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A study of different tapping times on latex production in smallholder rubber fields in Moneragala District in Sri Lanka

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Abstract

Harvesting latex from rubber trees at different times in the early hours of the day or so-called night tapping has led to more time to extract latex from trees and saves time for the tapper to engage in other farm activities during the daytime in non-traditional areas in Sri Lanka. A night tapping trial was conducted during the 2017-2018 period for one year in Moneragala District (IL1c) to investigate whether night tapping is advantageous for farmers to obtain higher latex yields from their fields. In this study, two smallholder rubber fields were selected in Moneragala District, and trees were tapped at S/2 d2 tapping system without rain guards. For each starting time, 10 trees were allocated for the collection of latex in each treatment, and treatments were set up at five different time intervals i.e., 1.30, 2.30, 3.30, 4.30, and 5.00 for field 1 and from 1.00 am to 5.00 am hourly intervals for field 2. Tapping time at 5.00 am was considered as the control treatment for both fields as the normal tapping time in Moneragala. A forehead-mounted torch was used by each tapper to illuminate the tapping cut. Results revealed that there was a variation in latex yield tapped from 1.00 am to 5.00 am in both fields. The present trial indicated that the latex yields are given at different tapping times before 4.30 am comparatively low in pre-dawn tapping.

Key words*:* climate, early, rainfall, weather, yield

Introduction

As far as technological developments in rubber cultivation are concerned, the improvements in harvesting practices have the longest history and also slow and uninterrupted developments over the years. Starting from ad-hock wounding made to take the latex out from Amazonian wild rubber trees up to robot-driven harvesting machines today demonstrate the interest of the scientists and growers in harvesting practices of rubber. Whatever the method of harvesting or the devices used, the basic principle is the same; the opening of microscopic latex vessels in which the latex is stored and located in the bark of the tree making the latex ooze out (Priyadarshan, 2011).

The time of tapping of rubber trees is usually the daytime mostly as the day dawn, and sometimes later in the day

due to rain interferences in the morning (Priyadarshan, 2011). Due to a shortage of tappers, each tapper is given two tapping blocks and the second block is tapped in the afternoon.

One reason to start tapping in the morning hours is the higher latex yield collected. The time was decided by the amount of light available for the tapper to see the tapping cut to perform tapping without wounding the tree (Nayanakantha, 2021). Another valid reason is for the tapper to come to the field and move about without facing accidents if started in the dark. As the day goes by, a reduction of the latex yield is expected by 10-15%, but the amount of reduction depends on the weather condition of the day.

However, the biggest challenge in front of the scientists, industrialists, or engineers right from the beginning of the rubber industry was to develop a knife or a device to tap the tree without wounding the tree or the bark and also to be used without any skill on tapping. However, in the recent past, farmers and scientists thought of the advantages if tapping was done at the night. It has one main advantage if the tapper engages in another job during the daytime. Nevertheless, even if a person needs a rest, one can engage in any activity depending on the task to be undertaken. Then which job is to be done at the night should be judiciously decided. Rubber tapping in the traditional rubber growing areas is not easy even during the daytime due to uneven terrain with rock outcrops drains and ditches, covered with weeds and cover crops. Also, snakes are normally out, searching for food during dark hours. Scorpions, Centipedes, Porcupines, and even Wild bores are common in rubber lands.

Tapping quality is the most important factor for the amount of latex that can be harvested from the tree as well as for the life span of the tree. The life span of a commercial plantation is determined by the availability of tappable bark. If the tapper cannot see the panel or the tapping cut properly, correct tapping without wounding is a challenge. However, in non-traditional rubber growing areas in Sri Lanka, namely Moneragala and Ampara, the cultivable lands are flat and the land owner himself taps the rubber trees in the early hours and engages in his usual on-farm activities during the daytime. Since rubber cultivation in those areas is new and not popularized, demand for a job like a "rubber tapper" is not experienced yet. As the knowledge on proper tapping, *i.e.* getting the potential crop while making minimum damage to the tree, is poor in this area due to rubber being a new plant to the people of the region, there are many miss-concepts and miss-beliefs. One such is night tapping yields high latex yield. Therefore, the main objective of this trial was to see whether a higher crop can be obtained by tapping in the early hours than usual 5-6 am. Some state-

owned large estates are available in the Moneragala area but this study focused on smallholder farmers in Moneragala District.

Methodology

Two smallholder farmers' fields were selected for this trial in Moneragala District belongs to the Agro-climatic Zone of IL 1. Details of the two fields where the trial was conducted are given in Table 1. As given in Table 1, trial periods were different for the two fields. Due to the low rubber price prevailing after about 10 months of the commencement of the trial, tapping of Field 2 was stopped and the data collection had to be discontinued after 10 months. Data collection from Field 1 was continued for 18 months. Different starting times of tapping of each field, which were the treatments are given in Table 2. Tapping time at 5.00 a.m. was considered as the control for this trial for both fields. The reason to test two different tapping times for each field was to swap between the fields in order to supervise, when tapping fell on the same day, due to no tapping in one field.

Both fields were tapped at the S/2 d2 tapping system without rain guards. Trees were randomly selected with a total number of 50 trees and there were five blocks of each with 10 trees for each tapping time. For a given tapping day, each block had been assigned with one tapping time (Table 2) and latex was collected from 10 trees for each block at each time tapped; DRC values were estimated and thereby g/t/t was calculated. In order to alleviate the influence of tree-to-tree variation for latex yield, the tapping time was changed every new day according to a roster for each block. In this manner each set of 10 trees was tapped at all five tapping times in order to minimize any errors. A forehead-mounted torch was used by each tapper to illuminate the tapping cut. The latex volume of individual trees was measured daily by using a measuring cylinder. Metrolac reading was taken daily from the bulk sample after collecting latex from each treatment block and dry rubber content of the latex yield was calculated in relation to gram per tapper per tapping (g/t/t). Rainfall data was recorded from a non-recording type rain gauge which was installed at the Moneragala Substation of RRISL. Statistical analysis was done by the analysis of variance followed by a mean separation procedure, Duncan's Multiple Range test (DMRT), at a probability level of 0.05. SAS statistical software package – version 9.0 (SAS Inc., USA) was used to analyze data.

Table 1. *Details of the two rubber fields used for the trial*

Field	Location	Clone	Extent (Ha)	No of rubber trees	Year of planted	Year of tapping	Tapping panel	Type of rubber manufactured	Trial period
1.	Unawatuna Buttala	RRIC 121	1.01	520	2007	2016	A	Sell latex	From 07.04.2017 to 15.11.2018
2.	Yundaganawa Buttala	RRIC 121	0.81	440	2006	2016	A	Produce RSS	From 18.05.2017 to 06.03.2018

Table 2. *Starting time of tapping of two rubber fields*

Field 1	Field 2
1.30 am	1.00 am
2.30 am	2.00 am
3.30 am	3.00 am
4.30 am	4.00 am
5.00 am	5.00 am

Results

The yield data collected for the period specified for the two fields are given in Fig. 1a and 1b. Since the two fields were not identical in tapping time, micro-climate, and agro management, yield data are presented separately in Figs.1a and 1b.

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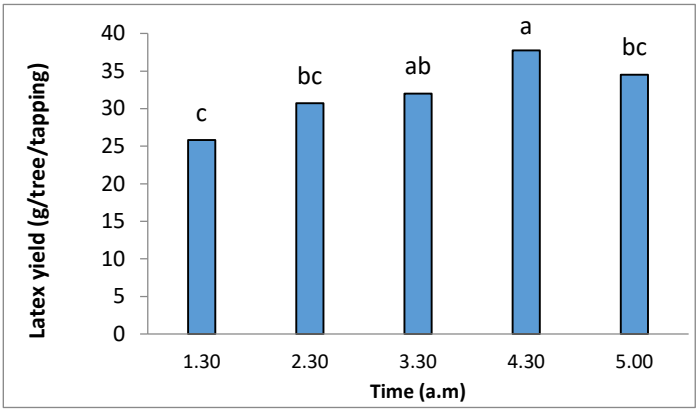


Fig. 1a. The mean yield of trees tapped at hourly intervals from 1.30 am to 5.00 am (Field 1)

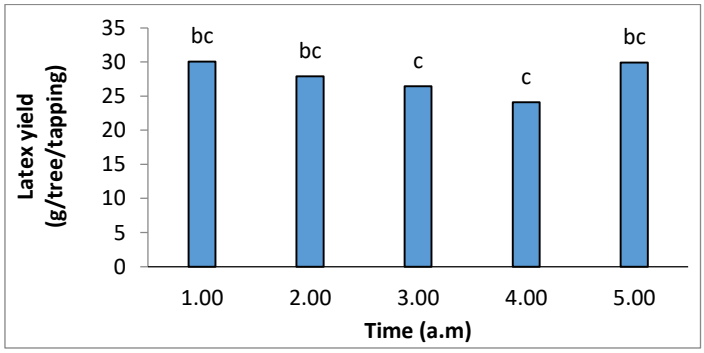
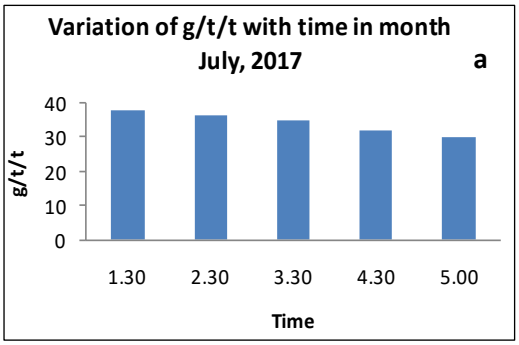
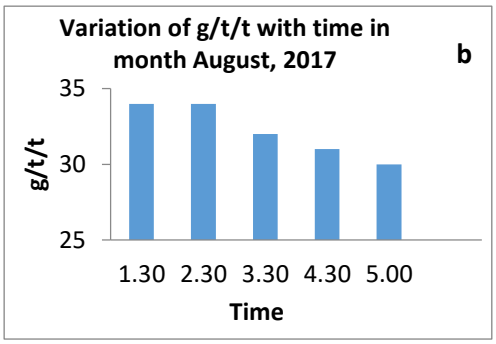


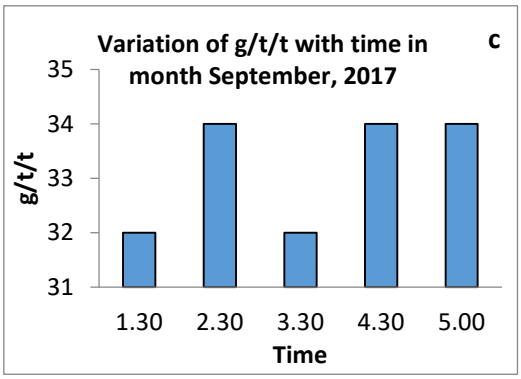
Fig. 1b. The mean yield of trees tapped at hourly intervals from 1.00 am to 5.00 am (Field 2).

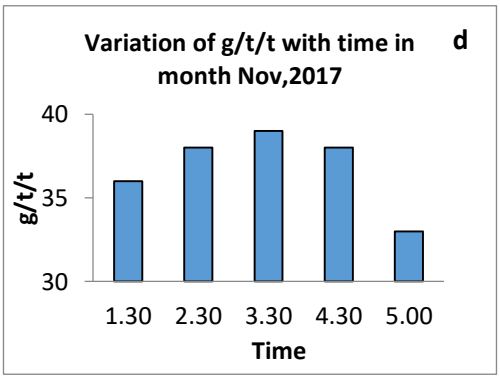
The data collected on tapping revealed that there was variation in latex yield obtained at different tapping intervals (Figs. 1a &b). In field 1, a yield increase could be obtained when tapped from 4.30 as compared to that from other tapping times (Fig. 1a). In Field 2, latex yield is comparably low ($p \leq 0.05$) when compared with the Field 1 due to the changes in micro-climates (Fig. 1b). Data collection in Field 2 was terminated after 10 months due to lack of interest of the smallholder with price dropdown at the study period. Data collection was continuously done in Field 1 for one year starting from July 2017 to June 2018. The mean latex yield of the trees of Field 1, tapped from 1.30 am to 5.00 am from July 2017 to June 2018 period are shown in Figs. 2a to 2i.

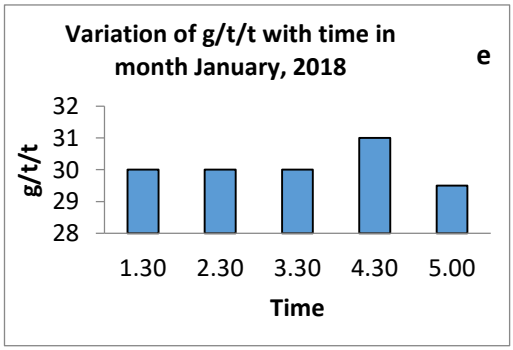
Tapping was undertaken throughout the study period except for a few days during the heavy rains that prevailed in second inter-monsoonal and North-East monsoon periods from October and December 2017 to April 2018. According to Figures 2a to 2i, there was no marked yield increase observed during the early hours before 4.30 am. Monthly rainfall during the study period was recorded from the meteorological station established at the Moneragala Substation of Rubber Research Institute of Sri Lanka. Monthly rainfall data are shown in Fig. 3.

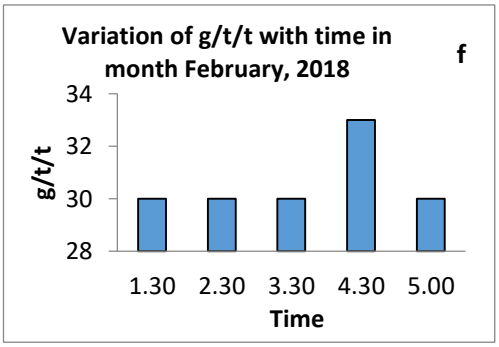

Variation of g/t/t with time in month July, 2017
a
g/t/t
40
30
20
10
0
1.30
2.30
3.30
4.30
5.00
Time


Variation of g/t/t with time in month August, 2017
b
g/t/t
35
30
25
1.30
2.30
3.30
4.30
5.00
Time


Variation of g/t/t with time in month September, 2017
c
g/t/t
35
34
33
32
31
1.30
2.30
3.30
4.30
5.00
Time


Variation of g/t/t with time in month Nov,2017
d
g/t/t
40
35
30
1.30
2.30
3.30
4.30
5.00
Time


Variation of g/t/t with time in month January, 2018
e
g/t/t
32
31
30
29
28
1.30
2.30
3.30
4.30
5.00
Time


Variation of g/t/t with time in month February, 2018
f
g/t/t
34
32
30
28
1.30
2.30
3.30
4.30
5.00
Time

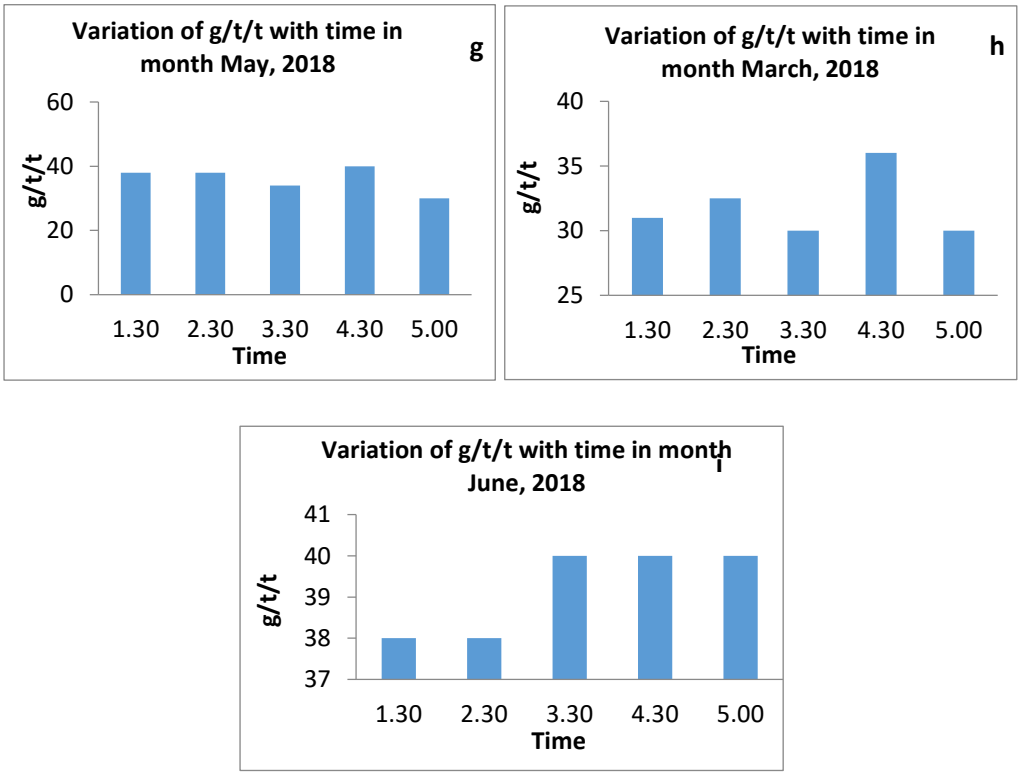


Fig. 2. Latex yield variation of Field 1, tapped from 1.30 am to 5.00 am from July 2017 to June 2018 (**a -i**)

A high monthly rainfall variation was observed during the study period with distinct dry months *i.e.;* July-September 2017, January-February, and June 2018 (Fig. 3). Tapping was not commenced in some months (October and December) under heavy rains as the trees were not rain-guarded. Nearly 60% of the rainfall was experienced during the second inter-monsoonal (October – November) and North-East monsoon rainy season from December to February (Fig. 3).

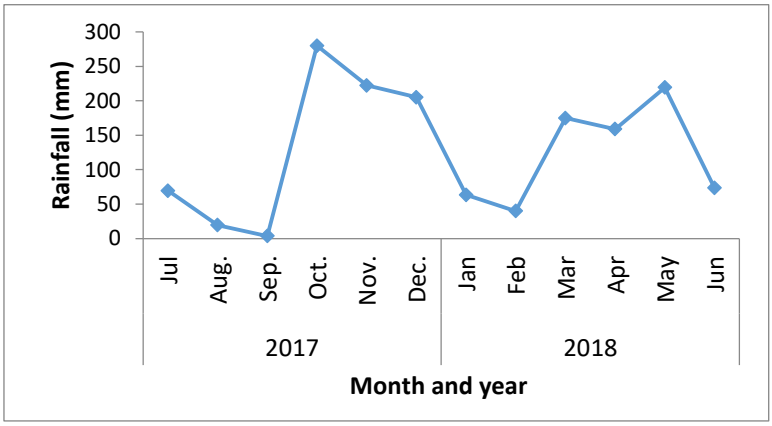


Fig. 3. Monthly rainfall during the study period (from July 2017 to June 2018)

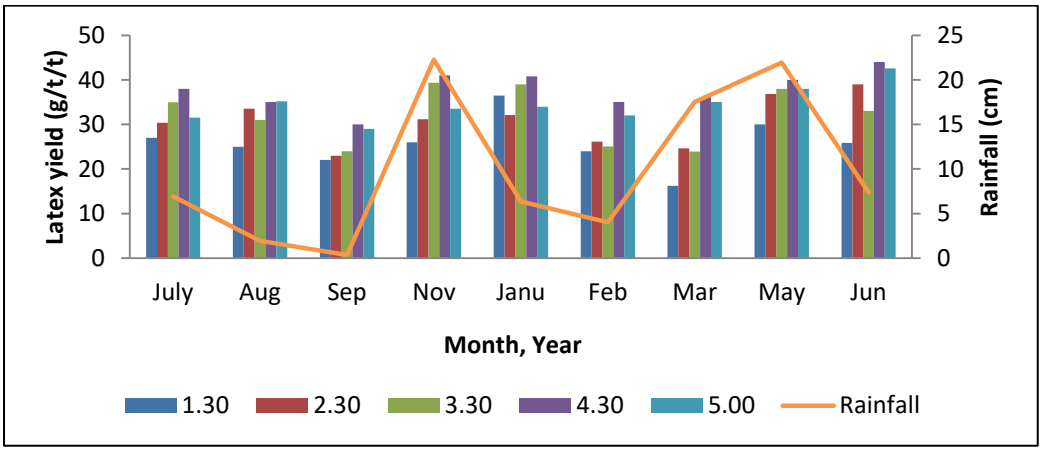


Fig. 4. The latex yield when tapped at different times from 1.30 am to 5 am in Field 1 from July 2017 to June 2018 (Bars show SEM values)

As seen in Fig. 4, it is revealed that the latex yields are given at the tapping time before 4.30 am comparatively low in pre-dawn tapping. The yield difference in every month is occurred due to a positive correlation between monthly variations in rainfall.

Discussion

Results obtained from the trial conducted over a period of one year revealed that there was a variation in latex yield when tapped from 1.00 am to 5.00 am in both fields in the smallholder fields in the Moneragala district. The

time of tapping is generally determined by the time of dawn of the day as the tapper should see the tapping cut clearly in order to do proper tapping without wounding the bark or to avoid shallow tapping. A higher yield obtained at dawn was discussed by Priyadarshan (2011) due to its direct bearing on the turgidity of the tree with transpiration being at a minimum in the early hours of the day under high atmospheric pressure and high relative humidity. However, the climatic conditions in the Moneragala area are adverse and marginal with regard to rainfall experiencing with marked dry periods that affect the growth of rubber and latex yields.

A similar study was conducted by Nayanakantha *et al.* (2022) in Wet and Intermediate Zones for a one-year period in 2019 to see if there is any effect of time on the latex yield in Wet and Intermediate Zones of Sri Lanka. Accordingly, they have tested 3.00 am to 8.00 am in hourly tapping intervals for Wet Zone and 2.00 am to 7.00 am for the Intermediate Zone. The overall results of that study revealed that there were no significant differences among different time intervals in latex yield. According to Nayanakantha *et al.* (2022), there was a very insignificant increase in latex yield by 0.04% when trees were tapped from 5.00 am to 7.30 am in wet regions. However, the results reported in the same study revealed that, about 5.1% yield increment resulted for trees tapped between 2.00 am and 4.30 am in the Intermediate Zone. Another study conducted in the wet region of Kalutara district, in Dartonfield estate for about one year revealed a negative impact on the yield when tapped at 3.00 am (-5.76%) and 4.00 am (-1.87%) and a higher yield when tapped at 5.00 am (Anon, 2019). A study conducted by the Rubber Research Institute of Sri Lanka in the Eastern province has reported that tapping before 6.00 am yields a higher latex volume. But dry rubber content of latex has increased after 6.00 am tapping attributed to the water status of the tress which is governed by evapotranspiration (Kudaligama *et al.*, 2019). As reported by Haridas (1985) rubber plantations transpire 4-6 mm of water vapor daily when soil moisture availability is adequate and only 2-4 mm when it is inadequate. Rao and Vijayakumar (1992) also explained that the distribution of rainfall, temperature, sunshine, and humidity are the major conditions contributing to yield variability. About 40-62% of the total variation in monthly rubber production could be explained by prevailing environmental factors as reported by Jiang (1988). This is on par with the monthly variation observed in the latex yield than the variation or the pattern observed among different times of tapping in the present study (Figs. 3 & 4), indicating a stronger relationship with the rainfall and its related parameters reported for the month. Rao *et al.*, (1998) have carried out a commercial-scale trial with RRII 105 which is considered drought tolerant. Trees have been tapped at S/2 d2 and the tapping operation has been taken place from 7.00 am to 11.00 am. They have concluded that the maximum

temperature, sunshine duration, vapor pressure deficit, and pan evaporation had a negative correlation but a significant positive correlation with rainfall.

Latex yield variation within the day is often correlated with the turgor pressure in lactiferous phloem tissues. There are more weather related factors such as relative humidity influencing turgor pressure. Riches and Gooding (1952) have reported early morning pressure falling during the day and recovering at night. They correlate the diurnal pressure changes with atmospheric relative humidity. Negative correlations with changes in temperature, evaporation, leaf water deficit, and stomatal opening are also demonstrated by them. The loss in turgor is explained probably as the result of the withdrawal of water from the phloem tissues under transpiration stress. A general turgor gradient from the base to the crown does not preclude mass flow in sieve tubes in the opposite direction provided that the rates of loading and unloading are such that a sufficient osmotic gradient is maintained in them in the required direction, as reported by them. The latex contains 65-70% of water and hence the moisture stress influences the yield. Heavy rainfall for a prolonged period, however, can also have a negative effect on yield. Shorter duration of sunshine, associated with heavy rainfall results in low photosynthetic efficiency. Heavy rainfall also occurs nutrient loss. Therefore, the results obtained during the study do not indicate any marked effect of tapping time on latex yield. But seasonal changes associated with climatic factors were experienced. Furthermore, the quality of tapping has a high impact on the latex yield than many other factors such as time of tapping. Tapping is a skilled job and good eyesight is considered an important factor to perform proper tapping. Similarly, the availability of enough light for the tapper to see the tapping cut is equally important. This is the main reason to commence the tapping operation as the day dawn. With the personal experience gained in conducting the present trial, even though head-mounted torches were used to tap in the dark, it was difficult to maintain the correct depth of the cut and the angle of the tapping which resulted in low yields. The poor tapping quality resulted after about a year or two made some estates abandon early tapping, which was done at 3.30 - 4.00 am in the Wet Zone. Even though the early tapping saves the tapper's time more at day time, the terrain in the rubber fields in the Wet Zone does not permit tapping in the dark due to the difficulty faced by the tapper to walk from tree to tree in the uneven and rocky fields and the other, venomous and carnivorous animals such as scorpions, snakes, *etc.* found under the weeds in the dark hours. Snake bites are often reported by rubber tappers and taking them to a hospital may challenging at night. Though the terrain is flat in the Moneragala area, the dangerous animals searching for prey and water at the night is common. In estates and most of the time in the smallholder sector also, only the tapper is in the field without a helper or a supporter. A higher percentage of tappers is female and night tapping may

create social security issues too. In conclusion, the present trial indicated that the latex yields given at different tapping times before 4.30 am are comparatively low in pre-dawn tapping.

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