Incidence of Tapping Panel Dryness in Vogue Widely Planted Rubber Clones in Sri Lanka

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ABSTRACT

Rubber (*Hevea brasiliensis*) is a one of the important major plantation crops in Sri Lanka and tapping panel dryness (TPD) is a physiological disorder that negatively affects the performance of its commercial cultivations. This study attempts to investigate clonal difference in TPD, among some widely planted rubber clones in the country, i.e. RRIC 121, RRISL 203 and RRIC 130. From each clone two tapping blocks of same tapping age was selected for the study. Tapping panel dryness trees were counted in each tapping block and TPD percentage of each clone was determined. Further, the time taken for the onset TPD and the yield potential of each of the clones were estimated. It is apparent that clone with the highest yield potential records a higher TPD percentage and also such trees become dry earlier than the relatively low yielding clones. Potential crop loss (PCL) due to TPD was found to be highest in clone RRIC 130, i.e. 430 kg/ha/annum.

KEYWORDS: Bark consumption, Crop loss, Dry rubber content, Tappable trees, Tapping panel dryness

INTRODUCTION

Rubber tree (*Hevea brasiliensis* Muell. Arg.) is a perennial tropical plant cultivated for the production of Natural Rubber (NR). In the world, there are more than 2,000 plant species with the potential to produce latex, but the rubber tree is the only economically viable source of NR. World NR production is about 12,042 million kg (Anon, 2013a). Sri Lanka produces around 130 million kg of natural rubber annually (Anon, 2013b). The rubber extent in Sri Lanka is approximately 133,668 ha (Anon, 2013b). From Sri Lanka, the rubber plant was introduced to the other Asian countries. Rubber (cis-1, 4-polyisoprene) is one of the most important naturally produced polymers and it is a strategic raw material used in over 40,000 products, including more than 400 medical appliances (Mooibroek and Cornish, 2000).

Rubber molecules are produced, aggregated and packed in the latex vessels (laticifers) of the rubber tree. Latex, a cytoplasmic component of the laticifers, expels from the laticifers upon tapping. Over the past decades, the rubber yield has increased significantly due to the cultivation of high yielding clones and the adoption of new technologies. Stimulation is also a widely used practice to enhance latex yields. Ethephon (an ethylene generator) is widely used for yield stimulation. However, globally latex production faces a serious threat due to a physiological disorder called tapping panel dryness (TPD). Tapping panel dryness is a complex physiological syndrome widely found in rubber plantations, resulting in severe crop losses in all NR producing countries. Further, there is no effective treatment for the prevention of this serious incidence (Venkatachalam *et al.*, 2006). The first symptom of TPD is the appearance of partial dry zones (no latex flow) along the tapping panel. In the advanced stage, the tapping panel may even become completely dry and other symptoms such as browning, thickening, or even flaking of bark can occur. There are reports of two types of TPD-necrotic TPD and over-exploitation induced TPD. The former occurs randomly in plantations and then spreads along the rows of trees. The latter type is believed to be a condition caused by physiological fatigue (Lacrotte *et al.*, 1997). Late dripping has been reported as the initial indication of TPD.

Rubber plantations are severely affected by TPD and this phenomenon is growing in scale. Tapping panel dryness occurs in 12 to 50% of rubber trees in almost every rubber growing region. It leads to loss of about 12 to 14% of the global annual rubber production (Ziang and Zhou, 1997). There is presently no effective prevention or treatment for this serious physiological condition. Response to stimulation and susceptibility to TPD are also clone related (Yan and Fan, 1995). Some trees may also suddenly stop producing latex whilst in others only part of the tapping cut dries up initially. Late dripping is a phenomenon that has long been recognized as the first obvious symptom of TPD (Petch, 1921).

This study aims at finding the incidence of TPD in *Hevea brasiliensis* clones recommended for planting more recently. Further, the study also aims at estimating the potential crop loss due to the incidence of TPD in the clones selected for the study.

MATERIALS AND METHODS

Location

The study was conducted at the Sapumalkanda Group in Deraniyagala located in the Kegalle District of the country from January to April 2016. This area belongs to the Wet zone of the country and receives a mean annual rainfall of over 3 500 mm with a temperature ranging from 27 °C to 33 °C.

Experimental Area

Three (03) clones (RRIC 121, RRISL 203 and RRIC 130) recommended to the industry were used for the study. From each clone identified for the study one (01) field in the fifth (05) year of tapping in the panel BO-1 was selected to gather the data. The fields are being tapped based on the recommendations given by the Rubber Research Institute of Sri Lanka (Nugawela, 2001) which were planted in 2004. Two (02) randomly selected tapping blocks (around 300 rubber trees pre block) were used from each clone to gather data.

Clonal Differences in the Incidence of TPD

Data collection was made early in the morning with the commencement of tapping. Tapping cut of each tree was examined during tapping and the total dry and healthy trees were counted. Using this information, the percentage of dry trees in each tapping block was calculated as follows.

$$Percentage\ TPD = \frac{Number\ of\ TPD\ trees}{\substack{Total\ number\ of\ trees \\ in\ the\ block}} \times 100$$

Number of Tappings for the Onset of TPD (NTFOTPD)

In the total dry trees the bark consumption was measured at both ends of the tapping cut using a measuring tape and average bark consumption was calculated. Similarly the bark consumption was measured in ten randomly selected trees that are being tapped continuously since commencement of tapping. From the mean bark consumption of healthy trees the average bark consumption per tapping per block was calculated using the number of tapping days in a block since the commencement of tapping.

The time period for onset of TPD was estimated individually for each tree using the following formula.

$$NTFOTPD = \frac{\substack{Total\ bark \\ cunsumption\ of\ the\ TPD\ tree}}{\substack{average\ bark\ cunsumption \\ per\ tapping}}$$

Potential Crop Loss per Hectare (PCLH) due to Incidence of TPD

The mean yield per tapping of a healthy tree (g/t/t) was calculated as follows by dividing the intake of a harvester by the total number of tappable trees (TTT) in that block. Intake of a harvester is determined based on the latex volume and the dry rubber content (DRC) of that latex determined as grammes per liter using the metrolac.

$$g/t/t=(Latex\ volume \times DRC)/TTT \qquad [1]$$

The potential crop loss per hectare (PCLH) for each clone selected for the study due to TPD was estimated from the mean yield per tapping of a healthy tree (g/t/t), the number of tapping days per tree per annum (TDTA), the potential stand per hectare (SPH) and the percentage of fully dry trees (%TPD) using the following formula.

$$PCLH=(g/t/t \times TDTA)\times(SPH \times \%TPD) \qquad [2]$$

Data were analyzed descriptively using Microsoft Excel 2013. Mean comparisons were done and are illustrated graphically and using Tables.

RESULTS AND DISCUSSION

Clonal Differences in the Incidence of TPD

The average TPD percentages of the three clones selected for the study were compared. Highest average TPD percentage (28.0%) was evident in clone RRIC 130 whilst the lowest TPD percentage was in clone RRISL 203 (17.9%). The clone RRIC 121 showed a moderate value of 22.1% (Figure 1).

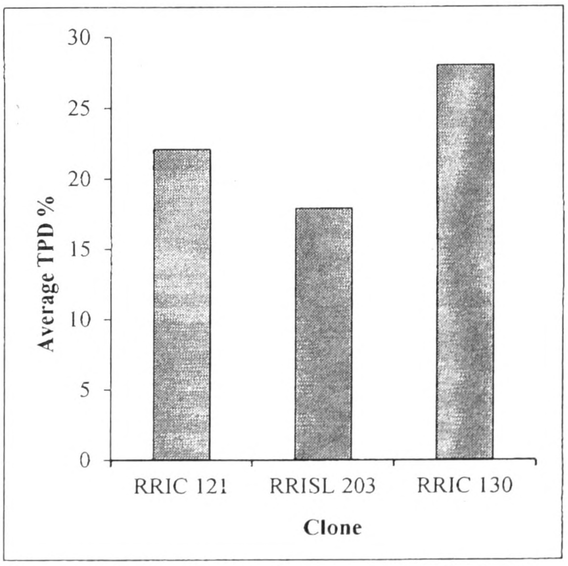

Figure 1. Average tapping panel dryness (TPD) percentages of the clones

Number of Tappings for the Onset of TPD (NTFOTPD)

The average total bark consumption of a healthy tree that had been tapped uninterruptedly in each clone and the average number of total tappings undertaken during that period is given in Table 1. Based on this information the average bark consumption per tree per tapping was calculated (Table 1). The bark consumption of TPD trees was divided by the average bark consumption per tapping to estimate the number of tappings for the onset of TPD.

Table 1. Average bark consumption in healthy trees (HT), the number of tappings per tree and the calculated average bark consumption (BC) per tree per tapping

Clone	Average BC in HT (cm)	Total tappings for five year	Average BC per tapping (cm)
RRIC 121	103.25	595	0.173
RRISL 203	95.85	588	0.163
RRIC 130	112.08	591	0.189

BC- bark consumption, HT- healthy trees

The average number of tappings for the onset of TPD was lowest, i.e. 365 tappings, in clone RRIC 130. Among the three clones tested the highest number of tappings, i.e. 410, for the onset of TPD was in clone RRIC 121. The mean number of tappings for the onset of TPD in clone RRISL 203 was 392 (Figure 2).

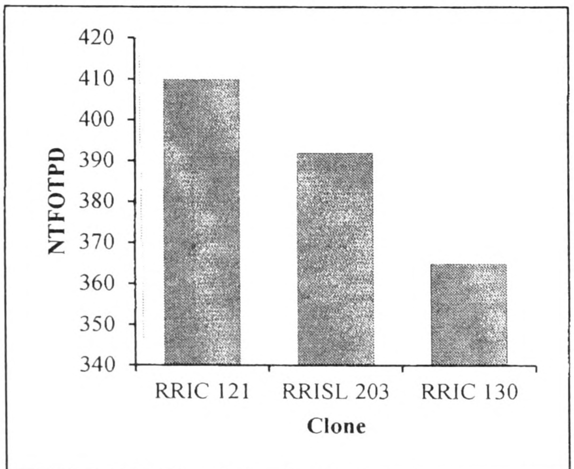

Figure 2. The mean number of tappings for the onset of tapping panel dryness (NTFOTPD) in each clone

Potential Crop Loss per Hectare (PCLH) due to Incidence of TPD

Average total dry rubber yield (ATDRY) per tapping per block during March 2016 for the clones RRIC 121, RRISL 203 and RRIC 130 were 6.02, 6.42 and 5.83 kg respectively. The mean yield per tapping of a healthy tree (g/t/t) was highest in RRIC 130 (25.23 g/t/t). RRISL 203 recorded a moderate value (23.17 g/t/t) whilst it was lowest in clone RRIC 121 (21.81 g/t/t; Figure 3).

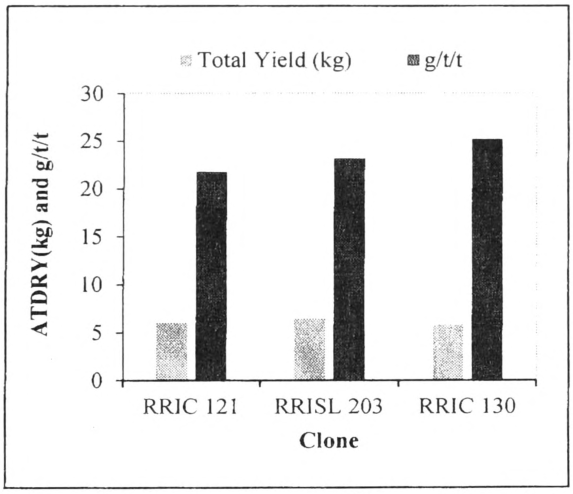

Figure 3. The average total dry rubber yield (ATDRY) per tapping block per day during March 2016 and the mean yield per tree per tapping (g/t/t) for the three clones selected for the study

Due to TPD incidence the potential crop loss is highest in RRIC 130 and lowest in RRISL 203. The estimations were based on 515 trees per hectare (Table 2).

Table 2. Potential crop loss per hectare and g/t/t

Clone	g/t/t	TDTA	PCLH (kg/ha)
RRIC 121	21.81	118	292.78
RRISL 203	23.17	118	252.03
RRIC 130	25.23	118	429.30

PCLH- potential crop loss per hectare, TDTA- total days of tapping per tree per annum; g/t/t- mean yield per tapping

The results indicated that clone RRIC 130 was the most susceptible clone for TPD (Figure 1). This clone also gives the highest yield as indicated by the relatively high g/t/t than in the other two clones tested (Figure 3). It is reported that high yielding clones are more susceptible for TPD (Gohet *et al.*, 1997). This study also shows that the time taken for the onset of TPD is lowest in clone RRIC 130. Therefore it could be concluded that high yielding clones become dry at an early stage of tapping and also the incidence of TPD is higher than in the low yielding clones.

The estimated potential crop loss per hectare due to TPD is also highest in the clone RRIC 130. In order to minimize the incidence of TPD and to lower the crop loss due to the same it is proposed to rest the trees from tapping when the initial symptoms of late dripping and partial TPD are evident. This could lower the stress condition caused to the tree through harvesting and may result in the recovery of such trees.

Lowest TPD percentage was recorded in clone RRISL 203. However, the g/t/t/ of clone RRISL 203 was higher than in clone in RRIC 121. Hence it appears that the relationship between yield and incidence of TPD is not consistent. However, it should be mentioned that the parameter used to measure the yield potential was the g/t/t and also it was determined and compared in the month of March. March is a relatively lower yielding month in a year due to leaf defoliation and refoliation and would not give a reasonable estimation of the yield potential of a clone. Hence the annual mean g/t/t will be a better indicator of the yield potential of a clone.

Average bark consumption per tapping was found to be around 0.17 cm in this study. However, the recommended bark consumption per tapping is 0.125 cm (Nugawela, 2001). Hence the actual bark consumption rate is about 36% higher than the recommended level. The implications of this will be shorter tapping cycles leading to lowering of the return on investments.

CONCLUSIONS

The results revealed that there is a clonal difference in the incidence of TPD and that the tendency is for high yielding clones to be more susceptible. The number of tappings for onset TPD was also less the relatively high yielding clone RRIC 130. The annual crop loss due to TPD differs with the clone and could be high as 430 kg/ha/annum. The actual bark consumption rates in the plantations are found to be higher than the recommended levels.

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