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YIELD PERFORMANCE OF CLONE RRII 105 UNDER LOW FREQUENCY TAPPING IN BO-2 AND BI-1 PANELS

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In India, cost of production of natural rubber is high due to undulating topography, less favorable agroclimate and additional cultural practices. Reduction in cost of production by adopting low frequency tapping (LFT) with judicious application of yield stimulants like Ethephon is one of the approaches to make rubber cultivation more cost effective. An experiment was laid out in the Experimental Farm Unit of Rubber Research Institute of India, Kottayam, Kerala to compare the long term yield response of clone RRII 105 to low frequency tapping in BO-2 and BI-1 panels. Cumulative dry rubber yield over eight years under d3 and d4 tapping frequency with stimulation is comparable to unstimulated alternate daily tapping (d2). There was no reduction in yield from the renewed bark compared to virgin BO-2 panel. Total tapping days during the study period for d2, d3 and d4 frequencies of tapping were 1149, 780 and 598 days, respectively. Thus by adopting d3 and d4 frequencies of tapping, requirement of tappers can be reduced by 32% and 48% respectively, compared to alternate daily (d2) tapping. Benefits of adopting LFT are sustainable high yield and extended period of tapping on the same panel leading to longer economic life of rubber trees. Adoption of LFT is also expected to reduce the impact of the scarcity of skilled tappers in rubber plantation sector.

Keywords: Ethephon, *Hevea brasiliensis*, Low frequency tapping, Stimulation, Yield

INTRODUCTION

Hevea brasiliensis Muell. Arg. (Para rubber) is the most important source of natural rubber (NR). India holds the fourth position in NR production and productivity in India is the highest in recent years. Land productivity of rubber plantation is governed by factors like clone, stand per hectare and intensity of tapping practices *etc.* The recent increase in NR price has brought bright hope to the rubber industry. However, increase in the cost of production and shortage of skilled tappers haunting the NR industry in India. In some other Asian countries tapping alone accounts for more than 70% of the cost of production of NR (Vijayakumar *et al*., 2005). India and other rubber growing countries are facing shortage of skilled tappers and this problem is likely to aggravate in future. In such situations, grower has to pay very high wages to attract the tappers or they leave the trees untapped. Increase in cost of production and unavailability of skilled

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tappers have led to practice low frequency tapping, such as third daily (d3), fourth daily (d4) and weekly (d6) tapping with different frequencies of stimulation in India (Karunaichamy *et al*., 2001; Vijayakumar *et al*., 2002).

Increasing labour productivity by adopting low frequency tapping with yield stimulation (ethephon) is an important approach to reduce the cost of production (Gohet *et al*., 1991; Vijayakumar *et al*., 2001; Karunaichamy *et al*., 2001). Earlier reports had also shown good yield response of rubber clones to less labour input tapping systems with ethephon application (Sivakumaran and Chong, 1994; Nugawela *et al*., 1997; Thanh *et al*., 1996). On account of high incidence of tapping panel dryness (TPD), associated with high intensity tapping, alternate daily tapping (d2) is not recommended in rubber plantations and only third daily tapping (d3) is recommended in high yielding clones like RRII 105 and PB 235 (Vijayakumar *et al*., 2001). Productivity of high yielding clones can be further enhanced without any adverse effect by judicious yield stimulation under third daily tapping. In India, significant and sustainable yield increase was achieved in RRII 105 under third daily tapping (d3) by judicious application of ethephon from the opening onwards without any harmful effect in the long run (Vijayakumar *et al*., 2001, Karunaichamy *et al*., 2001; Rajagopal *et al*., 2004).

An experiment was therefore laid out in 1997, with clone RRII 105 in the Experimental Farm Unit of Rubber Research Institute of India to compare the long term yield response in virgin (BO-2) and renewed (BI-1) tapping panel under different tapping frequencies and stimulation.

MATERIALS AND METHODS

The experiment was carried out in the Experimental Farm Unit (EFU) of Rubber Research institute of India located at Kottayam, Kerala ($9^0$32'N; $76^0$36'E) to compare the long term yield response of the clone RRII 105 under low frequency tapping in BO-2 and BI-1 panel. Average stand per hectare was 450 trees. There were seven treatments comprising d2, d3 and d4 frequencies of tapping of half spiral cuts and different frequencies of stimulation. The experiment was laid out in randomized block design (RBD) with five replications and each replication comprised of 25 trees (125 trees/treatment). Yield stimulation was carried out by applying 2.5% ethephon (2-Chloro-ethyl-phosphonic acid; 17.5 mg active ingredient/tree) on the panel (Rajagopal *et al*., 2000). The treatment details (T0 to T6) are given below as per the new tapping notations (Vijayakumar *et al*., 2009).

T0 – S/2 d2 6d/7 (Control)

T1 – S/2 d3 6d/7. ET2.5% Pa1(1.5) 3/y*

T2 – S/2 d3 6d/7. ET2.5% Pa1(1.5) 4/y*

T3 – S/2 d3 6d/7. ET2.5% Pa1(1.5) 5/y*

T4 – S/2 d4 6d/7. ET2.5% Pa1(1.5) 5/y*

T5 – S/2 d4 6d/7. ET2.5% Pa1(1.5) 7/y*

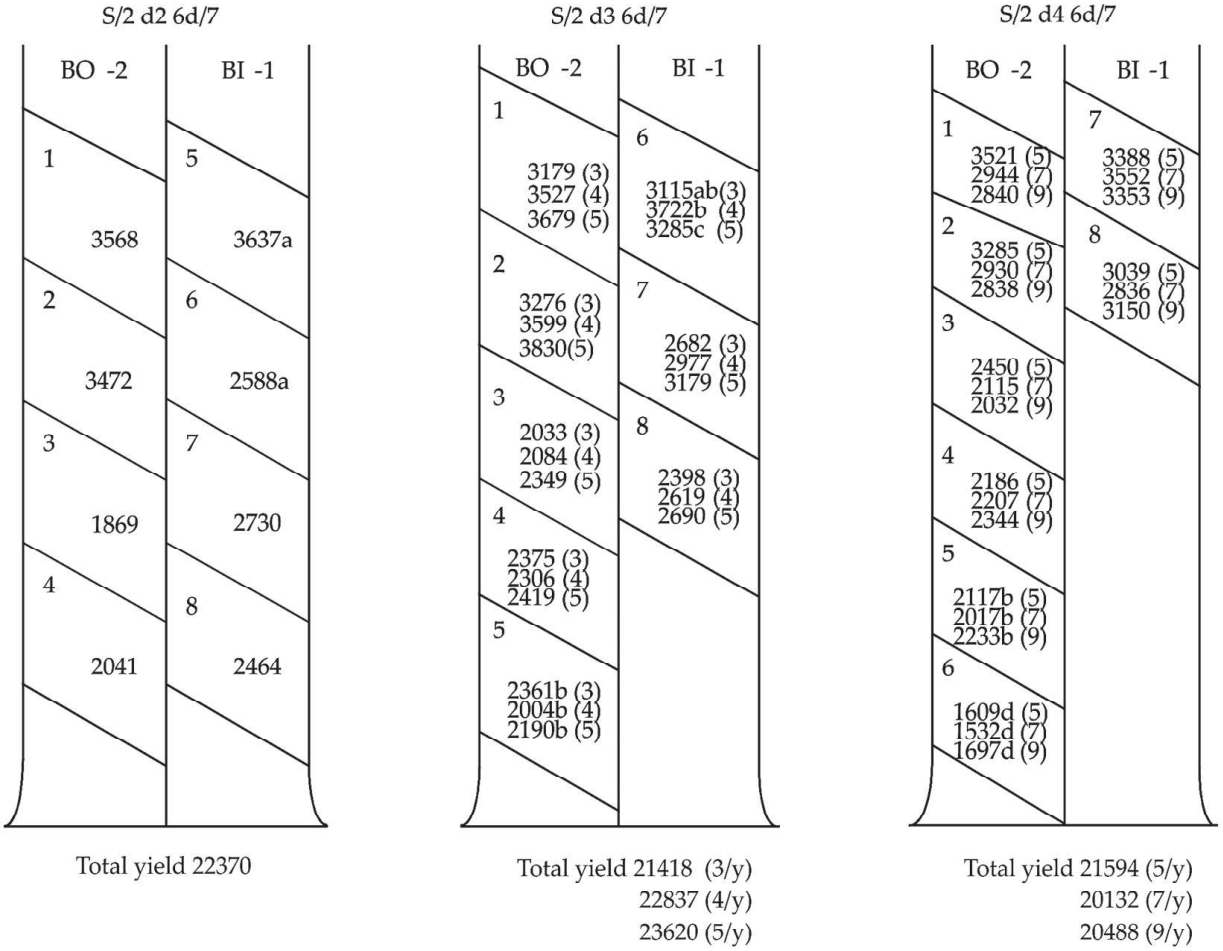
T6 – S/2 d4 6d/7. ET2.5% Pa1(1.5) 9/y*

All the experimental trees were rainguarded and tapped throughout the year without giving any tapping rest. All the cultural practices were as per the standard package of practices (Rubber Board, 2010). Yield from each replicate was recorded as latex and scrap separately for all tappings. Dry rubber yield was arrived at by converting latex weight proportionate to the dry rubber content (d.r.c) and scrap weight

based on 60% d.r.c. All the data collected were analysed statistically and means are presented with least significant difference (LSD). Data on yield and other parameters are presented for the period from April 1997 to March 2005.

RESULTS AND DISCUSSION

Annual dry rubber yield (kg/ha) for eight years (1997 to 2005) under different tapping frequencies and varying levels of stimulation are statistically analyzed and presented in Fig.1. Yield under third daily tapping (d3) and fourth daily tapping (d4) frequencies were comparable to that of d2 tapping (Table 1). In India, estate trials started in 1995 were also showed similar results (Vijayakumar *et al.*, 2002). In the present study, BI-1 panel was opened in the 5th year under d2, 6th year under d3 and 7th year under d4 frequencies with high yield compared to previous year tapping on BO-2 panel (Fig.1). During the panel change, very high yield was obtained due to the



Values followed by same letters are not critically different from each other.
LSD (P=0.05) 1, 2, 3, 4, 7& 8 years are NS; 5th year- 467 and 6th year- 460 NS- Not Significant

Fig. 1. Yield performance (kg/ha) of clone RRII 105 under different tapping frequencies on the BO-2 and BI-I panel over eight years of tapping. Values in parenthesis are number of stimulations per year

Table 1. **Mean yield (eight years) and other parameters of clone RRII 105 tapped in BO-2 and BI-1 panels under different frequencies of tapping and stimulation.**

Treatments	Yield (Kg/ha)	Kg/tap	Kg/tree	BO-2 panel Yield (Kg/cm)	DRC (%)	Number of tappings
T0- S/2(RG) d2 6d/7. (Control)	2796	22.7 d	8.2 a	91.3	38.3 c	144
T1- S/2(RG) d3 6d/7. ET 2.5% Pa1(1.5) 3/y*	2677	31.1 c	7.6 ab	110.2	39.5 b	98
T2- S/2(RG) d3 6d/7. ET 2.5% Pa1(1.5) 4/y*	2855	33.2 bc	8.1 abc	112.7	38.6 c	98
T3- S/2(RG) d3 6d/7. ET 2.5% Pa1(1.5) 5/y*	2953	32.1 bc	7.8 abc	120.6	38.5 c	97
T4- S/2(RG) d4 6d/7. ET 2.5% Pa1(1.5) 5/y*	2699	38.1 a	7.1 bc	126.4	40.4 a	75
T5- S/2(RG) d4 6d/7. ET 2.5% Pa1(1.5) 7/y*	2517	36.5 ab	6.8 c	114.5	39.9 ab	75
T6- S/2(RG) d4 6d/7. ET 2.5% Pa1(1.5) 9/y*	2561	37.7 a	7.1 c	116.5	39.4 b	75
LSD (P=0.05)	**NS**	**4.5**	**0.9**	**-**	**0.6 -**	

Within the column, values followed by same letters are not stastistically different from each other;
NS- Not Significant

extension of drainage area on the panel. Similar results of higher yield after panel change (BO-2) was reported earlier in other rubber clones and in clone RRII 105 (Thanh *et al*., 1998; Rajagopal *et al*., 2004; 2005; Karunaichamy *et al*., 2008). Low yield noticed during last year tapping on BO-2 panel may be associated with proximity of tapping cut to bud union. It is evident that there was resurgence in yield during the first year of tapping in panel BI-1 in all frequencies after the panel changed over from BO-2.

The cumulative dry rubber yield obtained in d3 with three stimulations per year and d4 with five stimulations per year were 96% and 97% of d2 frequency of tapping (Fig. 1). Cumulative yield over eight years from low frequency tapping system with stimulation is comparable to unstimulated alternate daily tapping. Reports from Malaysia on low intensity tapping system (LITS) indicated that, it would be profitable if break-even yield of 90% of that of alternate daily tapping are obtained (Pee and P'Ng, 1970; Nayagam *et al*., 1986). Considering the overall effect, d3 and d4 frequencies of tapping resulted in 25% and 31% cumulative yield increase in BO-2 panel over d2 system of tapping (Figs. 2 and 3). Rubber yield per unit length (kg/cm) in BO-2 panel was also higher under LFT (Table 1). Prolonged latex flow in stimulated trees may be due to large extension of drainage area on the panel (Pakianathan *et al*., 1976). During second year in BI-1 panel under d2, d3 with three stimulation and d4 with five stimulation frequencies of tapping, the yield was lowered by 29%, 14% and 10%, respectively (Fig.1). Use of ethephon under low frequency tapping (LFT) at recommended level is to compensate the potential yield loss due to enhanced interval between tappings. The present study shows that sustainable yield can be achieved under LFT with yield stimulation. There was no reduction in yield from the renewed bark compared to virgin panel (BO-2).

The mean annual number of tapping days under d2, d3 and d4 frequencies of tapping was 144, 98 and 75, respectively

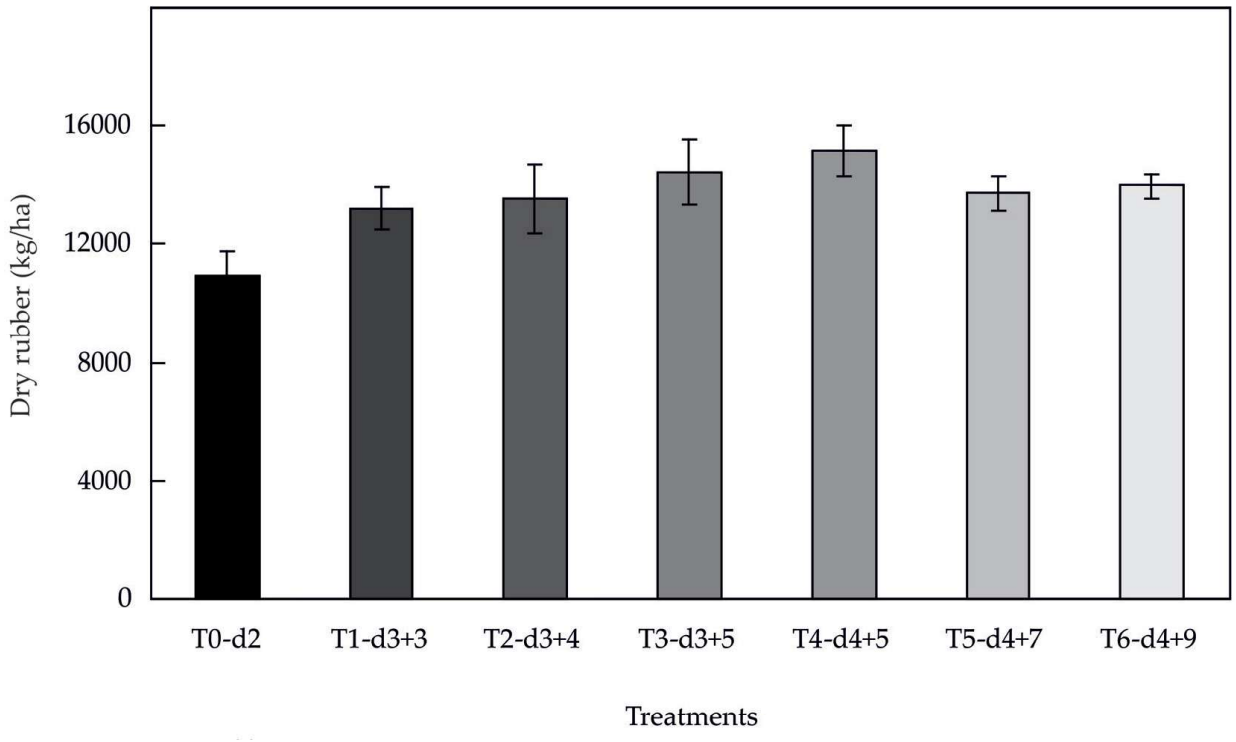


Fig. 2. Total rubber yield (kg/ha) in BO-2 panel under different frequencies of tapping and stimulation in clone RRII 105 Vertical bar represent SE; n = 5

(Table 1). By adopting d3 and d4 frequencies with stimulation, tappers requirement can be substantially reduced by 32% and 48% respectively, compared to d2 tapping. Mean dry rubber yield (kg/tap) and yield per tree are presented in Table 1. There was increased yield per tap with lower frequencies of tapping. The mean annual dry rubber yield per tapping is significantly higher in d3 and d4 frequencies of tapping than d2 frequency of tapping. The increase in yield per tap with reduced tapping frequency can be due to the fact that such trees had long intervals between successive tapping days which allows better regeneration (Sivakumaran *et al*., 1982). Annual dry rubber yield (kg/tree) during the study period in both the panels was higher (more than 7 kg/tree) in all the treatments.

Mean monthly variation of yield (g/t/t) over eight years under d2, d3 and d4 frequencies with 0, 3 and 5 stimulations per year are presented in Fig. 4. Mean yield of 95.2 g/t/t was obtained in trees tapped under d4 frequency. Alternate daily tapped trees showed the lowest rubber yield (56.8 g/t/t). Similar trend was observed when the trees were tapped under different frequencies of tapping (d2, d3, d4 and d6) in BO-1 panel (Karunaichamy *et al*., 2008). High per tap yield under low frequency tapping indicates the need for additional or delayed collection for reducing the scrap production. Mean dry rubber content (d.r.c) is presented in Table 1. The d.r.c values of trees tapped under low frequency tapping systems are higher than the conventional tapping system (d2).

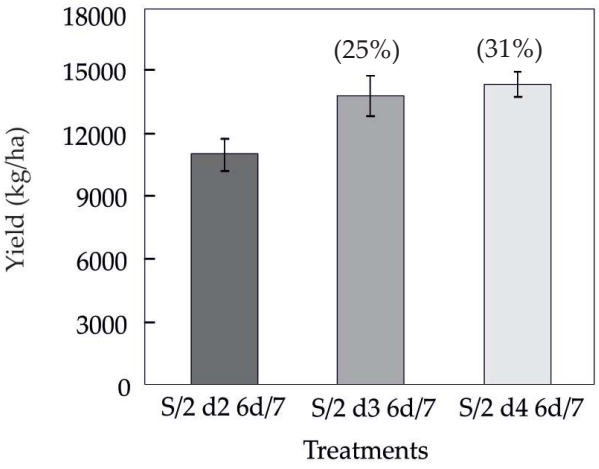


Fig. 3. Cumulative dry rubber yield (kg/ha) of clone RRII 105 under different frequency of tapping in BO-2 panel Values in parenthesis are percent increase over d2 frequency of tapping. Vertical bar represent SE; n=5

The incidence of panel dryness under LFT was small. Use of ethephon under low frequency tapping is mainly to compensate the potential loss of yield due to low frequency tapping. Ethephon delays plug formation on tip of latex vessels thereby prolonging latex flow and results in higher yield (Kush *et al.*, 1990). Increased alkalanisation and increased chitinase activity leads to increased rate and duration of latex flow (Koshy, 1997; Thanh *et al.*, 1998). The rubber synthesizing capacity of the panel was less affected by LFT with appropriate yield stimulation than that of trees tapped under higher intensity of tapping like d2 (Sivakumaran *et al.*, 1984). The results of this study showed that low frequency tapping can be successfully carried out in India. Success of LFT warrants regular tapping, which is made possible by proper rainguarding of the tapping panels, a practice successfully followed in India.

There are several other benefits such as high d.r.c, low incidence of tapping panel

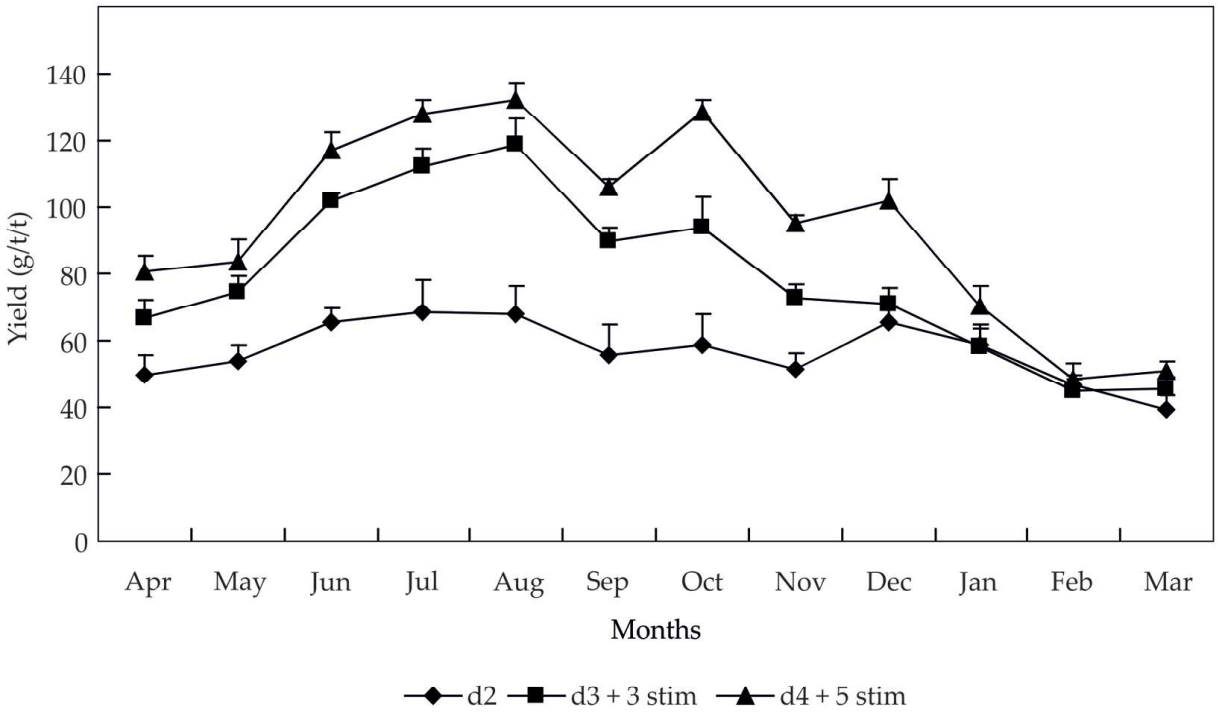


Fig. 4. Monthly variation in mean dry rubber yield (g/t/t) under different frequencies of tapping and stimulation in clone RRII 105 (mean of eight years). Vertical bar represent SE; n=8

dryness (TPD) and extended period of tapping on the same panel. Beside these, changing from high frequency (d2) to low frequency tapping such as d3, d4 *etc*. would increase the daily earnings of tappers if over-poundage system of incentive is being practiced. In India, low frequency tapping systems have been successfully carried out in many estates and medium rubber holdings at different agroclimatic regions. During 2009, demonstration plot on LFT (d3) have been initiated under all regional offices as the first step of extension of LFT to small holdings. It is envisaged that if 50% of small holdings of rubber plantations convert from d2 to d3 frequency, the current skilled tapper shortage can be resolved to certain extend.

LFT with ethephon stimulation has shown great potential for commercial adoption in clone RRII 105, because of high productivity of tapper and increased crop productivity when compared to alternate daily tapping. Yield can be substantially increased by 3 to 4 stimulation under d3 tapping without any adverse effect. Fourth daily (d4) tapping also can be done successfully with appropriate stimulations schedule. The income of tappers will be increased as a result of the adoption of LFT. By practicing LFT, grower can also benefit from reduction in tapping cost and increased economic life of rubber trees.

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