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# RESPONSE OF RUBBER TREES (*HEVEA BRASILIENSIS* MUELL. ARG., CLONE RRII 105) TO LOW FREQUENCY TAPPING (LFT) SYSTEMS

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Yield of *Hevea brasiliensis* Müell. Arg. (clone RRII 105) over a period of three years under third daily (d/3), fourth daily (d/4) and weekly (d/7) frequencies of tapping of half spiral cuts with different frequencies of ethephon application (stimulation) were compared with that of unstimulated trees under alternate daily tapping (d/2). Tapping under d/2 frequency was injurious and resulted in yield depression in the third year. Tapping under d/3 frequency with stimulation resulted in high yield of 7382 kg/ha for three years. Comparable yield could be achieved under d/4 frequency of tapping with appropriate stimulation. There was yield depression under weekly tapping in the first two years. In the third year, yield responses under weekly tapping were comparable to those of d/3 and d/4 frequencies of tapping. The low yield under d/7 frequency of tapping in the newly opened trees can be overcome by increased frequency of stimulation. Under d/7 frequency of tapping, maximum response to stimulation was observed when it was done between 48 – 72 h before tapping. Thus the low frequency tapping systems including weekly tapping can be successfully adopted in India without compromising production.

Key words: Ethephon, Exploitation, *Hevea brasiliensis*, Low frequency tapping, Stimulation, Yield.

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## INTRODUCTION

*Hevea brasiliensis* Muell. Arg. (Para rubber) is the most important commercial source of natural rubber (NR). Land productivity of rubber plantation is governed by the genotype of the tree, stand per hectare, intensity of exploitation and many other factors. *Hevea* clones are generally categorized into slow, medium and fast metabolisers (Gohet *et al.*, 1991). Frequency of tapping recommended for medium metabolizing clones like GT 1, and RRIM 600 is alternate daily (Vijayakumar *et al.*, 2001). On account of high incidence of tapping panel dryness (TPD), the frequency of tapping recommended for high yielding fast metabolizing clones like RRII 105, PB 235 and PB 260 is third daily (d/3) (Gohet *et al.*, 1991; Sulochanamma *et al.*, 1993; Vijayakumar *et al.*, 2001).

Gohet *et al.* (1991) reported that productivity of high yielding clones can be further enhanced without any adverse effect by judicious yield stimulation under d/3 frequency of tapping. Under such tapping system, moderate stimulation from the opening onwards does not cause any harmful effect even in the long run. However, for clone RRII 105, the most popular one in India, only limited information is available on stimulation requirement under d/3 frequency of tapping. From block level experiments in clone RRII 105 in different estates, Vijayakumar *et al.* (2001) reported significant and sustainable yield increase from third daily tapping by limited number of stimulations.

Low price of NR and non-availability of skilled tappers have led to attempts to evolve low frequency tapping (LFT) systems such as fourth daily (d/4) and weekly (d/6) with stimulation (Gohet *et al.*, 1991; Sulochanamma *et al.*, 1993; Vijayakumar *et al.*, 2001). Stimulation schedules for d/4 frequency of tapping have been reported for high yielding clones (Gohet *et al.*, 1991; Thanh *et al.*, 1996; Vijayakumar *et al.*, 2001). However, yield reduction was reported under d/6 frequency of tapping (Gohet *et al.*, 1991; Sivakumaran *et al.*, 1993). High yield from d/4 and d/7 frequencies of tapping, with stimulation from long-term block level experiments have been reported in clone RRII 105 (Vijayakumar *et al.*, 2001). However, poor yield was observed under weekly tapping in the initial years of exploitation (RRII, 1994).

Results of the experiments laid out in 1997, with clone RRII 105 to compare yield performance under different frequencies of tapping and stimulation are reported here.

## MATERIALS AND METHODS

Three experiments were carried out in the Experimental Farm Unit (EFU) of Rubber Research Institute of India located at Kottayam, Kerala (9° 32′ N; 76° 36′E) with clone RRII 105 planted in 1989. Average stand of trees was 450 per ha.

### Experiment 1 : Effect of different frequencies of tapping and stimulation on yield

The experiment was laid out in newly opened trees in 1997. There were ten treatments comprising d/2, d/3, d/4 and d/7 frequencies of tapping of half spiral cuts and different frequencies of stimulation. The experiment had randomized block design with five replications comprising 15 trees per replication. Yield stimulation was done by applying 2.5 per cent ethephon (2-chloro-ethyl phosphonic acid; 17.5 a.i. mg/tree) on the panel (Rajagopal *et al.*, 2000). The treatments are given below :

T0 - 1/2S d/2 6d/7 (control)
T1 - 1/2S d/3 6d/7. ET2.5%. Pa. 3/y
T2 - 1/2S d/3 6d/7. ET2.5%. Pa. 4/y
T3 - 1/2S d/3 6d/7. ET2.5%. Pa. 5/y
T4 - 1/2S d/4 6d/7. E2.5%. Pa. 5/y
T5 - 1/2S d/4 6d/7. ET2.5%. Pa. 7/y
T6 - 1/2S d/4 6d/7. ET2.5%. Pa. 9/y
T7 - 1/2S d/6 6d/7. ET2.5% Pa. 10/y
T8 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y
T9 - 1/2S d/6 6d/7. ET2.5%. Pa. 15/y

The trees were rainguarded and tapped throughout the year. Other cultural practices were followed as per the package of practices recommendations. Yield was recorded from all the tappings as latex and scrap separately. Dry rubber content (DRC) was determined gravimetrically. Dry rubber yield was calculated by converting latex weight proportionate to the DRC and scrap weight based on 60 per cent DRC. Tapping panel dryness (TPD) in the entire tapping cut was recorded in the third year.

### Experiment 2. Effect of different frequencies of stimulation on newly opened trees under weekly tapping.

The experiment was carried out in newly opened trees (clone RRII 105) with completely randomized single tree single plot design consisting 40 trees in each treatment. The trees were tapped under half-spiral system with two tapping frequencies, *viz.* d/3 and d/7. Under d/7 frequency of tapping, stimulations were given at different frequencies (weekly, once in 10 days, fortnightly and monthly). Details of the treatments are given below:

T1 - 1/2S d/3 6d/7
T2 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y
T3 - 1/2S d/6 6d/7. ET2.5%. Pa. 24/y
T4 - 1/2S d/6 6d/7. ET2.5%. Pa. 36/y
T5 - 1/2S d/6 6d/7. ET2.5%. Pa. 48/y

Tapping was commenced in January 2000. Dry rubber yield (g/tree/tap) was

recorded by cup coagulation (50% DRC) on all tapping days.

**Experiment 3. Effect of different intervals between stimulation and tapping on yield performance under weekly tapping**

To find out the optimum interval between stimulation and tapping under d/7 frequency, a single tree single plot experiment with completely randomized design (CRD) was laid out in newly opened trees of clone RRII 105. Intervals between stimulation (panel application) and tapping were 2, 3, 4, 5 and 6 days respectively. The treatments are given below:

T1 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y (Two days before tapping)

T2 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y (Three days before tapping)

T3 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y (Four days before tapping)

T4 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y (Five days before tapping)

T5 - 1/2S d/6 6d/7. ET2.5%. Pa. 12/y (Six days before tapping)

Yield (g/tree/tap) was recorded as cup lumps on all tapping days.

## RESULTS

Annual yield from different tapping frequencies and different intensity of stimulation are presented in Table 1. In the first year of tapping, during 1997-1998, yield obtained from unstimulated alternate daily tapping was 1810 kg/ha. Under d/3 frequency of tapping, yield responses from the three frequencies of stimulation were similar and ranged from 1805 to 1967 kg/ha, and these were comparable to the yield obtained from alternate daily tapping. In the case of d/4 frequency of tapping, 7 and 9 stimulations per year gave comparable yield responses to that of alternate daily tapping. Yield obtained with five stimulations per year was significantly lower. Under d/7 frequency of tapping, yield from all the three frequencies of stimulation were low. However, there was increasing trend with increasing number of stimulations.

During the second year (1998-99) there was considerable increase in yield. Yield obtained from alternate daily tapping was 2817 kg/ha. Yield from third daily tapping with 3, 4 and 5 stimulations per year were similar and comparable to that obtained from d/2 frequency of tapping. With seven or nine stimulations per year, similar yield could be achieved from d/4 frequency tapping also. In the case of d/7 frequency of tapping, yield continued to be lower in the second year also. However, with 15 stimulations per year, the yield obtained was comparable to the yield obtained from d/4 frequency of tapping with different frequencies of stimulation.

Table 1. **Effect of tapping and stimulation frequency on yield (kg/ha) of clone RRII 105 (Panel BO-1)**

| Treatment | 1997-1998 * | 1998-1999** | 1999-2000+ | 1997-2000++ |
|---|---|---|---|---|
| T0 - 1/2S d/2 6d/7. (control) | 1810 ab | 2817 a | 2085 b | 6712 abc |
| T1 - 1/2S d/3 6d/7. ET 2.5%. Pa. 3/y | 1919 ab | 2590 ab | 2602 a | 7112 ab |
| T2 - 1/2S d/3 6d/7. ET 2.5%. Pa. 4/y | 1805 ab | 2880 a | 2809 a | 7495 a |
| T3 - 1/2S d/3 6d/7. ET 2.5%. Pa. 5/y | 1967 a | 2829 a | 2743 a | 7539 a |
| T4 - 1/2S d/4 6d/7. ET 2.5%. Pa. 5/y | 1420 cde | 2386 bc | 2589 a | 6394 bcd |
| T5 - 1/2S d/4 6d/7. ET 2.5%. Pa. 7/y | 1739 abc | 2498 abc | 2395 ab | 6632 abc |
| T6 - 1/2S d/4 6d/7. ET 2.5%. Pa. 9/y | 1618 bcd | 2578 ab | 2606 a | 6801 abc |
| T7 - 1/2S d/6 6d/7. ET 2.5%. Pa. 10/y | 1170 e | 2148 cd | 2581 a | 5900 cd |
| T8 - 1/2S d/6 6d/7. ET 2.5%. Pa. 12/y | 1268 e | 1931 d | 2458 ab | 5657 d |
| T9 - 1/2S d/6 6d/7. ET 2.5%. Pa. 15/y | 1361 de | 2264 bcd | 2652 a | 6277 bcd |

Values followed by same letter/s are not significantly different from each other.

* LSD (P = 0.05) = 328 ** LSD (P = 0.05) = 405 + LSD (P = 0.05) = 465 ++ LSD (P = 0.05) = 940

Yield response in all treatments, except alternate daily tapping frequency were comparable in the third year (1999-2000). During the year there was decline in yield under d/2 frequency of tapping. Under d/3 and d/4 frequencies of tapping, with different frequencies of stimulation, yield responses were comparable to responses obtained in the second year. In the case of weekly tapping, there was considerable increase in yield during the third year under all frequencies of stimulation.

Cumulative yield for three years from d/3 frequency of tapping with different frequencies of stimulation gave comparable yield and ranged from 7112 to 7539 kg/ha. Under d/4 frequency of tapping, stimulation frequencies of seven and nine per year gave yield responses of 6632 and 6801 kg/ha. Cumulative yield obtained from d/7 frequency of tapping with different stimulation schedules were significantly lower and ranged from 5900 to 6277 kg/ha.

Mean dry rubber yield per tapping (kg/400 trees) and number of tapping days for each year during the study period under different tapping and stimulation treatments are presented in Table 2. In the first year, yield per tapping ranged from 10.9 kg (1/2S d/2 6d/7) to 25.2 kg (1/2S d/6 6d/7 with 15 stimulations per year). There was considerable increase in yield per tapping during the second year. The values ranged from 18.6 kg in the case of d/2 frequency of tapping to 40.7 kg in the case of d/7 frequency of tapping with 15 stimulations per year. During the third year, yield per tapping from alternate daily tapping showed only small increase. With lower frequencies of tapping, there was greater increase in yield per tap, the increase being maximum under weekly tapping.

Variation in mean monthly yield per tapping from d/3, d/4 and d/7 frequencies with five, nine and 15 annual stimulations per year respectively, during the third year, are presented in Fig. 1. Highest yield per tapping (84 kg/400 trees) was observed during July in trees tapped under weekly frequency with 15 annual stimulations. In the case of d/2 frequency of tapping, mean yield per tapping in the corresponding month was 28.7 kg. Yield under d/3 and d/4 frequencies of tapping was between the values under d/2 and d/7 frequencies. In all the cases high yield was observed in the months of June, July and August. In all frequencies, except in weekly tapping, there was subsequent decline with a minor peak in October. In general, weekly tapped trees showed higher yield per tapping, followed by trees under d/4 and d/3 frequencies of tapping. Alternate daily tapped trees showed the lowest per tap yield throughout the year.

Table 2. **Effect of tapping and stimulation frequency on yield per tapping (kg/400 trees) in clone RRII 105 (Panel BO-1)**

| Treatment | 1997-1998 * | | 1998-1999** | | 1999-2000 + | |
|---|---|---|---|---|---|---|
| T0 - 1/2S d/2 6d/7. (control) | 10.9 f | (148) | 18.6 h | (144) | 19.3 g | (128.6) |
| T1 - 1/2S d/3 6d/7. ET 2.5%. Pa. 3/y | 18.0 cde | (95) | 25.1 g | (96.4) | 30.2 f | (86.8) |
| T2 - 1/2S d/3 6d/7. ET 2.5%. Pa. 4/y | 16.9 e | (95) | 27.1 efg | (96.2) | 31.3 ef | (86.2) |
| T3 - 1/2S d/3 6d/7. ET 2.5%. Pa. 5/y | 18.4 cde | (95) | 26.7 fg | (96.2) | 33.3 ef | (86.8) |
| T4 - 1/2S d/4 6d/7. ET 2.5%. Pa. 5/y | 17.5 de | (72) | 30.3 def | (72.6) | 41.0 cd | (65.6) |
| T5 - 1/2S d/4 6d/7. ET 2.5%. Pa. 7/y | 21.5 abcd | (72) | 31.8 cde | (72.6) | 36.4 de | (67.2) |
| T6 - 1/2S d/4 6d/7. ET 2.5%. Pa. 9/y | 20.0 bcde | (72) | 34.2 bcd | (72.2) | 41.9 bc | (66.4) |
| T7 - 1/2S d/6 6d/7. ET 2.5%. Pa. 10/y | 21.7 abc | (48) | 38.0 ab | (50.6) | 49.1 a | (50.6) |
| T8 - 1/2S d/6 6d/7. ET 2.5%. Pa. 12/y | 23.5 ab | (48) | 35.3 bc | (51.6) | 46.9 ab | (51.6) |
| T9 - 1/2S d/6 6d/7. ET 2.5%. Pa. 15/y | 25.2 a | (48) | 40.7 a | (52.0) | 50.3 a | (52.0) |

Values followed by same letter/s are not significantly different from each other.
Figures in parentheses indicate number of tapping days.
* LSD (P = 0.05) = 3.9 ** LSD (P = 0.05) = 4.7 + LSD (P = 0.05) = 5.4

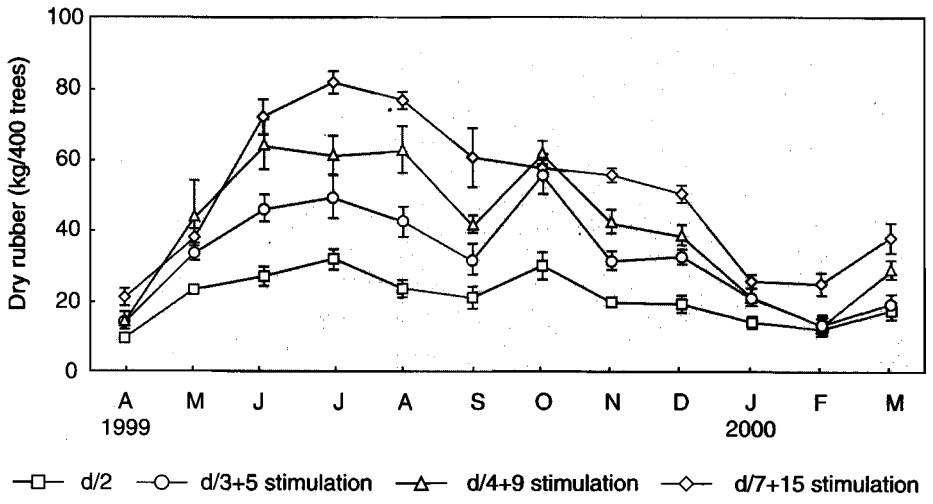


Fig. 1. Mean monthly yield per tapping under different tapping and stimulation frequencies in clone RRII 105 in the third year of tapping (Vertical bars represent SE, n=5)

Data on yield per tree (excluding TPD affected trees) is presented in Table 3. In the first year, trees tapped under d/2 and d/3 frequencies gave comparable yield. Trees tapped once in four days with five annual stimulations showed lower yield. However, with seven and nine stimulations per year, yield obtained was higher compared to the yield obtained from alternate daily tapping. Yield from d/7 frequency of tapping was very low. During the second year, there was considerable increase in yield per tree. Relative performance of the treatments was comparable to that of the first year. In the third year, yield per tree declined under alternate daily tapping. However, under lower frequencies, yield per tree continued to show increase in the third year also, the increase being maximum under weekly tapping.

Incidence of tapping panel dryness (TPD) in the third year is presented in Table 4. In general, the incidence was high and ranged from 7.7 per cent in weekly tapped trees with 10 stimulations per year to 25 per cent in alternate daily tapped trees.

Data on the effect of high frequency stimulation on yield performance of newly

Table 3. **Effect of tapping and stimulation frequency on per tree yield (kg) in clone RRII 105 (Panel BO-1)**

| Treatment | 1997-1998 * | 1998-1999** | 1999-2000+ | Mean++ |
|---|---|---|---|---|
| T0 - 1/2S d/2 6d/7. (control) | 4.023 ab | 6.688 a | 6.180 b | 5.630 abc |
| T1 - 1/2S d/3 6d/7. ET 2.5%. Pa. 3/y | 4.265 ab | 6.055 abcd | 6.548 ab | 5.623 abc |
| T2 - 1/2S d/3 6d/7. ET 2.5%. Pa. 4/y | 4.013 ab | 6.518 ab | 6.745 ab | 5.758 ab |
| T3 - 1/2S d/3 6d/7. ET 2.5%. Pa. 5/y | 4.370 a | 6.423 ab | 7.228 a | 6.007 a |
| T4 - 1/2S d/4 6d/7. ET 2.5%. Pa. 5/y | 3.155 cde | 5.488 cde | 6.723 ab | 5.122 cd |
| T5 - 1/2S d/4 6d/7. ET 2.5%. Pa. 7/y | 3.865 abc | 5.770 bcd | 6.118 b | 5.251 bcd |
| T6 - 1/2S d/4 6d/7. ET 2.5%. Pa. 9/y | 3.595 bcd | 6.168 abc | 6.950 ab | 5.571 abc |
| T7 - 1/2S d/6 6d/7. ET 2.5%. Pa. 10/y | 2.600 e | 4.808 ef | 6.210 b | 4.539 e |
| T8 - 1/2S d/6 6d/7. ET 2.5%. Pa. 12/y | 2.818 e | 4.550 f | 6.043 b | 4.470 e |
| T9 - 1/2S d/6 6d/7. ET 2.5%. Pa. 15/y | 3.023 de | 5.288 def | 6.540 ab | 4.950 de |

Values followed by same letter/s are not significantly different from each other
* LSD (P = 0.05) = 0.727 ** LSD (P = 0.05) = 0.810
+ LSD (P = 0.05) = 0.887 ++ LSD (P = 0.05) = 0.582

Table 4. **Effect of tapping and stimulation frequency on the incidence of tapping panel dryness in clone RRII 105 (Panel BO-1).**

| Treatment | TPD (%) | |
|---|---|---|
| T0 - 1/2S d/2 6d/7. (control) | 25.1 | a |
| T1 - 1/2S d/3 6d/7. ET 2.5%. Pa. 3/y | 11.6 | b |
| T2 - 1/2S d/3 6d/7. ET 2.5%. Pa. 4/y | 7.4 | b |
| T3 - 1/2S d/3 6d/7. ET 2.5%. Pa. 5/y | 15.3 | ab |
| T4 - 1/2S d/4 6d/7. ET 2.5%. Pa. 5/y | 14.0 | b |
| T5 - 1/2S d/4 6d/7. ET 2.5%. Pa. 7/y | 13.1 | b |
| T6 - 1/2S d/4 6d/7. ET 2.5%. Pa. 9/y | 16.2 | ab |
| T7 - 1/2S d/6 6d/7. ET 2.5%. Pa. 10/y | 7.7 | b |
| T8 - 1/2S d/6 6d/7. ET 2.5%. Pa. 12/y | 9.2 | b |
| T9 - 1/2S d/6 6d/7. ET 2.5% .Pa. 15/y | 9.7 | b |

Values followed by same letter/s are not significantly different from each other

* LSD (P 3 ≤ 0.05) = 10.78

opened trees under d/7 frequency (January – October 2000) is presented in Fig. 2. Significant increase in yield from weekly tapped trees could be achieved by increasing the frequency of stimulation. Compared to monthly stimulation, weekly stimulation resulted in higher response. Stimulation at 10 day and fortnightly intervals also resulted in significantly higher yield comparable to the yield from unstimulated d/3 frequency of tapping.

Effect of different intervals between stimulation and tapping on yield performance of newly opened weekly tapped trees (January – October 2000) is shown in Fig. 3. Maximum response to stimulation was observed when it was done two or three days prior to tapping. At higher intervals between stimulation and tapping the response was significantly lower.

## DISCUSSION

Present study shows that low frequency tapping systems can be successfully done in India. It was observed that alternate daily tapping, affects production adversely in the long run. Earlier studies in West Africa have shown that mild stimulation under d/3 frequency of tapping, from opening onwards increases production in many clones without adverse effects (Gohet *et al.*, 1991). Alternate daily tapping was less productive. Data presented here for clone RRII 105 is in agreement with the above findings. Poor productivity in clone RRII 105 under d/2 frequency tapping, after high yield in the initial years, was reported earlier (Sulochanamma *et al.*, 1993). This study shows that comparable or higher yield can be obtained by third daily tapping (1/2S d/3 6d/7) with three stimulations per year than that from d/2 frequency of tapping.

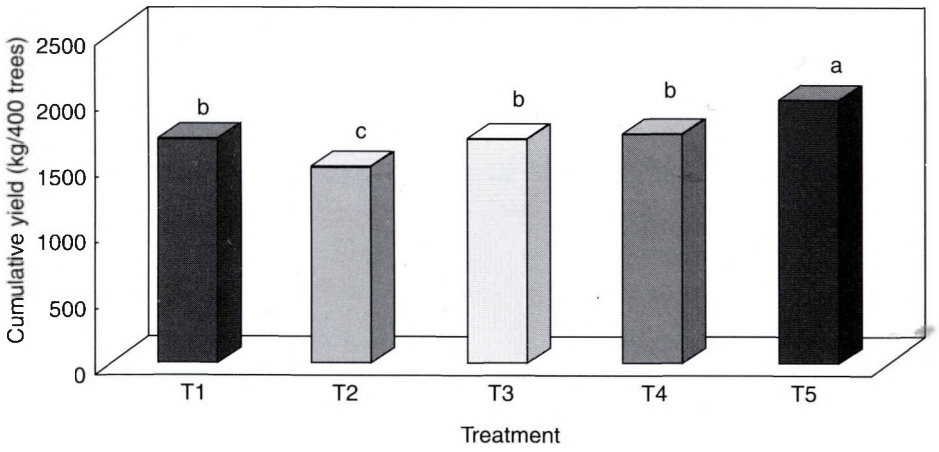


Fig. 2. Yield response of weekly tapped newly opened trees (clone RRII 105) to different frequencies of stimulation (Bars sharing the common letter/s do not differ significantly at P<0.05, LSD =179)

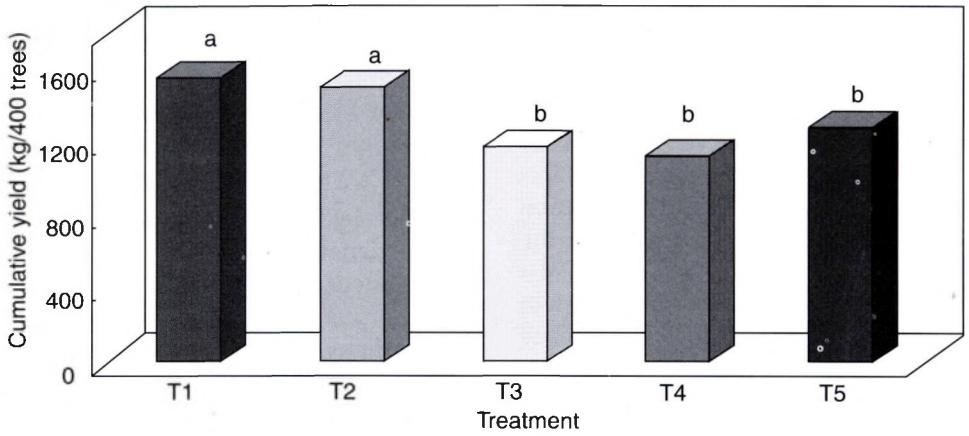


Fig. 3. Effect of intervals between stimulation and tapping on the yield performance of weekly tapped newly opened trees of clone RRII 105 (Bars sharing the common letter/s do not differ significantly at P≤0.05, LSD = 203)

Though this report is only for three years, other studies conducted by Rubber Research Institute of India have shown that three to four stimulations per year under d/3 frequency of tapping gives consistently higher yield, with stable response, for longer periods (Vijayakumar *et al.*, 2001). Data for the third year of tapping indicates that the differences in yield between alternate daily tapping and lower frequencies of tapping are likely to increase further.

Yield reduction under d/2 frequency of tapping in the third year is associated with high incidence of TPD (Table 3). Under alternate daily tapping, clone RRII 105 is more susceptible to TPD than medium metabolizing clones like GT 1 (Vijayakumar *et al.*, 1990; Sulochanamma *et al.*, 1993). In the present study, relatively higher incidence of TPD was observed in trees under lower frequencies of tapping also. Such higher incidence under low frequency tapping has been reported earlier (Eschbach, 1986). Part of the incidence might be due to disease as reported by Lukman (1989). Decrease in yield per tree under d/2 frequency of tapping (Table 4) also indicates tapping stress. However, the marginal increase in yield per tapping observed during the third year is due to reduction in number of tapping days (Table 2). Under third daily tapping, there was increase in per tree and per tapping yield in the third year also. This indicates absence of tapping stress.

Good yield performance is observed under d/4 frequency of tapping with stimulation (Table 1). Reports from West Africa (Gohet *et al.*, 1991) and Malaysia (Thanh *et al.*, 1996) show similar results under fourth daily tapping. Ongoing estate trials in India (Vijayakumar *et al.*, 2001) started in 1995 show similar results. However, Zarin *et al.* (1991) reported poor yield performance in many clones under d/4 frequency of tapping with stimulation. Present data shows requirement of around seven stimulations per year for clone RRII 105 under fourth daily tapping. Considerable yield increase in third year indicates the absence of stress. This is further evidenced by the lower incidence of TPD (Table 4).

Present study shows that tapping at d/7 frequency with appropriate stimulation schedule can result in production of crop comparable to the that under d/3 and d/4 frequencies of tapping (Table 1). Lower yield under weekly tapping in the initial years

reported here is in agreement with earlier observations (Abraham, 1984; RRII, 1994). Unlike the earlier report (RRII, 1994), in the experiment reported here, good yield performance was obtained from weekly tapping as early as third year itself. This might be due to the insufficient stimulation (2.5% of lace application) adopted in the earlier experiment (RRII, 1994). In West Africa and Malaysia, weekly tapping system did not result in satisfactory yield response even in subsequent years (Gohet *et al.*, 1991; Zarin *et al.*, 1991, Sivakumaran *et al.*, 1993). Low yield performance in the first and second year, from d/7 frequency of tapping indicates requirement of higher frequencies of stimulation during this period. Experiment conducted with higher frequencies of stimulation in the first year of opening, confirms the above hypothesis (Fig. 1). Such observation was not reported so far. These observations are contrary to the general belief that newly opened trees should be given only mild stimulation. Requirement of high frequency stimulation can be ascribed to low stability of latex in the initial years (Koshy, 1997). Higher frequency of stimulation is needed for attaining increased stability of latex. The present study indicates that under weekly tapping,15 stimulations per year do not result in any adverse effect (Table 1). Results show that fortnightly stimulation in the initial years would be optimal for weekly tapping. Optimum yield response from weekly tapping obtained by stimulation between 48 and 72 hours before tapping is in agreement with earlier reports (Sivakumaran and Hashim, 1985). Results show that unlike in other countries, weekly tapping can be successfully carried out in India. This can be ascribed to regular tapping, which is possible because of rainguarding of the tapping panels, a practice followed in India. For d/7 frequency of tapping, it is proposed that fortnightly stimulation may be adopted in the initial years followed by monthly stimulation in the later years. Suitability of monthly stimulation from third year onwards for clone RRII 105 was reported earlier (Vijayakumar *et al.*, 2001).

High yield per tapping observed under low frequency of tapping indicates the need for delayed or additional collection for reducing scrap production. However, data on monthly variation in yield per tap show that second collection need not be done in all months (Fig. 1). Effectiveness of panel application of 2.5 per cent ethephon observed in these studies confirms possible saving in cost of stimulation as reported earlier (Rajagopal *et al.*, 2000).

## CONCLUSIONS

Present studies confirm the adverse response to alternate daily tapping in clone RRII 105. The yield can be substantially increased by three to four stimulation under d/3 frequency of tapping without any adverse effect. Fourth daily (d/4) and weekly (d/7) tapping can be successfully done with appropriate stimulation intensities, provided tapping is done regularly. For d/4 frequency of tapping, seven stimulations per year would be optimum. Under d/7 frequency of tapping, fortnightly stimulation in the first two years followed by monthly stimulation in the subsequent years can be adopted. Under d/7 frequency, stimulation may be done two or three days before tapping. In high yielding clones like RRII 105, low frequency tapping systems combined with judicious stimulation can reduce the cost of production of NR by reducing in tapping cost, maximizing production and increasing in economic life.

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