 97/47 and 97/182 showed 79.29, 21.64 and 17.03 percent heterosis over the standard clone. Standard heterosis for girth ranged from 7.14 to 110 percent, the hybrid clone 97/300 exhibited the highest followed by 97/170 (82.87%). Other high yielders viz., clones 97/4, 97/213, 97/182 and 97/47 recorded 73.89, 21.17, 20.33 and 20.13 percent heterosis respectively.

Among the five high yielding hybrid clones, three of them viz., 97/300, 97/182 and 97/4 were the progenies in which MT 1014 was used as the male parent, the first two were the progenies of RRIM 600 x MT1014 and 97/4 was the progeny of RRII 105 x MT1014. The parentage of the second high yielder (97/213) was RRII 105 x MT 1005 and the third one (97/47) was RRIM 600 x RO 380. Progenies of Mato Grosso wild accessions showed higher yield than the other two groups *viz.,* Acre and Rondonia. Though most of the progenies of Wickhan x Amazonian crosses are expected to be low yielders, recombination

between such diverse parents could result in new genotypes, with high yield as well as the desired wild genes. Breeding of clones capable of withstanding different constraints like extremes of temperature in winter and summer, prolonged drought, high velocity wind, high altitudes, diseases etc. requires a wide array of genes which only the wild germplasm can provide. According to Simmonds (1989) yield and vigour in the crop are hardly separable. All the high yielding hybrid clones in the present study exhibited high girth also. Yield and growth attributes would be of great value in the selection of superior clones. Incidence of major diseases in general was very low. Incorporation of wild genes in the cultivars by hybridization will improve yield and simultaneously broaden the genetic base of this crop. The most important method of developing clones of desirable genetic constitution is the controlled hybridization between selected parent clones (Varghese *et al.*, 2006). The performance of the hybrid clones in comparison with the control clone is presented in Fig.1. Among the 27 Wickham x Amazonian hybrids, five clones viz., 97/4, 97/47, 97/182, 97/213 and 97/300 which showed high yield combined with high vigour when compared to the check clone RRII 105 were selected for the next phase of evaluation in the participatory trials.

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Table 1. Details of the clones and their parentage

Sl. No	Clone	Percentage	Sl. No	Clone	Percentage
1.	97/4	RRII 105 x MT 1014	15.	97/255	RRIM 600 X MT 1005
2.	97/10	RRII 105 x MT 1027	16.	97/125	RRIM 600 X MT 1014
3.	97/213	RRII 105 x MT 1005	17.	97/181	RRIM 600 x MT 1014
4.	97/219	RRII 105 x MT 1005	18.	97/182	RRIM 600 x MT 1014
5.	97/224	RRII 105 x MT 1005	19.	97/300	RRIM 600 x MT 1014
6.	97/225	RRII 105 x MT 1005	20.	97/166	RRIM 600 x AC 495
7.	97/238	RRII 105 x MT 1021	21.	97/170	RRIM 600 x AC 495
8.	97/13	RRIM 600 x MT 999	22.	97/173	RRIM 600 x AC 495
9.	97/47	RRIM 600 x RO 380	23.	97/279	RRIM 600 x AC 495
10.	97/62	RRIM 600 x MT 1021	24.	97/289	RRIM 600 x AC 495
11.	97/63	RRIM 600 x MT 1021	25.	97/189	RRIM 600 x MT 1027
12.	97/72	RRIM 600 x MT 1021	26.	97/196	RRIM 600 x MT 1027
13.	97/98	RRIM 600 x MT 1005	27.	97/199	RRIM 600 x MT 1027
14.	97/245	RRIM 600 x MT 1005	28	RRII 105 (Control)	Tjir1 x Gl 1

Table 2. Mean test tap yield and girth of clones evaluated

Clone	Mean test tap yield over 3 years (gm/tree/10tap)	Mean girth in the 5th year (cm)	Clone	Mean test tap yield over 3 years (gm/tree/10tap)	Mean girth in the 5th year (cm)
97/4	18.33	20.92	97/125	11.27	17.61
97/10	14.48	20.31	97/181	12.19	21.92
97/213	28.83	21.17	97/182	18.82	20.33
97/219	13.63	20.83	97/300	29.32	25.25
97/224	6.79	15.00	97/166	4.91	13.94
97/225	14.15	16.67	97/170	7.77	22.00
97/238	8.84	15.92	97/173	9.95	21.08
97/13	12.19	18.08	97/279	7.82	20.50
97/47	19.56	20.13	97/289	6.86	19.28
97/62	10.94	19.33	97/189	6.85	15.75
97/63	11.62	18.67	97/196	15.12	18.58
97/72	12.71	16.94	97/199	13.28	17.19
97/98	11.79	16.75	RRIM 600	15.23	17.58
97/245	15.52	20.17	RRII 105	16.08	12.03
97/255	7.45	12.89	CD=(0.05)	10.74	5.29

Table 3. Estimates of heterosis in the hybrid clones

Clone	Parentage	Standard heterosis for girth (%)	Standard heterosis for yield (%)	Clone	Parentage	Standard heterosis for girth (%)	Standard heterosis for yield (%)
97/4	RRII 105 x MT 1014	73.89	14.00	97/255	RRIM 600 x MT 1005	7.14	-
97/10	RRII 105 x MT 1027	68.82	-	97/125	RRIM 600 x MT 1014	46.38	-
97/213	RRII 105 x MT 1005	75.97	79.29	97/181	RRIM 600 x MT 1014	82.21	-
97/219	RRII 105 x MT 1005	73.15	-	97/182	RRIM 600 x MT 1014	68.99	17.03
97/224	RRII 105 x MT 1005	24.68	-	97/300	RRIM 600 x MT 1014	110.00	82.34
97/225	RRII 105 x MT 1005	38.57	-	97/166	RRIM 600 x AC 495	15.87	-
97/238	RRII 105 x MT 1021	32.33	-	97/170	RRIM 600 x AC 495	82.87	-
97/13	RRIM 600 x MT 999	50.29	-	97/173	RRIM 600 x AC 495	75.22	-
97/47	RRIM 600 x RO 380	67.33	21.64	97/279	RRIM 600 x AC 495	70.4	-
97/62	RRIM 600 x MT 1021	60.68	-	97/289	RRIM 600 x AC 495	60.26	-
97/63	RRIM 600 x MT 1021	55.19	-	97/189	RRIM 600 x MT 1027	30.92	-
97/72	RRIM 600 x MT 1021	40.81	-	97/196	RRIM 600 x MT 1027	54.44	-
97/98	RRIM 600 x MT 1005	39.23	-	97/199	RRIM 600 x MT 1027	42.89	-
97/245	RRIM 600 x MT 1005	67.66	-	RRII 105 (Control)		-	-

Fig.1. Girth vs. yield in the hybrid clones