*Rubber Science*, **25**(2): 223-232, 2012

# PERFORMANCE OF *HEVEA* CLONES UNDER TWO TAPPING PRACTICES IN ASSAM

**G. C. Mondal, N. Ashithraj and M.A. Nazeer***

Rubber Research Institute of India, Regional Research Station,
Housefed Complex, Dispur, Guwahati - 781 006, Assam, India
* Rubber Research Institute of India, Rubber Board, Kottayam - 686 009, Kerala, India

Received: 06 November 2011 Accepted: 09 July 2012

Mondal, G.C., Ashithraj, N. and Nazeer, M.A. (2012). Performance of *Hevea* clones under two tapping practices in Assam. *Rubber Science,* **25**(2): 223-232.

A comparison of two tapping practices (continuous tapping throughout the year and with annual tapping rest during February to April) with respect to 18 *Hevea* clones (*viz*. RRII 105, RRII118, RRII 203, RRIM 600, RRIM 605, PB 86, PB 235, PB 5/51, GT 1, Gl 1, RRIC 102, RRIC 105, RRII 208, RRII 5, PB 260, PB 310, PB 311 and PR 255) of varying yield potential was evaluated in Assam. The performance of these clones with respect to rubber yield, girth, dry rubber content (DRC) and tapping panel dryness (TPD) under two tapping practices during Regime I (non-cold season) and Regime II (cold season) were evaluated. Trend in yield was always higher in annual tapping rest (ATR) than in continuous tapping (CT) except in 3 clones (PB 260, PB 5/51 and PB 311). Among the clones evaluated, RRIM 600, RRII 203, RRII 208, PB 235, PB 310, RRII 118 and GT 1 yielded above average under both tapping practices indicating these clones were more efficient in yield potential under sub-tropical humid conditions of Assam.

**Keywords**: Assam, DRC, Girth, *Hevea* clones, Tapping practices, TPD, Yield

## INTRODUCTION

North East India, especially Assam, has been identified as one of the most potential non-traditional tract for *Hevea* rubber plantation (Mondal *et al*., 1999; 2007a). Assam has a sub-tropical humid climate experiencing a low temperature spell beginning with a cool period (October-November), which stimulates the production of dry rubber yield and total volume of latex (Priyadarshan *et al*., 1998). Thereafter, a recession in yield follows consequent to further decline in temperature towards the end of December to January. The preceding months (February to July) form a low yielding regime due to changes in the attributes of macroenvironment. In north east region, *H. brasiliensis* presents two distinct yielding regimes (Priyadarshan *et al*., 1998; Mondal *et al*., 1999) consisting of non-cold season (April to September - Regime I) and cold season (October to March - Regime II). Information on the relative performance of *Hevea* clones with regard to yielding trends in different months under continuous tapping (CT) and annual tapping rest (ATR) in Assam is very meagre. Moreover, the information on the impact of CT on the growth of rubber plants and TPD as compared to ATR is also very little. This

Correspondence: G.C. Mondal (E-mail: gopalchandra@rubberboard.org.in)

paper reports the relative performance of 18 *H. brasiliensis* clones under CT and ATR practices in Assam.

## MATERIALS AND METHODS

Eighteen *H. brasiliensis* clones (*viz*. RRII 105, RRII 118, RRII 203, RRIM 600, RRIM 605, PB 86, PB 235, PB 5/51, GT 1, Gl 1, RRIC 102, RRIC 105, RRII 208, RRII 5, PB 260, PB 310, PB 311 and PR 255) were established in two clone evaluation trials during 1985 and 1986. An experiment was laid out in completely randomized design with 40 trees per clone at the Regional Research Station of the Rubber Research Institute of India, Sarutari Farm, Guwahati in Kamrup District of Assam (26$^o$ 35' N; 90$^o$ 52' E) at an elevation of 50 to 105 m above MSL for the study. Eight years after planting, trees were opened for tapping at a height of 125 cm from the bud union. Girth of the plants in 10 replications of each clone was used to calculate the mean girth increment in mature phases of growth over years. Based on uniform girth, ten trees of each clone were selected at random for yield assessment in terms of dry rubber (g/t/t), volume of latex (mL/t/t) and dry rubber content (%) at monthly intervals under S/2 d2 6d/7 of the tapping practices. The trees were not rainguarded and tapped throughout the year (CT) and with ATR. Yield in terms of dry rubber (g/t/t) was collected from 1996 (3$^{rd}$ year of tapping) to 2008 and from 2000 (6$^{th}$ year of tapping) to 2008 in trial I and trial II, respectively under both ATR (May to January) and CT (April to March). Yield in terms of latex volume (mL/t/t) was also measured from 2001 to 2007 in both the trials. The yield data collected was used to find out the impact of CT over ATR of 3 months (February to April). Per cent yield decrease or increase under CT over ATR during Regime I (non-cold season - April to September) and Regime II (cold season - October to March) was also calculated in different clones using the following formula:

$$\frac{\text{Difference in yield between two tapping practices of each regime}}{\text{Mean yield of the regime period under annual tapping rest}} \times 100$$

Dry rubber content (DRC) of different clones was measured from 2000 to 2008 under both tapping practices. Incidence of tapping panel dryness (TPD) syndrome (75% and above) was also recorded periodically. The data were statistically analysed and means are presented with least significant difference (LSD).

## RESULTS AND DISCUSSION

The data on mean girth, girth increment, yield (mL/t/t), DRC (%) and TPD (%) of 18 *H. brasiliensis* clones are given in Table 1. Growth as expressed by values of absolute girth at opening (8 years after planting) showed that except three clones *viz*. RRII 105, PB 5/51 and Gl 1, all the other 15 clones were above the average. At the age of 23 years after planting, ranking of clones based on absolute girth showed RRIC 102, RRII 118, RRII 203, PB 86, PB 235, GT 1, RRIM 600, RRIC 105 in the order of hierarchy during ATR and RRII 118, RRIC 102, PB 310, GT 1, RRII 203, PB 86, RRIM 600, PB 311 and PB 235 during CT. Under ATR the highest annual average girth increment was noticed in RRIC 102 followed by RRII 118, RRII 203, GT 1,PB 86, PB 310, RRIM 600, PR 255 and PB 235 and were also above the average under ATR. Clone RRII 118

Table 1. **Girth and DRC of *H. brasiliensis* clones under two tapping practices**

| Clone | Girth (cm) Immature (8 YAP) | | Girth (cm) Mature (23 YAP) | | Mean girth increment over 15 years in mature phase (cm) | | Mean DRC (%) over 9 years | | TPD (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ATR | CT | ATR | CT | ATR | CT | ATR | CT | ATR | CT |
| RRII 105 | 48.2 | 52.6 | 65.4 | 70.1 | 1.14 | 1.16 | 34.6 | 32.5 | 6.7 | 10.0 |
| RRII 118 | 55.2 | 53.6 | 89.0 | 89.4 | 2.25 | 2.38 | 34.8 | 34.3 | 5.9 | 12.9 |
| RRII 203 | 54.4 | 52.5 | 87.5 | 83.1 | 2.20 | 2.03 | 34.4 | 32.9 | 3.7 | 2.2 |
| RRIM 600 | 51.7 | 56.1 | 77.7 | 80.0 | 1.72 | 1.59 | 33.7 | 32.1 | 6.5 | 10.0 |
| RRIM 605 | 52.9 | 52.2 | 73.2 | 73.9 | 1.35 | 1.44 | 34.2 | 33.1 | 7.9 | 15.3 |
| PB 86 | 56.4 | 54.6 | 84.2 | 82.9 | 1.84 | 1.88 | 33.4 | 32.5 | 8.7 | 11.7 |
| PB 235 | 55.4 | 53.4 | 80.0 | 78.6 | 1.64 | 1.67 | 34.8 | 33.1 | 4.7 | 2.7 |
| PB 5/51 | 44.0 | 52.2 | 58.6 | 75.0 | 0.97 | 1.52 | 34.4 | 33.2 | 6.0 | 8.5 |
| GT 1 | 52.6 | 53.1 | 79.2 | 84.4 | 1.77 | 2.09 | 34.8 | 33.3 | 5.3 | 0.0 |
| Gl 1 | 43.1 | 49.7 | 61.3 | 69.0 | 1.21 | 1.28 | 33.7 | 32.5 | 6.5 | 16.2 |
| RRIC 102 | 58.1 | 58.0 | 98.1 | 87.0 | 2.85 | 2.07 | 33.4 | 32.1 | 12.0 | 15.7 |
| RRIC 105 | 58.4 | 57.0 | 77.0 | 76.4 | 1.32 | 1.38 | 32.3 | 31.3 | 8.0 | 9.5 |
| RRII 208 | 54.6 | 53.0 | 73.7 | 75.9 | 1.36 | 1.63 | 34.5 | 32.9 | 0.0 | 4.5 |
| RRII 5 | 54.0 | 55.8 | 74.3 | 76.6 | 1.45 | 1.48 | 31.8 | 31.5 | 4.0 | 0.0 |
| PB 260 | 54.8 | 53.1 | 65.6 | 68.6 | 0.72 | 1.10 | 31.9 | 31.4 | 4.0 | 7.6 |
| PB 310 | 48.2 | 54.9 | 73.8 | 84.6 | 1.82 | 2.12 | 32.9 | 32.4 | 4.0 | 4.3 |
| PB 311 | 53.1 | 55.6 | 68.0 | 79.0 | 1.06 | 1.67 | 30.3 | 31.3 | 4.0 | 7.1 |
| PR 255 | 43.8 | 57.2 | 67.0 | 77.6 | 1.65 | 1.45 | 33.7 | 31.7 | 13.3 | 13.3 |
| Mean | 52.2 | 54.2 | 75.2 | 78.5 | 1.57 | 1.66 | 33.6 | 32.5 | 6.2 | 8.5 |
| LSD (P<0.05) | 3.83 | 3.15 | 1.82 | 1.25 | NS | NS | NS | NS | - | - |

showed the highest annual girth increment followed by PB 310, GT 1, RRIC 102, RRII 203, PB 86, PB 235 and PB 311 and were also above the mean in CT. Out of 18 *H. brasiliensis* clones, a remarkable girth increment was noticed only in 3 clones tapped under CT with maximum in PB 311 followed by PB 5/51 and PB 260 as compared to ATR.

The mean latex yield (mL/t/t) over 7 years under ATR was maximum in RRIM 600 followed by RRII 118, GT 1, RRII 203, PB 235, RRII 105, PB 310, PR 255 and PB 86. In case of CT, RRIM 600 ranked first over 7 years followed by PB 86, GT 1, PB 310, RRII 118, PB 311, RRII 105 and RRII 208 (Table 1). Out of 18 *H. brasiliensis* clones, only three clones PB 311, PB 5/51 and PB 260 yielded maximum in CT than ATR.

Mean DRC (%) over 9 years under ATR was found high (34.8%) in three clones *viz*. PB 235, RRII 118 and GT 1 followed by RRII 105, RRII 208, RRII 203, PB 5/51, RRIM 605 and RRIM 600. Dry rubber content under CT system was found comparatively lower in all the 18 clones compared to ATR (Table 1).

The mean yield (g/t/t) recorded in different months under two tapping practices are presented in Tables 2 and 3. The yielding pattern of all the clones over months in Assam showed a uniform trend of low and high yielding periods. The low yielding phase starts from February to July with a peak in May and high yielding phase starts from August to January with the peak yielding periods during October and November. The low yield during February and March for all the clones can be attributed to low winter temperature which leads to defoliation in January. Factors like utilization of reserve foods for refoliation and flowering along with moisture stress may result in the low yield during February and March. With the rise in temperature from March onwards, a substantial increase in yield was noticed in May in all the clones tapped under both tapping practices. This may probably due to refoliation (Chua, 1970;

Table 2. **Mean rubber yield under two tapping practices in different months over 13 years**

| Clone | Tapping practices | Mean yield (g/t/t) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | M | J | J | A | S | O | N | D | J | F | M |
| RRII 105 | ATR | | 32.5 | 26.6 | 20.9 | 30.5 | 36.3 | 51.0 | 59.0 | 53.3 | 38.4 | | |
| | CT | 22.6 | 25.3 | 22.0 | 18.7 | 23.5 | 31.2 | 44.1 | 55.2 | 47.8 | 27.9 | 19.5 | 17.7 |
| RRII 118 | ATR | | 36.8 | 30.0 | 26.0 | 33.0 | 38.8 | 50.9 | 54.6 | 49.2 | 44.3 | | |
| | CT | 24.4 | 30.7 | 26.2 | 25.0 | 27.3 | 37.3 | 43.5 | 56.2 | 47.2 | 34.8 | 24.7 | 26.6 |
| RRII 203 | ATR | | 36.8 | 35.3 | 25.4 | 34.5 | 40.6 | 52.8 | 52.0 | 47.9 | 47.1 | | |
| | CT | 21.2 | 25.7 | 24.6 | 20.5 | 27.8 | 30.7 | 40.9 | 46.5 | 37.9 | 27.8 | 20.0 | 20.2 |
| RRIM 600 | ATR | | 39.6 | 36.0 | 25.2 | 35.5 | 41.2 | 54.6 | 65.8 | 56.8 | 46.0 | | |
| | CT | 28.3 | 29.7 | 27.2 | 22.9 | 27.9 | 35.5 | 45.9 | 55.8 | 55.6 | 37.2 | 30.0 | 25.1 |
| RRIM 605 | ATR | | 28.5 | 23.5 | 17.0 | 25.7 | 30.1 | 45.6 | 51.5 | 49.8 | 40.7 | | |
| | CT | 19.2 | 24.6 | 21.0 | 16.2 | 21.6 | 25.5 | 37.9 | 49.6 | 49.1 | 32.2 | 20.3 | 15.7 |
| PB 86 | ATR | | 30.6 | 25.2 | 21.1 | 30.4 | 31.3 | 43.4 | 49.4 | 42.8 | 30.9 | | |
| | CT | 22.6 | 27.5 | 24.3 | 21.0 | 28.0 | 30.3 | 40.2 | 46.8 | 45.2 | 33.4 | 22.3 | 18.9 |
| PB 235 | ATR | | 31.7 | 27.1 | 24.1 | 33.2 | 45.2 | 54.7 | 62.3 | 47.4 | 44.8 | | |
| | CT | 24.0 | 26.5 | 23.2 | 18.9 | 21.6 | 33.8 | 44.0 | 52.8 | 43.3 | 28.5 | 20.7 | 21.0 |
| PB 5/51 | ATR | | 21.2 | 17.5 | 12.1 | 18.9 | 22.3 | 32.1 | 37.6 | 31.8 | 15.9 | | |
| | CT | 20.5 | 20.6 | 20.4 | 17.2 | 21.7 | 25.1 | 34.6 | 42.5 | 39.1 | 27.7 | 21.2 | 17.3 |
| GT 1 | ATR | | 33.1 | 27.5 | 22.0 | 29.1 | 35.5 | 47.8 | 58.4 | 53.0 | 46.0 | | |
| | CT | 23.0 | 31.8 | 25.9 | 20.8 | 25.2 | 32.6 | 42.2 | 54.3 | 50.3 | 38.8 | 26.0 | 20.5 |
| GI 1 | ATR | | 25.7 | 17.8 | 15.0 | 20.8 | 23.5 | 31.6 | 39.5 | 37.9 | 26.1 | | |
| | CT | 19.0 | 20.9 | 17.8 | 14.0 | 17.5 | 20.8 | 32.7 | 37.3 | 38.5 | 26.1 | 17.7 | 16.2 |
| Mean | ATR | | 31.7 | 26.7 | 20.9 | 29.2 | 34.5 | 46.5 | 53.1 | 47.0 | 38.1 | | |
| | CT | 22.5 | 26.4 | 23.3 | 19.6 | 24.3 | 30.3 | 40.6 | 49.7 | 45.4 | 31.5 | 22.3 | 20.0 |

Table 3. **Mean rubber yield under two tapping practices in different months over 9 years**

| Clone | Tapping practices | Mean yield (g/t/t) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | M | J | J | A | S | O | N | D | J | F | M |
| RRIC 102 | ATR | | 41.0 | 33.5 | 23.6 | 32.7 | 40.5 | 42.4 | 49.6 | 45.7 | 40.9 | | |
| | CT | 15.4 | 19.1 | 20.0 | 17.9 | 21.3 | 26.2 | 37.7 | 37.1 | 33.9 | 28.5 | 21.7 | 15.9 |
| RRIC105 | ATR | | 24.5 | 24.4 | 20.2 | 22.2 | 24.3 | 35.9 | 42.3 | 31.3 | 30.4 | | |
| | CT | 15.8 | 21.8 | 20.1 | 15.9 | 23.8 | 23.5 | 39.4 | 41.3 | 34.5 | 21.9 | 15.5 | 12.8 |
| RRII 5 | ATR | | 23.7 | 27.8 | 20.6 | 24.3 | 36.3 | 50.8 | 52.7 | 36.8 | 33.7 | | |
| | CT | 19.0 | 24.6 | 25.3 | 21.4 | 27.5 | 29.9 | 38.6 | 44.7 | 36.4 | 26.5 | 19.8 | 18.3 |
| RRII 208 | ATR | | 35.1 | 31.6 | 27.6 | 30.4 | 46.6 | 57.4 | 63.8 | 41.0 | 39.8 | | |
| | CT | 22.2 | 27.2 | 24.8 | 22.3 | 31.6 | 32.4 | 44.0 | 51.2 | 42.6 | 28.7 | 24.0 | 21.3 |
| PB 260 | ATR | | 22.6 | 21.3 | 16.4 | 17.8 | 28.4 | 33.1 | 31.7 | 22.5 | 20.0 | | |
| | CT | 19.3 | 26.6 | 25.8 | 18.0 | 25.0 | 27.9 | 40.4 | 42.7 | 33.0 | 24.0 | 20.2 | 18.3 |
| PB 310 | ATR | | 34.6 | 27.4 | 25.6 | 40.9 | 42.7 | 58.3 | 55.2 | 37.5 | 32.2 | | |
| | CT | 26.9 | 31.0 | 30.9 | 25.9 | 33.7 | 37.8 | 50.7 | 49.5 | 40.7 | 33.6 | 24.7 | 24.4 |
| PB 311 | ATR | | 30.6 | 26.8 | 21.5 | 29.7 | 32.4 | 43.9 | 46.3 | 36.5 | 23.0 | | |
| | CT | 25.1 | 31.0 | 28.3 | 27.9 | 33.4 | 35.1 | 46.4 | 50.8 | 37.7 | 26.9 | 24.1 | 24.9 |
| PR 255 | ATR | | 37.9 | 36.3 | 29.7 | 35.9 | 42.6 | 60.6 | 52.7 | 49.7 | 40.2 | | |
| | CT | 20.3 | 23.6 | 27.7 | 19.0 | 21.2 | 33.6 | 42.7 | 42.6 | 35.3 | 30.2 | 20.3 | 17.7 |
| Mean | ATR | | 31.3 | 28.7 | 23.2 | 29.3 | 36.8 | 47.8 | 49.3 | 37.7 | 32.6 | | |
| | CT | 20.5 | 25.7 | 24.8 | 21.1 | 27.2 | 30.8 | 42.0 | 45.0 | 36.8 | 27.6 | 21.3 | 19.2 |

Yaohua and Xie, 1985) which starts by the first or second week of February and the new flushes become mature by March/April (Mondal *et al*., 1998; 2007a). Thereafter, a slight decrease in yield was noticed in all the clones which remained low till July. The marked reduction in yield during summer months as reported here could be due to low level of soil moisture and high vapour pressure deficits (Sethuraj and George, 1976; Sethuraj and Raghavendra, 1984; Chandrasekhar *et al*., 1990). It is well established that temperature and availability of water are the two major factors influencing growth and yield of rubber plants (Rao *et al*., 1993). This could also be due to low latex flow rate and reduced duration of flow (Devakumar *et al*., 1988). The fall in temperature during October and November stimulates yield as the atmospheric conditions are most ideal for latex flow and production (Priyadarshan *et al*., 2000). Except PB 311, PB 5/51 and PB 260, all other clones yielded high over months under ATR as compared to CT. The clones RRIM 600, RRII 208, RRII 203, PB 235, RRII 118, PB 310 and GT 1 yielded above the average over months under both tapping practices indicating thereby that these clones are more efficient in terms of yield potential for future planting in north east region except PB 235 since the promising clone PB 235 is highly susceptible to powdery mildew disease (Mondal *et al*., 2007b). When the yielding trend of *H. brasiliensis* clones were evaluated at Agartala in Tripura, all the clones exhibited higher yield during

Table 4. **Yield of *H. brasiliensis* clones under two tapping practices during Regime I and Regime II period**

| Clone | Mean yield during Regime I | | Mean yield during Regime II | | Per cent yield under CT over ATR | |
|---|---|---|---|---|---|---|
| | Yield (g/t/t) ATR | Yield(mL/t/t) CT | Yield(g/t/t) ATR | Yield(mL/t/t) CT | Regime I Yield(g/t/t) | Regime II Yield(g/t/t) |
| RRII 105 | 29.4 | 23.9 | 50.5 | 35.4 | -18.7 | -29.0 |
| RRII 118 | 33.0 | 28.5 | 49.8 | 38.9 | -13.7 | -21.9 |
| RRII 203 | 34.6 | 25.1 | 50.5 | 32.3 | -27.5 | -35.4 |
| RRIM 600 | 35.5 | 28.6 | 55.8 | 41.6 | -19.5 | -25.5 |
| RRIM 605 | 25.0 | 21.4 | 46.9 | 34.2 | -14.4 | -27.1 |
| PB 86 | 27.8 | 25.7 | 41.7 | 34.5 | -7.6 | -17.3 |
| PB 235 | 32.3 | 24.7 | 52.3 | 35.1 | -23.6 | -32.9 |
| PB 5/51 | 18.4 | 21.0 | 29.4 | 30.4 | +14.2 | +3.4 |
| GT 1 | 29.5 | 26.6 | 51.3 | 38.7 | -9.9 | -24.6 |
| GI 1 | 20.6 | 18.4 | 33.8 | 28.1 | -10.7 | -16.9 |
| RRIC 102 | 34.3 | 20.0 | 44.7 | 28.5 | -41.7 | -36.3 |
| RRIC 105 | 23.2 | 20.2 | 35.0 | 27.6 | -13.0 | -21.2 |
| RRII 5 | 26.6 | 24.7 | 43.5 | 30.8 | -7.2 | -29.2 |
| RRII 208 | 34.3 | 26.8 | 50.5 | 35.3 | -21.9 | -30.1 |
| PB 260 | 21.3 | 23.8 | 26.9 | 29.8 | +11.8 | +10.8 |
| PB 310 | 34.3 | 31.1 | 45.8 | 37.3 | -9.4 | -18.6 |
| PB 311 | 28.2 | 30.2 | 37.5 | 35.2 | +7.1 | -6.2 |
| PR 255 | 36.5 | 23.4 | 50.8 | 31.5 | -35.9 | -38.0 |
| Mean | 29.2 | 24.7 | 44.3 | 33.7 | -15.5 | -24.0 |

November only (Priyadarshan *et al*., 2000). However, in Assam, all the clones showed two peak yielding periods during May and November. This might be due to difference in macroenvironment factors present in Assam and Tripura.

The yielding pattern of *H. brasiliensis* clones in Assam generally showed two regimes *viz*. low yielding period (February to July) as Regime 1 and high yielding period (August to January) as Regime II. The data on mean rubber yield and latex during Regime I and Regime II and the per cent decrease or increase in yield under CT over ATR during Regime I and Regime II were presented in Table 4. Among the clones evaluated, RRIM 600, RRII 203, RRII 208, PB 310, RRII 118, PB 235 and GT 1 yielded above the average in both the regimes under two tapping practices indicating that these clones were more efficient in yield potential under Assam conditions as compared to other clones.

The yield superiority of a clone is judged by its capacity to maintain a considerable yield levels during stress (John *et al*., 2004). *H. brasiliensis* clones generally exhibit a depression in yield during February to

April, which is the period of refoliation after wintering combining with prominent moisture deficit and during May to July with higher evaporation and wind speeds. The depression in yield during this period varies from clone to clone. Performance of clones during the stress period revealed that clone RRIM 600 to be the best with a mean yield of 35.5 g and 28.6 g under ATR and CT, respectively. Clones *viz*. RRII 203, RRII 208, PB 310, RRII 118, PB 235 and GT 1 were also superior to other clones in terms of yield potential during non-cold season.

Except three clones *viz*. PB 311, PB 260 and PB 5/51 (very low yielder), all other clones showed remarkable decrease in per cent yield under CT over ATR during both regimes. Among the high yielding clones, the highest per cent decrease in yield of dry rubber and latex volume was noticed in RRII 203 during both regimes (27.5 and 35.7% in Regime I and 35.4 and 50.2% in Regime II). The considerable decrease in per cent yield under CT over ATR during both regimes noticed in all high yielding clones suggests the ATR from February to April is economically viable in Assam for high returns from the stand over months.

Mean yield of *H. brasiliensis* clones over years under ATR versus CT are shown in Table 5. Out of 10 clones, an evaluation of yield over 13 years revealed RRIM 600 as

Table 5. **Annual mean yield of *H. brasiliensis* clones under two tapping practices**

| Clone | Annual mean yield (g/t/t) | | Per cent change over mean yield | | Per cent change under CT over annual mean yield |
|---|---|---|---|---|---|
| | ATR | CT | ATR | CT | |
| RRII 105 | 38.8 | 29.7 | + 8.1 | + 1.8 | -23.5 |
| RRII 118 | 40.4 | 33.7 | +12.6 | +15.5 | -16.6 |
| RRII 203 | 41.4 | 28.7 | +15.4 | -1.8 | -30.7 |
| RRIM 600 | 44.6 | 35.1 | +24.3 | +20.2 | -21.3 |
| RRIM 605 | 34.8 | 27.8 | -3.1 | -4.8 | -20.1 |
| PB 86 | 33.9 | 30.1 | -5.6 | +3.1 | -11.2 |
| PB 235 | 41.2 | 29.9 | +14.8 | +2.4 | -27.4 |
| PB 5/51 | 23.3 | 25.7 | -35.1 | -12.0 | +10.3 |
| GT 1 | 39.2 | 32.7 | +9.2 | +12.0 | -16.6 |
| Gl 1 | 26.5 | 23.3 | -26.2 | -20.2 | -12.1 |
| RRIC 102 | 38.9 | 24.3 | +8.4 | -16.8 | -37.5 |
| RRIC 105 | 28.4 | 23.9 | -20.9 | -18.2 | -15.8 |
| RRII 5 | 34.1 | 27.7 | -5.1 | -5.2 | -17.7 |
| RRII 208 | 41.5 | 31.1 | +15.6 | +6.5 | -25.1 |
| PB 260 | 23.8 | 26.8 | -33.7 | -8.3 | +12.6 |
| PB 310 | 39.4 | 34.2 | +9.8 | +17.2 | -13.2 |
| PB 311 | 32.3 | 32.7 | -10.1 | -12.0 | +1.2 |
| PR 255 | 42.9 | 27.5 | +19.5 | -5.9 | -35.9 |
| Mean | 35.9 | 29.2 | - | - | |

the top yielder (44.6 g) in Assam followed by, RRII 203 (41.4 g), PB 235 (41.2 g), RRII 118 (40.4 g), GT 1 (39.2 g) and RRII 105 (38.8 g) in the order of hierarchy under ATR. RRIM 600 as the top yielder in CT followed by RRII 118 (33.7 g), GT 1 (32.7 g), PB 235 (29.9 g), RRII 105 (29.7 g) and RRII 203 (28.3 g). Out of the eight clones in another set of clone trial (Table 5), an evaluation of mean yield over nine years revealed RRII 208 and PB 310 as high yielder in both tapping practices. However, the trend of yield in different clones was always higher in ATR than CT except with three clones (PB 260, PB 5/51 and PB 311). These clones exhibited higher yield in CT than in ATR. Per cent increase in yield of *H. brasiliensis* clones over the average yield under ATR was maximum in RRIM 600 (above 20%) followed by RRII 208, RRII 203, PB 235, RRII 118, PB 310, GT 1 and RRII 105 (Table 5). Under CT, the per cent increase in yield was also maximum in RRIM 600 (above 20 %) followed by PB 310, RRII 118, GT 1, RRII 208, PB 235 and RRII 105 indicating that these clones are having high yield potential and are suitable for Assam. Except in three clones (PB 260, PB 5/51 and PB 311), a per cent decrease in yield under CT over the average yield of ATR was observed in all other clones thereby revealed that ATR is better than CT.

Grouping of *H. brasiliensis* clones based on yield potential was presented in Table 6. RRIM 600 ranked first in terms of yield potential, more than 20% yield over the average yield under both tapping practices. Clones *viz*. RRII 118, RRII 203, PB 235, RRII 208, GT 1, RRII 105 and PB 310 recorded up to 20% more yield than the average under both tapping practices indicating thereby that these clones were also high yielder in Assam. Clones *viz*. RRIM 605, PB 86, RRII 5, PB 311, PB 5/51, Gl 1, RRIC 105 and PB 260 showed below the population average yield under ATR, suggested that these were low yielders.

High incidence of TPD was noticed in most of the *H. brasiliensis* clones under CT as compared to ATR (Table 1). All the high yielders, except RRII 208 showed TPD in the ranges from 3.7 to 6.5% under ATR while

Table 6. **Grouping of *H. brasiliensis* clones based on per cent change over the average yield under two tapping practices**

| Category | ATR | CT |
|---|---|---|
| <0 – 5% | RRII 5, RRIM 600 | RRIM 605, RRII 203 |
| <5 – 10% | PB 311, PB 86 | PR 255, PB 260, RRII 5 |
| <10 – 15% | Nil | PB 311, PB 5/51 |
| <15 – 20% | Nil | RRIC 105, RRIC 102, Gl 1 |
| <20% and above | PB 260, RRIC 105, PB 5/51, Gl 1 | Nil |
| >0 – 5% | Nil | PB 235, PB 86, RRII 105 |
| >5 – 10% | RRII 105, GT 1, RRIC 102, PB 310 | RRII 208 |
| >10 – 15% | RRII 118, PB 235 | GT 1 |
| >15 – 20% | RRII 203, RRII 208, PR 255 | PB 310, RRII 118 |
| >20% and above | RRIM 600 | RRIM 600 |

CT except GT 1 showed TPD in the ranges from 2.2 to 12.9%. Under CT practice, clones GT 1 and RRII 5 did not show any symptoms of TPD over the years. Tapping panel dryness, generally considered to be a physiological disorder associated with excessive exploitation (Chrestin *et al.*, 1985), is reported to occur in varying intensities among clones (Mydin *et al*., 1999).

From the results it was evident that the yielding pattern of *H. brasiliensis* clones in Assam showed a low yielding period during February to July while high yielding period starts from August to January. Yielding trends in different clones was always higher in ATR than in CT. Clones, RRIM 600, RRII 203, RRII 208, PB 310, RRII 118, PB 235 and GT 1 yielded above the average in both the regimes under ATR and CT practices indicating that these clones are more efficient in yield potential under Assam conditions. The considerable decrease in per cent yield under CT over ATR during both regimes noticed in all high yielding clones suggests the ATR from February to April is economically viable for high returns from the rubber trees in Assam.

## ACKNOWLEDGEMENT

The authors are grateful to Dr. Kavitha K. Mydin, Joint Director (Crop Improvement), RRII, Kottayam for valuable suggestions during preparation for the manuscript. Authors also wish to thank Dr. Dhurjati Chaudhuri, Project Coordinator (North East), and Dr. Gitali Das, Deputy Director (RS), Regional Research Station, Guwahati for their support in the study.

## REFERENCES

Chandrasekhar, T. R., Jana, M. K., Thomas, J., Vijayakumar, K. R. and Sethuraj, M. R. (1990). Seasonal changes in physiological characteristics and yield in newly opened trees of *Hevea brasiliensis* in North Konkan. *Indian Journal of Natural Rubber Research*, **3**(2): 88-97.

Chrestin, H., Jacob, J. L. and d'Auzac, J. (1985). Biochemical basis for cessation of latex flow and occurrence of physiological bark dryness. *Proceedings of International Rubber Conference*, Kuala Lumpur, Malaysia, **3**:20-42.

Chua, S. E. (1970). Physiology of foliar senescence and abscission in *Hevea brasiliensis* Muell. Arg., Ph.D. Thesis, University of Singapore.

Devakumar, A. S., Rao, G. G., Rajagopal, R., Rao, P. S., George, M. J., Vijayakumar, K. R. and Sethuraj, M. R. (1988). Studies on soil-plant-atmosphere system in *Hevea*: 2. Seasonal effects on water relations and yield. *Indian Journal of Natural Rubber Research*, **1**(2): 45-60.

Hu, Y. and Haisheng, X. (1985). A study on growth of new plant body and the low of growth and decline of stored matter in the plant body during the sprouting of the first leaf storey of *Hevea*. *Chinese Journal of Tropical Crops*, **6**: 29-38.

John, A., Varghese, Y. A., Mydin, K. K., Sebastian, T., Thomas, V. and Saraswathyamma, C. K. (2004). Performance of certain introduced clones of *Hevea brasiliensis* in India. *Natural Rubber Research,* **17**(2): 115-120.

Mondal, G. C., Sethuraj, M. R., Potty, S. N. and Sinha, R. R. (1998). Influence of wintering pattern on the incidence of *Oidium* SLF disease in different clones of *Hevea* rubber in Assam. *Rubber Board Bulletin*, **27**(3): 18-24.

Mondal, G. C., Das, K., Singh, R. P., Mandal, D., Gupta, C., Gohain, T., Deka, H. K., and Thapliyal, A. P. (1999). Performance of *Hevea* clones in Assam. *Indian Journal of Natural Rubber Research*, **12**(1 & 2): 55-61.

Mondal, G. C., Singh, R. P., Mandal, D., Gohain, T., Chaudhuri, D., Nazeer, M. A. and Nair, R. B. (2007a). Evaluation of yield potential of *Hevea* *brasiliensis* clones over ten years of tapping in Assam. *Natural Rubber Research*, **20**(1 & 2): 32-38.

Mondal, G. C., Deka, H. K. and Chaudhuri, D. (2007b). Reaction of *Hevea brasiliensis* clones against powdery mildew disease in north Eastern region of India. *Natural Rubber Research*, **20**(1 & 2): 90-93.

Mydin, K. K., John, A., Marattukalam, J. G., Saraswathyamma, C. K. and Saraswathy, P. (1999). Variability and distribution of tapping panel dryness in *Hevea brasiliensis*. *Proceedings of IRRDB Symposium,* Breeding and Selection, China, 1999, pp.83-90.

Priyadarshan, P. M., Sowmyalatha, M. K. S., Sasikumar, S., Varghese, Y. A. and Dey, S. K. (1998). Relative performance of six *Hevea brasiliensis* clones during two yielding regimes in Tripura. *Indian Journal of Natural Rubber Research*, **11**(1 & 2): 67-72.

Priyadarshan, 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.

Rao, P. S., Jayarathnam, K. and Sethuraj, M. R. (1993). An index to assess areas hydrothermally suitable for rubber cultivation. *Indian Journal of Natural Rubber Research,* **6**(1 & 2): 80-91.

Sethuraj, M. R. and George, M. J. (1976). Drainage area of the bark and soil moisture content as factors influencing latex flow in *Hevea brasiliensis*. *Indian Journal of Natural Rubber Research*, **19**: 12-14.

Sethuraj, M. R. and Raghavendra, A. S. (1984). The pattern of latex flow from rubber tree (*Hevea brasiliensis*) in relation to water stress. *Journal of Cellular Biochemistry*, **8:** S-236.