

Can tapping panel dryness of rubber (*Hevea brasiliensis*) be minimised at field level with better management?

A M W K Senevirathna*, **S Wilbert***, **S A P S Perera*** and
A K H S Wijesinghe*

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Abstract

This study attempted to find the significance of tapping panel dryness (TPD) of extensively grown new clones in Sri Lanka, with a view to find possible ways to minimise or overcome this disorder at field level. A survey done for clones RRIC 100, 102, 121 and 130 showed that the incidence of TPD was high when tapping is done in renewed bark compared to that of virgin bark and it increased with the advancement of the tapping panel from B0-1 to B1-2. Also, % TPD increased with age, immature period, girth of plants, yield and with high intensity of tapping. Generally, the % TPD (partial + full) was high in RRIC 100 (22.5%) and RRIC 102 (19.7%) clones compared to the other clones surveyed. On average in any clone, 40% of the dry trees were with a partial dryness. The estimated average yield loss per tapping panel of RRIC 100 was ca. 20% and for the other clones surveyed it was ca. 15%. Morphologically, the majority of the TPD affected trees were without external symptoms (52%), whilst very few (3%) was with abnormal out growth on the trunk and the rest was with bark necrosis, which is irreversible. Since the TPD incidence was high in shallow areas (<10° land gradient) where water logging and occasional floods occur, such areas should be avoided in planting of rubber in future. Good quality planting material should also be used and the immature upkeep should be of good quality to minimise the immature period and any plant stresses. Implementation of low frequency tapping systems will also be helpful in controlling this disorder.

Keywords: fully dry, partial dry, physical factors, tapping panel dryness, TPD

Introduction

Productivity level of rubber (*Hevea brasiliensis* Muell Arg.) plays a key role in overall profitability of a plantation. The level of productivity varies considerably from plantation to

plantation due to various factors such as differences in genotypes, agronomic practices, climate *etc.* Some yield determinants are not clearly understood; and one of such causes for the decline in latex production is the tapping panel

* Rubber Research Institute of Sri Lanka, Dartonfield, Agalawatta, Sri Lanka.

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dryness (TPD); a physiological disorder, which ultimately results in decline or complete cessation of latex production. The actual mechanism of this disorder is not yet clearly known. TPD has basically been categorised into two, *i.e.* reversible and irreversible dryness (Jacob *et al.*, 1994) depending on the symptoms of latex production. However, symptoms of TPD in terms of morphological features and nature of latex production are rather complicated and shown as partial dryness, full dryness, dryness with bark out-growth and bark cracks and recovered dry trees etc. No studies have been concentrated on the characterisation of these different types of TPD and the associated factors.

Furthermore, the clonal differences in susceptibility to TPD had been reported in early recommended clones (de Soyza *et al.*, 1983; Gohet *et al.*, 1997; Omokhafa and Aniamaka, 2000) with the high yielding clones are more susceptible to TPD than the low yielding rubber clones (Gohet *et al.*, 1997). However, the genotypic susceptibility to TPD at early stages of growth or characterisation of different types of TPD in newly recommended, high yielding, extensively grown clones in Sri Lanka is not well understood. Therefore, the identification and characterisation of effects of different

types of TPD and associated physical factors are important in future planting programmes, to recommend possible remedies and ultimately to enhance the productivity and profitability of rubber plantations. This study was aimed to find the significance of tapping panel dryness in latex production and key physical and plant factors associated with genotypes that are extensively grown in Sri Lanka and to find possible remedies to minimise or overcome this disorder.

Materials and Methods

Four of popular high yielding rubber clones in the commercial plantations namely RRIC 100, 102, 121 and 130 were selected from the estates in the Kalutara region of the low country wet zone of Sri Lanka for a survey. Based on the availability of these clones, five different fields from each clone and tapping panel B0-1 (A), B0-2 (B), B1-1 (C) and B1-2 (D) were selected from five estates. Two adjacent tapping blocks (a tapping block consisted of 275-400 trees) tapped by two tappers were selected from each clone under each tapping panel (Table 1). In cases where there was no enough number of replicates, the entire number of fields available was taken for sampling.

Table 1. Number of tapping blocks and number of trees surveyed from each tapping panel and clone

Clone	Tapping panel	No. of tapping blocks	No. of trees
RRIC 100	B0-1	9	2580
	B0-2	10	2781
	B1-1	7	2007
	B1-2	1	299
RRIC 102	B0-1	4	917
	B0-2	7	2132
	B1-1	4	695
	B1-2	-	-
RRIC 121	B0-1	10	3030
	B0-2	11	2901
	B1-1	7	2159
	B1-2	2	663
RRIC 130	B0-1	6	1641
	B0-2	2	522
	B1-1	5	1098
	B1-2	-	-
Total		85	23425

Survey was begun early in the morning at the time of tapping, observing each tree with tappers. Tapping cut of each tree was examined for any signs of the incidence of TPD and the affected trees are categorised symptomatically (*i.e.* TPD trees with out-growths, with cracks, partial dry or TPD trees without external symptoms). The topography (rank 1-4, respectively $<10^\circ$, $10-30^\circ$, $30-45^\circ$ & $>45^\circ$ slope), rockiness (rank 1-4, respectively no, few, medium and highly rocky), soil characteristics and the distribution of TPD trees were also recorded. In

addition to field observations, monthly tapping days, intake per tapper and yield per hectare were also recorded for each site for a period of three years. Qualitative data on the tappers' knowledge of TPD disorder were also gathered from the relevant tappers through the informal checklist based interviews, in addition to the above primary and secondary data.

Percentage yield loss due to TPD was calculated based on the annual yield of a healthy tree and the % full dry and partial dry trees of a given clone. Data were analysed with 'Modelling of

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binomial proportions' in the Genstat package. Frequency procedure in SAS package was used to analyse the categorical data of clone, tapping panel, immature period, tapping system, range of tapping days, land slope and rockiness.

Results

Incidence of tapping panel dryness was tested with the factors: clone, present tapping panel, immature period, girth of healthy and affected trees, average annual yield, tapping system, number of tappings per year, rockiness and slope of the land, by a

survey. Results were summarised as follow:

Fig. 1a. shows that the % TPD (full + partial) per panel basis, was high in clones RRIC 100 (22.5%) and RRIC 102 (19.7%) compared to RRIC 121 (14.5%) and RRIC 130 (15.8%) irrespective to the age of the plant. Generally in any clone, the incidence of TPD was low in the virgin panel B0-1 (8.0%) and increased with the advancement of the tapping panel from B0-1 to B1-2 (28.9%; Fig. 1b,c). On average, 40% of the dry trees were partial dry irrespective to the clone and tapping panel (Fig. 1c).

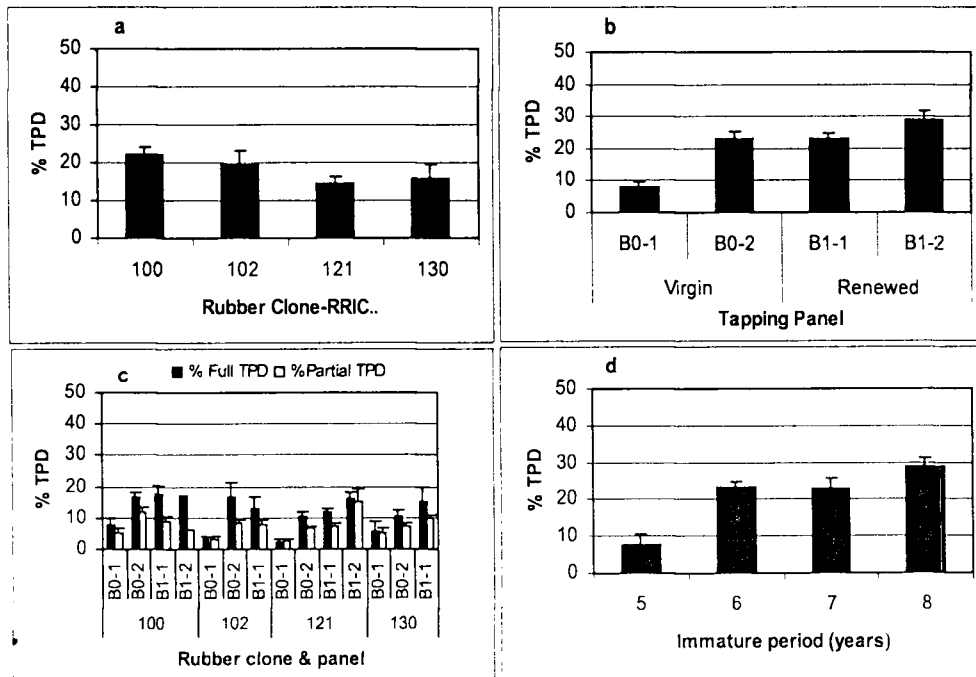


Fig. 1. Summary of the Tapping Panel Dryness (TPD) of rubber on, a. clone, b. tapping panel, c. % full and partial TPD and d. immature period of plantation. Data are presented for total of 85 tapping blocks of 275-400 trees per block

Percentage TPD was increased with the time taken to reach the tappable girth (immature period; Fig. 1*d*). When the immature period staggered from 5 to 8 years, the incidence of TPD increased by 3.6 fold. Estimated % TPD with age and yield of plants using binomial proportion modelling showed an exponential increase in the incidence

from 6.4% to 36.8%, respectively from 6 to 22 years of age (Fig. 2*a*), and with increasing yield (Fig. 2*b*). Similarly, % TPD estimated using the same model, was found to increase with increasing stem girth measured at 1.5 m height of both affected and unaffected trees (Fig. 2*c,d*).

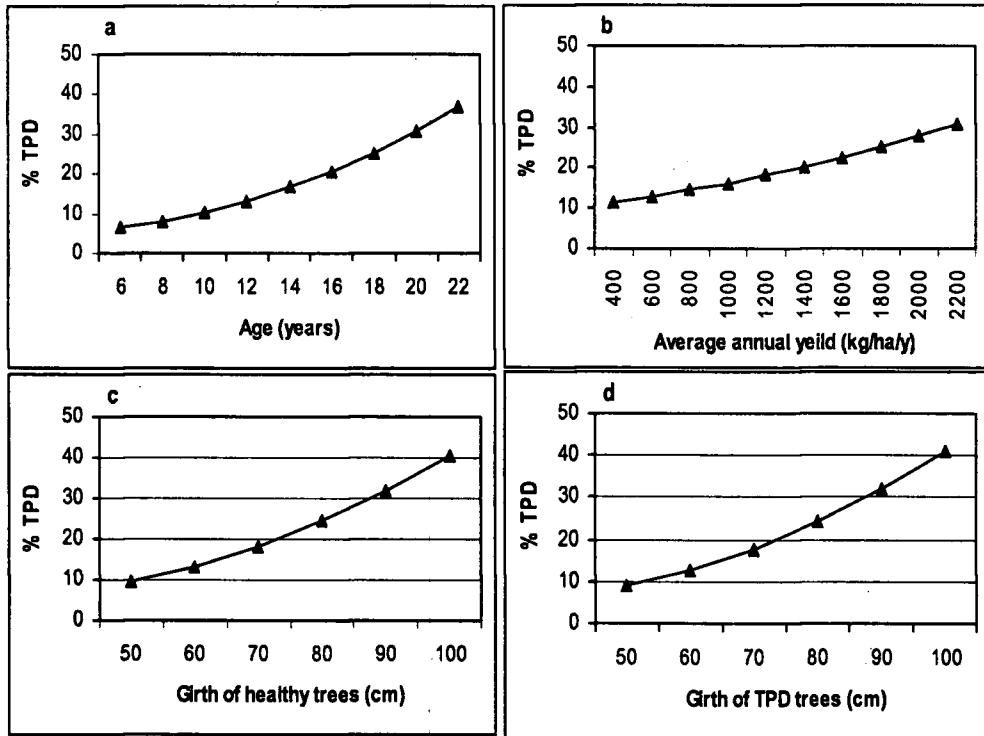


Fig. 2. The effect of Tapping Panel Dryness (TPD) of rubber on, a. age of plantation, b. average annual yield, c. girth of healthy trees and d. girth of TPD trees. Data are shown for total of 85 tapping blocks of 275-400 trees per block.

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The tapping system implemented had a significant effect ($p < 0.001$) on the incidence of TPD and it was 4% less in the low frequency tapping system of $\frac{1}{2}$ SD₃ ($\frac{1}{2}$ spiral cut, once in 3 days) compared to the $\frac{1}{2}$ SD₂ ($\frac{1}{2}$ spiral cut, every other day) system (Fig. 3a). It was further evident by the figure 3b where the % TPD was less (6%) when total

tapping days of a year was less than 250 compared to the higher rates of tappings per year. Land characteristics revealed that TPD percentage was similar and higher (20%) in land slope categories of $<10^\circ$ and $30-45^\circ$ compared to the $10-30^\circ$ slope category (Fig. 3c), whilst degree of rockiness of land did not show a remarkable pattern (Fig. 3d).

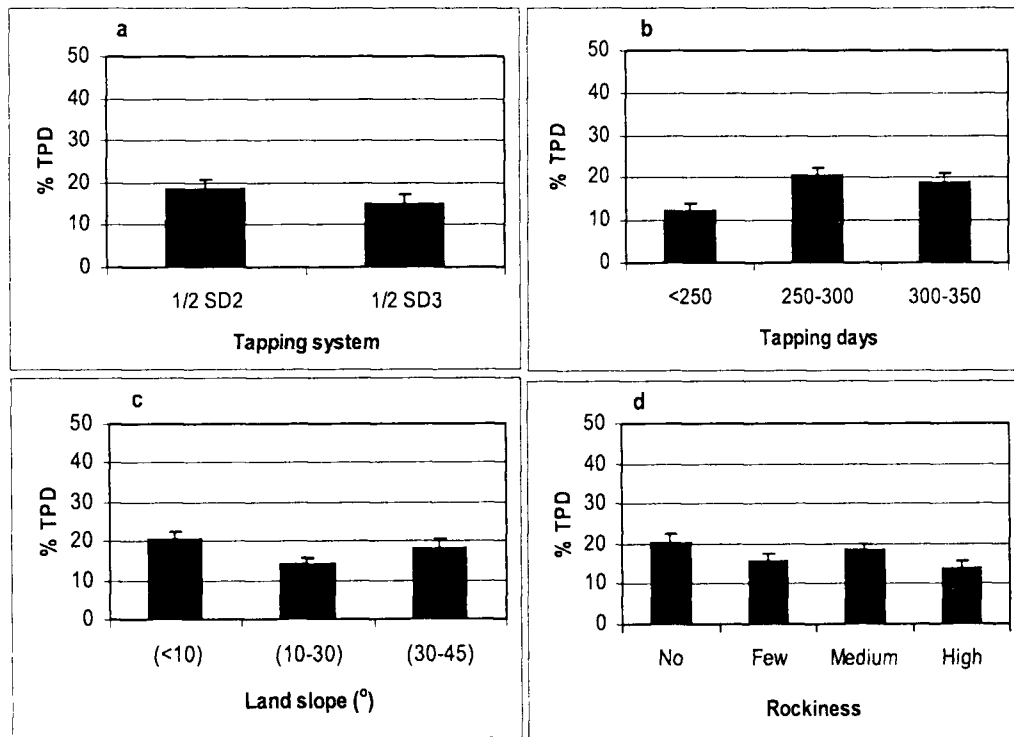


Fig. 3. The effect of Tapping Panel Dryness (TPD) of rubber on, a. tapping system, b. range of annual tapping days, c. land slope category and d. rockiness of the land. Data are shown for total of 85 tapping blocks of 275-400 trees per block

Figure 4a shows different categories of TPD and their proportions came across from the survey, irrespective to the clone and age of the plant. The majority of plants were without external symptoms (N/S; 51.8%) besides dryness of the tapping panel (Fig. 4a). TPD trees with out-growths (O/G) were the lowest (3.0%) whilst, 43% of the affected trees were with bark necrosis (B/N) showing external bark cracks. Of the surveyed tapping blocks, 52.4% of the sites were with TPD trees scattered in the site while 47.6% with clusters of affected trees (Fig. 4b). However, when concern the number of affected trees, 58% of trees were in clusters

while 42% were scattered (Fig. 4b).

The estimated average yield loss per tapping panel of RRIC 100, 102, 121 and 130 were 18.7, 14.5, 14.3 and 13.8%, respectively (Fig. 4c). From the non-leading interviews made with relevant tappers during the survey, about 70 % of tappers were with the idea that this disorder is mainly caused by tapping of rubber trees while they are wet or tapping during rains. About 20% of tappers were of the view that TPD is caused by high intensity of tapping and the rest mentioned other causes such as diseases, low nourishments *etc.* as the causes for TPD (data are not shown).

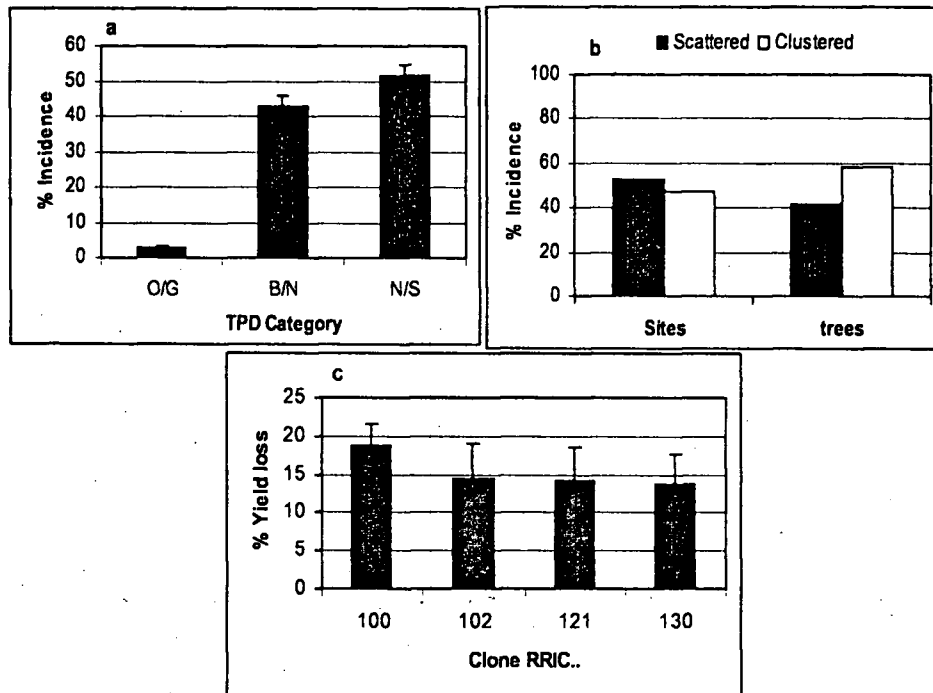


Fig. 4. a. Degree of the different categories of TPD viz, with out-growth (O/G), with bark necrosis (B/N), without external symptoms except panel dryness (N/S), b. distribution patterns of affected trees and c. Estimated % yield loss in different clones due to TPD. Data are presented for total of 85 tapping blocks of 275-400 trees per block.

Discussion

Plant related, histological, physiological, biochemical and molecular biological factors that are involved in the disorder of tapping panel dryness of rubber have been reported by a number of authors (Prematillaka *et al.*, 1985; Wickremasinghe *et al.*, 1987; Yusof *et al.*, 1995; Wu *et al.*, 1997; Thomas *et al.*, 1998; Krishnakumar *et al.*, 1999; Tian and Hao, 1999; Hamzah *et al.*, 2000), but records of external factors are limited. Furthermore, the clonal differences in susceptibility to TPD had been reported for some early recommended clones (de Soyza *et al.*, 1983; Gohet *et al.*, 1997; Omokhafa and Aniamaka, 2000), but the situation of this disorder largely varies genotypically and environmentally. Therefore, it is important to quantify the incidence of TPD with respect to clone and its environment.

According to the survey results, TPD incidence (full + partial) was comparatively high in RRIC 100 (22.5%) and RRIC 102 (19.7%) clones being under the current tapping practices in Sri Lankan plantations (Fig. 1a); of the dry trees, partial dry percentage was 35 and 38% for the two clones, respectively. From an earlier survey done, RRIC 100 trees which were only below 10 years of tapping showed about 8% of TPD (de Soyza *et al.*, 1983); however, the frequency of incidence of the other clones used for the survey has not been recorded

previously. Since about 40% of the rubber lands are planted with RRIC 100 at present, TPD seem to be one of the serious problems leading to low productivity in the country. Although survey results showed comparatively low incidence of TPD in clones RRIC 121 and RRIC 130 (Fig. 1a), continuous monitoring of trees for the incidence of TPD showed a higher intensity (over 30%) in RRIC 130 within 3 years of tapping in the first virgin panel in some sites (Senevirathna, 2006). This is mainly due to the high intensity of tapping over the recommended frequency for the clone. This indicates that over exploitation causes the increase of TPD. This was further evident by low TPD under low frequency tapping systems (Fig. 3a). Therefore, low frequency tapping systems ($\frac{1}{2}$ SD, *etc.*) are more suitable to minimise the incidence of TPD. Causes that weaken the growth of plants might have a greater effect on the incident of TPD, as reflected by increasing the %TPD with staggering the immature period from 5 to 8 years (Fig. 1d). It might be due to the use of poor quality planting material or/and poor immature upkeep of plantations. Therefore, the use of good quality planting materials at the beginning and implementation of correct management practices throughout are essential to shorten the immature period and hence to minimise this disorder.

External morphology of TPD affected trees showed that majority of

trees were without external symptoms besides dryness of the tapping cut, whilst a few (3%) trees were with abnormal out growth on the trunk, and the latter might be due to abnormal cell division and enlargement. TPD trees showing bark necrosis (Fig. 4a) are the irreversible type as observed by Jacob *et al.* (1994). Senevirathna (2006) has shown some other different categories of dry trees such as, 'throughout partial dry', 'throughout fully dry', 'conversion of partial to full dry' and 'recovered' trees. Therefore, the fluctuation of %TPD with time is expected, because of the differences in rates of onset and recovery of dry trees with time. Of these clones, the recovery percentage was less than that of conversion of partial to full dryness (Senevirathna, 2006). This is one of the reasons for exponential increase of TPD percentage from the tapping panel B0-1 to B1-2 and with the age of the plant (Fig. 1b, 2a). Similar exponential increase in TPD has been observed with girdling of plants of both affected and non-affected trees (Fig. 2c,d) and with the yield of plants (Fig. 2b) which was reflected by the behaviour with age of the plant (Fig. 2a). Since TPD affected trees are not tapped for a considerable period, rate of girdling is high in those trees. Therefore, the girth of affected trees is high compared to the healthy trees.

There was no clear pattern of distribution of affected trees as shown in the Fig. 4b. Unexpectedly, the % TPD was high in lands of less than 10°

gradient and in the sites where there were no rocks (Fig. 3c,d) compared to the other land categories. This is because, a number of shallow/ water logging/ flooding areas where the incidence of TPD was high, come under these two land categories. This is an indication that trees in those land categories are highly prone to TPD. This may be due to the physiological changes in such plants due to low root aeration or/and nutrient leaching. Therefore, such lands should be avoided as much as possible in future planting programmes. Furthermore, any stress factors that affect plants should be eliminated as far as possible in order to minimise the TPD disorder.

Since rubber tappers are the important regular observers of the trees and the environment, their observations are of prime importance in assessment of the degree and factors leading to this disorder. It was noticed that 70% of tappers are of the view that TPD is mainly caused by tapping on wet panels, and a future study on this aspect can be useful.

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Address for correspondence: Dr A.M.W.K. Senevirathna, Botanist, Rubber Research Institute of Sri Lanka, Dartonfield, Agalawatta, Sri Lanka.
E-mail: wasan@sltnet.lk, dirri@sltnet.lk