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Growth and yield performance of rubber clones in Meghalaya

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Hevea brasiliensis (Willd.ex A.Juss.) Muell. Arg., a native of the Amazon rain forests is now under cultivation in different agro-climate zones in world over owing to its ever increasing importance, being the major source of a strategically important commercial product, natural rubber, and the vast opportunities it offers to the people involved in the rubber plantation sector. In India, rubber cultivation is undertaken mainly in the state of Kerala and in certain places in the neighbouring states of Tamil Nadu and Karnataka. However, increase in demand for natural rubber has forced the rubber plantation industry to be expanded to areas in the North-Eastern parts of India where the climate is different from that of the traditional zones and is less hospitable to rubber (Sethuraj *et al.*, 1989). Growth and yield performance of various *Hevea* clones are available from different parts of the NE India (Sethuraj *et al.*, 1989; Meenattoor *et al.*, 1991; Vinod *et al.*, 1996, 2000; Priyadarshan *et al.*, 1998, 2002; Mondal *et al.*, 1999). Meghalaya in the NE India is a sub-tropical region where rubber, is now under cultivation. Cultivation of perennial crops like rubber is an alternative to the traditional 'jhumming' (shifting) cultivation in Meghalaya which involves slashing and burning the forest agricultural area for cultivation of short duration crops like paddy. Since income from rubber cultivation is on a daily basis, it helps the farmers to shift their attention from the traditional 'jhumming' cultivation. High altitude, low temperature during winter months, high wind velocity, less soil moisture content and the absence of North-East monsoon are the major environmental constraints to the rubber plantation sector in the NE region (Chandrasekar *et al.*, 1990; Sanjeeva Rao and Vijayakumar, 1992). Despite such limiting factors, rubber plantation establishment has so far been successful in the region. One of the challenges has been to identify suitable clones for these regions and also location specific clone development. In Meghalaya, cultivation of rubber started in 1985 for scientific evaluation of clones. This study is an attempt to screen clones of *H. brasiliensis* for their suitability for cultivation in Meghalaya. Growth and yield performance have been presented and discussed.

In the present study, data on girth and yield recorded from two clone evaluation trials from the district of West Garo Hills in Meghalaya were utilized. The clone trials were established at the Ganolgre research farm of the Regional Research Station, Tura (latitude 25°–26°; longitude 90°–91°; altitude 600 m above msl), with a sub-tropical climate. The first clone trial was laid out in 1985 and the second in 1986. Ten clones each were planted in the trials in single tree single plot randomized design. Spacing adopted was 6.6 x 3.3 m in the first trial with fifty replications and 6 x 3 m spacing in the second trial with forty replications. Clones used in the first trial are RRII 105, RRII 118, RRII 203, RRIM 600, RRIM 605, PB 86, PB 235, PB 5/51, GT 1 and GL 1. Ten clones used for the second trial are RRII 5, RRII 105, RRII 118, RRII 208, RRIC 102, RRIC 105, PB 260, PB 310, PB 311, and PR 255. Clones RRII 105 and RRII 118 were planted in both trials. Girth was recorded at a height of 150 cm from the bud-union from the third year after planting. Clones were subjected to S/2 d2 system of tapping. Rubber yield in terms of gram per tree per tap (g/t/t) was recorded fortnightly by cup coagulation method. Yield data from 1997 to 2008

were used from the 1985 clone trial for the study and the yield data from 1998 to 2008 were used from the 1986 clone trial. Weather parameters were recorded from the agro-meteorological observatory situated in the farm site. Since the observatory was established in 1989, data on weather parameters were recorded from 1990 and twenty years data from 1990 to 2009 are presented in the study. Weather conditions (Table 1) represented mainly by factors such as rainfall, which is 2417 mm, with a standard deviation of 670 mm, minimum air temperature of 16.5 °C (T_{min}), maximum air temperature of 28.8 °C (T_{max}), relative humidity (RH) of 89.5 per cent (6.20 AM) and 68.4 per cent (1.20 PM), bright sunshine hours (BSSH) of 5.9, and wind speed of 2.4 km/hr.

Table 1. Annual data on weather parameters recorded from 1990 to 2009

Year	Temperature (°C)		RH (%)		Rainfall	BSSH	Wind velocity
	T(Max)	T (Min)	6.20 AM	1.20 PM	(mm)	(hrs.)	(km/hr.)
1990	27.4	16.4	86.3	70.6	2486	6.1	5.0
1991	27.8	16.8	87.8	68.3	2451	5.8	4.8
1992	29.2	16.1	86.1	66.4	2080	6.4	4.8
1993	27.8	17.3	87.3	71.8	2835	6.5	4.0
1994	28.5	17.3	86.5	68.7	1640	6.9	3.4
1995	28.5	17.5	88.5	71.3	2188	6.2	3.0
1996	28.8	17.5	86.4	66.5	1983	6.7	2.9
1997	27.9	16.9	85.1	61.6	1425	6.5	2.4
1998	28.6	16.7	85.0	71.2	1912	5.9	2.8
1999	29.0	16.9	84.0	66.1	1764	5.9	1.5
2000	28.6	15.9	85.4	65.8	2570	6.0	1.9
2001	29.2	15.6	84.8	63.6	1817	5.4	1.3
2002	28.8	15.1	85.4	66.7	3105	5.6	1.1
2003	28.9	16.3	86.2	69.8	2128	5.9	0.9
2004	29.5	15.7	85.4	73.2	3256	5.6	1.2
2005	30.1	16.5	85.9	69.2	4002	5.4	1.7
2006	30.1	16.7	85.0	69.0	2224	5.7	1.4
2007	29.1	16.0	84.6	71.6	3303	5.3	1.2
2008	28.8	15.7	87.3	72.3	2668	5.2	1.5
2009	30.0	16.4	87.1	70.9	2433	5.0	1.2
Mean	28.8	16.5	85.9	68.4	2398 (total)	5.9	2.4
SD	0.7	0.7	1.2	2.9	670	0.5	1.4

Rubber trees are opened for tapping when the trees attained 50 cm girth at a height of 125 cm. Under normal conditions, in the traditional rubber growing regions of India, rubber trees attain tappabale girth after 7 years of growth. However, in Meghalaya, during the present study period no clones could reach tappabale girth in seven years of growth. Trees were, however, opened during the 9th year after planting with a few clones that could reach tappable girth (Table 2). When 70% of the trees attained tappability, the plantation was opened for tapping. In 1985 clone trial, girth ranged from 41.7 cm (PB 5/51) to 52.0 cm (PB 235). RRIM 600, RRII 203, PB 235, RRII 118, and PB 86 showed girth above average (48.2 cm), however, only three clones attained tappability, namely, PB 235 (71%), RRIM 600 (70%) and RRII 203 (70%).

In 1986 clone trial girth ranged from 40.1 cm (PR 255) to 57.8 cm (RRIC 105). Only one clone, namely, PB 311 attained tappability (74%) during the ninth year (Table 2). Clones RRIC 105, PB 311, RRIC 102, RRII 118 and RRII 208 showed girth above average (49.3 cm). Initial years data on growth and yield of clones were available from this region (Reju *et al.*, 2000, 2001). Clones that showed better growth performance in the initial years showed the same trend in the later years also in both the trials.

There was clonal variation in rubber yield which ranged from 26.9 g/t/t (RRIM 605) to 44.3 g/t/t (RRIM 600) in the 1985 clone trial (Table 3). Yield of clones like RRII 105, RRII 203 and PB 235 were comparable with the top yielder RRIM 600. Dry rubber yield in terms of kilogram per tree

Table 2. Girth and tappability attained by the clones during the year of opening

Clone	Parentage	Origin	Girth (cm) at opening during the 9th year	Tappability (%) during the 9th year
1985 clone trial				
RRII 105	Tjir 1 x Gl 1	Indian	45.2	34
RRII 118	Mil 3/2 x Hil 28	Indian	50.9	65
RRII 203	PB 86 x Mil 3/2	Indian	51.5	70
RRIM 600	Tjir 1 x PB 86	Malaysian	51.6	70
RRIM 605	PB 49 x Tjir 1	Malaysian	49.4	56
PB 86	Primary clone	Malaysian	48.5	54
PB 235	PB 5/51 x PB S/78	Malaysian	52.0	71
PB 5/51	PB 86 x PB 24	Malaysian	41.7	7
GT 1	Primary clone	Indonesian	47.4	45
GL 1	Primary clone	Malaysian	43.5	9
Mean			48.2	
SE			1.15	
1986 clone trial				
RRII 5	Primary clone	Indian	42.9	9
RRII 105	Tjir 1 x Gl 1	Indian	48.6	25
RRII 118	Mil 3/2 x Hil 28	Indian	50.0	69
RRII 208	Mil 3/2 x AVROS 255	Indian	52.2	41
RRIC 102	RRIC 52 x RRIC 7	Sri Lankan	51.1	42
RRIC 105	Tjir 1 x RRIC 52	Sri Lankan	57.8	65
PB 260	PB 5/51 x PB 49	Malaysian	47.6	8
PB 310	PB 5/51 x RRIM 600	Malaysian	50.0	50
PB 311	RRIM 600 x PB 235	Malaysian	53.0	74
PR 255	Tjir 1 x PR 107	Indonesian	40.1	11
Mean			49.3	
SE			1.59	

Table 3. Yield data from 1985 clone trial (Average of 12 years)

Clone	Dry rubber yield (g/t/t)	Dry rubber yield (kg/tree/yr)	Productivity (kg/ha/yr)
RRII 105	40.6	4.1	1421
RRII 118	33.5	3.4	1173
RRII 203	39.2	3.9	1372
RRIM 600	44.3	4.4	1551
RRIM 605	26.9	2.7	942
PB 86	29.7	3.0	1040
PB 235	37.2	3.7	1302
PB 5/51	27.4	2.7	959
GT 1	30.0	3.0	1050
GL 1	27.8	2.8	973
Mean	33.7	3.4	1180
CD (P=0.05)	7.6		

per year (kg/tree/yr) and kilogram per hectare per year (kg/ha/yr) were also calculated to estimate the yield potential of clones from trees and area of land. Four clones *viz*. RRIM 600 (4.4 kg/tree/yr and 1551 kg/ha/year), RRII 105 (4.1 kg/tree/yr and 1421 kg/ha/year), RRII 203 (3.9 kg/tree/yr and 1372 kg/ha/year), and PB 235 (3.7 kg/tree/yr and 1302 kg/ha/year) showed yield above average of 3.4 kg/tree/yr and 1180 kg/ha/year.

In the 1986 clone trial PB 311 was the top yielder (Table 4). Yield ranged between 26.9 g/t/t (RRIC 105) and 43.8 g/t/t (PB 311). Other promising clones in the trial were RRII 105 (36.6 g/t/t), RRII 208 (35.6 g/t/t) and PB 310 (35.2 g/t/t). Average tree

Table 4. Yield data from 1986 clone trial (Average of 11 years)

Clone	Dry rubber yield (g/t/t)	Dry rubber yield (kg/tree/yr)	Productivity (kg/ha/yr)
RRII 5	29.2	2.9	1023
RRII 105	36.6	3.7	1281
RRII 118	31.7	3.2	1110
RRII 208	35.6	3.6	1247
RRIC 102	26.9	2.7	940
RRIC 105	24.9	2.5	872
PB 260	30.6	3.1	1071
PB 310	35.2	3.5	1231
PB 311	43.8	4.4	1532
PR 255	28.4	2.8	994
Mean	32.3	3.2	1130
CD (P=0.05)	7.1		

wise yield from the trial was 3.2 kg/tree/yr and 1130 kg/ha/yr was the estimated area wise yield. Four clones from this trial *viz*. PB 311 (4.4 kg/tree/yr and 1532 kg/ha/yr), RRII 105 (3.7 kg/tree/yr and 1281 kg/ha/year), RRII 208 (3.6 kg/tree/yr and 1247 kg/ha/yr), and PB 310 (3.5 kg/tree/yr and 1231 kg/ha/yr) showed above average yield for both tree per year and hectare per year.

During 2010, a few clones from the 1985 clone trial namely, PB 235, RRII 203 and RRIM 600 were planted in the farmer's field on the basis of their performance in the experimental trials, in the East and West Garo Hills of Meghalaya in the first batch of on-farm trials.

Under the prevailing weather conditions, vigorous clones like PB 235, PB 311, RRIM 600 and RRII 203 are better for the Garo Hills of Meghalaya. Traditional agricultural practices like 'jhumming' cultivation can be replaced by adopting rubber cultivation which brings the farmer income on a daily basis. Early tappablility and higher yield, being the important concern for the rubber grower, adopting high yielding clones in the region may contribute to the income generation of the local people as well as extension of rubber cultivation in the region.

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