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The Impact of Vegetative Growth on the Incidence of Tapping Panel Dryness (TPD) in *Hevea brasiliensis*

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ABSTRACT

This study was carried out with a view of gathering information on incidence of tapping panel dryness (TPD) and the vegetative growth in *Hevea brasiliensis*. Two mature rubber fields of clone RRIC 121, one tapped for six and other for nine years were selected and three tapping blocks tapped by same harvester were identified from each of these two fields to conduct the study. In each tapping block the girth of all trees at a height of 150 cm from the bud union was measured. Further, on normaltapping days trees in all blocks were checked to identify yielding, partially dry and fully dry trees. Incidence of dryness was found to be more prevalent in trees in the highest and the lowest girth classes. Further analysis showed that the higher girth apparent in total dry trees was not dueto the untapped period of those trees. During harvesting trees in these girth classes could be subjected for over exploitation resulting in this behavior. Thus to arrest this situation it is proposed that such trees are exploited at a relatively lower tapping intensity through a shorter tapping cut than in the rest of the trees in the tapping block.

KEYWORDS: *Hevea brasiliensis*, Tapping intensity, Tapping panel dryness, Tree girth, Vegetative growth

INRTODUCTION

*Hevea brasiliensis*is one of the most economically important plantation crops in the world and is widely cultivated to harvest Natural Rubber (NR). These cultivations provide more than 95% of world natural rubber requirement. In Sri Lanka 127,000 ha are under rubber producing around 158 million kg of natural rubber annually (Anon, 2011). Chemically natural rubber is a cis-polyisoprene (Sethuraj and Mathew, 1992) and it cannot be completely substituted by synthetic rubber.

The natural rubber containing latex is found in the anastomosing latex vessel system found in the bark of the tree. The harvesting process in a rubber tree is known as Tapping and it induces the latex to flow out from the vessels. The total exploitation period of a tree is about 25 years (Sethuraj and Mathew, 1992). Tapping significantly affects the growth of the rubber tree due to tissue injury and regeneration of lost latex. Also, significant levels of mineral nutrients and photosynthetic assimilates are removed with latex during tapping. Therefore, with tapping the tree becomes fatigue. This is believed to cause tapping panel dryness (TPD) in *Hevea* (Seneviratne, 2012). TPD is defined as a "Tappable rubber tree from a recommended clone, unable to give economic yields through any recommended tapping technique, due to non-production or obstruction in latex flow in the drainage area of the tapping cut" (Anon, 2009).

It is considered a physiological disorder and is generally believed that the high yielding clones of natural rubber are relatively more susceptible to it (Tillakaratne and Nugawela, 2001). Productivity level of rubber cultivations plays a key role in overall profitability. The level of productivity varies considerably from cultivation to cultivation due to various factors such as differences in clones planted, agronomic practices adopted, climate *etc.* TPD is also one other factor determining productivity and could result in decline in land productivity by approximately 15-20%.

The common symptom of a TPD affected tree is panel dryness which gives the name to the disorder. TPD has basically been categorized into two, *i.e.* reversible and irreversible dryness depending on the ability to yield latex on tapping. However, symptoms of TPD in terms of morphological features and nature of latex production are rather complicated. This is evident by trees with partial and fully dryness, trees with bark out-growth and bark cracks, and trees recovered from dryness *etc.* (Anon, 2007). Also brown discoloration of cortical tissues may or may not occur. Besides cessation of latex flow, terminal symptoms like bulging, necrosis and cracking of the bark have been observed. Cracking of bark below the tapping panel is commonly noticed. But rarely this symptom appears above the tapping panel. Coagulation of latex inside vessels and partial emptiness of latex vessels are also observed. The symptoms are observed also on the root stock and root. In most of the partially affected trees, dry portion is confined to the roots below the dry portion in the scion (Anon,2009). In some instances dryness is temporary. Such trees will yield when the tree is rested for a period of six months (Tillakaratne and Nugawela, 2001).

Fatigue related TPD is due to over exploitation leading to reduce sucrose content in the latex during early stages of the syndrome and can be either reversible or irreversible depending on the degree of the fatigue. Also, this may either be converted or not into necrotic TPD. Over exploitation *i.e.* high frequency tapping, long cuts, deep tapping and over stimulation can aggravate the condition of TPD. Also, it has been found that over stimulation results in large dry patches in the tapping panel (Anon, 2009).

There is no chemical treatment available to-date for curing the TPD syndrome in rubber plants. Preventive measures are the best strategies to overcome this disorder. Use of good quality planting material in new plantings, adoption of good agricultural practices throughout the lifespan and use of low frequency tapping are the control measures for TPD (Anon, 2009).

There is a belief among growers and researchers that the incidence of TPD is more prevalent in trees with a relatively higher vegetative growth as indicated by a higher girth (Perera and Nugawela, 2011), but has not been conclusive due to inadequate number of plants selected for the study. The objective of this study is to investigate the relationship between tree girth and TPD using an adequate sample of trees.

The outcome of this study will provide new knowledge about TPD to the rubber growers enabling them to control the incidence of TPD levels in their rubber cultivations.

MATERIALS AND METHODS

Location

The study was carried out at Muwankanda estate, Mawathagama and Kurunegala during the period of February to March 2013. Kurunegala district belongs to the mid country intermediate zone (NWP) where annual rainfall ranges from 1750 to 2500 mm whilst the annual mean temperature ranges from 24° C to 31° C.

Experimental Area

Two mature rubber fields of clone RRIC 121,one tapped for six and the other for nine years were selected for the study. From each of the two fields, three tapping blocks tapped by same harvester were identifiedto collect data. Generally, one tapping block consists of about 300 trees which is the number of trees that can be tapped by a harvester per day.

Collection of Data

In each of the tapping blocks selected for the study, the girth of all rubber trees were measured at a height of 150 cm from the bud union of the tree. Then the trees in each tapping block were categorized into girth classes of, 45 cm or less, 46 to 50 cm, 51 to 55 cm, 56 to 60 cm, 61 to 65 cm, 66 to 70 cm, 71 to 75 cm, 76 to 80 cm, 81 to 85 cm and 86 cm or higher. In the field to identify as to which girth class a tree belongs the trees were labeled one to ten, with one representing the lowest and highest girth classes. The number of trees belonging to each of the ten girth categories in the different tapping blocks selected for the study (Table 1).

Separately, for each tapping block and girth category, and the total number of trees and the number of fully and partially dry trees were counted. During tapping period, if the entire length of tapping cut was found to be dry it was taken as a fully dry tree. Partial dry trees were those that yielded in less than 50% of the length of the tapping cut. The rest were counted as healthy trees.

In each of these trees, the total bark consumptionwas measured using a measuring tape. The difference in bark consumption of healthy and dry trees was used to estimate the period in which the dry trees were left untapped.

Table 1. The number of trees in each girth category of the selected tapping blocks

Girth class	2002 – Field			1998 - Field		
	Tapping block			Tapping block		
	1	2	3	1	2	3
1	1	1	1	7	0	5
2	6	3	4	3	6	2
3	9	6	15	4	13	9
4	29	11	41	10	15	21
5	53	38	70	24	27	27
6	58	42	74	39	39	38
7	54	47	44	36	43	36
8	52	41	27	29	25	44
9	32	33	19	36	27	31
10	21	31	8	52	34	29
Total	**315**	**253**	**303**	**240**	**229**	**242**

Statistical Analysis

The data were statistically analyzed by performing regression analysis and pearson correlation test using statistical package of Minitab 15.

RESULTS

Effect of Number of Years Tapped on TPD

The percentage of fully TPD trees increased with the increasing number of years tapped. Thetotal number of TPD trees, i.e. both partially and fully dried trees, was also high in the field tapped for the highest number of years. It was 14 and 20 percent in the fields tapped for six and nine years respectively (Figure 1).

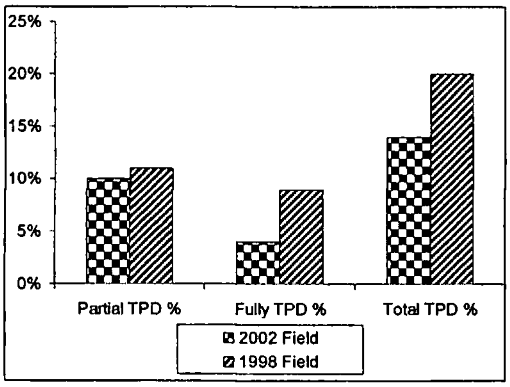

Figure 1. Field wise total, fully and partially dried trees as a percentage of the total number of trees in the field

Relationship between Girth and TPD

In all fields studied, the percentage of total TPD trees tends to be high in the highest and lowest girth classes. Further the total TPD percentage appears to be highest in girth class two in all fields (Figure 2).

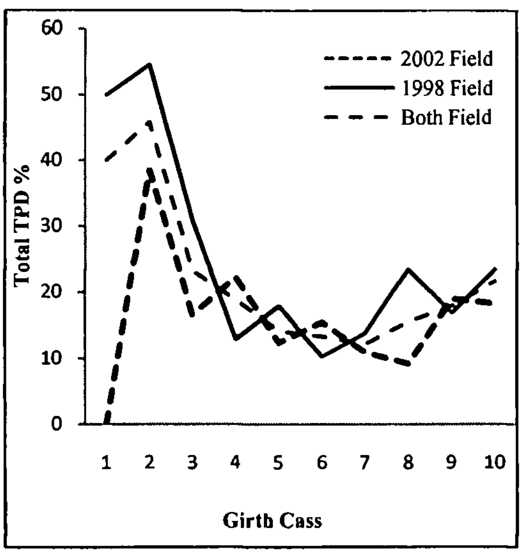

Figure 2. Percentage of total TPD trees (Full and Partial) in different girth classes

The above relationship was further examined using only the fully dry trees. The relationship observed was similar to the relationship observed with the total dry trees(Figure 3). Further, the percentages of fully TPD trees appear to be increasing gradually from the fifth to the tenth girth class(Figure3).

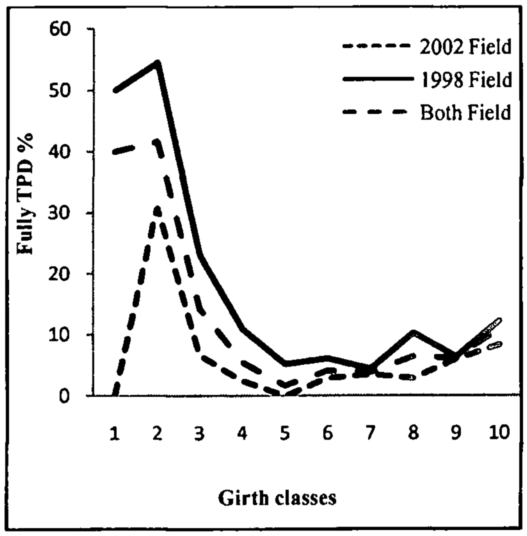

Figure 3.Percentage of fully TPD trees in different girth classes

Further this relationship was studiedby using the data which gathered from the fieldsof 2002and 1998. In both fields an almost a linear relationship between girthclasses and percentage of fully TPD trees was apparent from girth class five to ten.

Using the data which gathered from this girth range a regression and a correlation analysis was performed using Minitab 15. A strong positive correlation was observed between girth class and percentage total dry trees (Figure 4 and Table 2).

Table 2. Equations fitted to figures 4 and 5

	Regression equation	P-Value	Pearson correlation
Figure 4	Y = 5.12+0.608 X	0.006	0.935
Figure 5	Y = 4.26+0.439 X	0.102	0.727

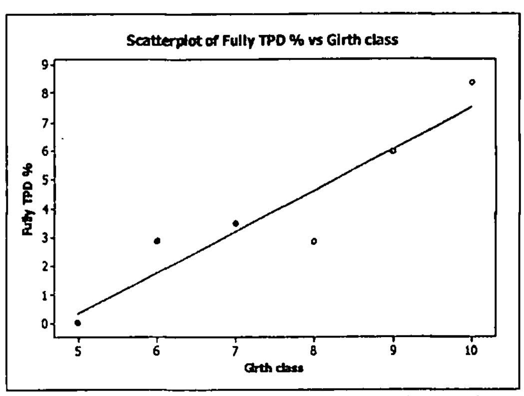

Figure 4. Relationship between girth class andfully TPD trees in the 2002 field

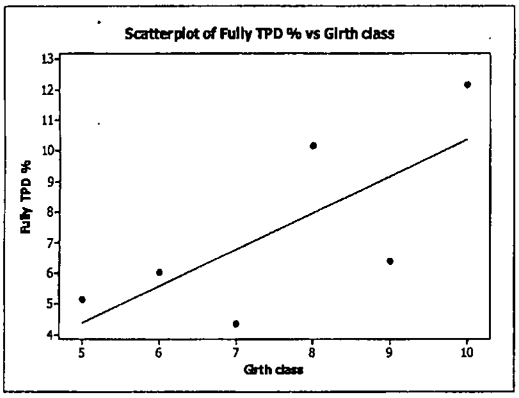

Figure 5. Relationship between girth class and fully TPD trees in the 1998 field

A higher incidence of TPD was also apparent in the lowest girth classes. One might argue that this is due to an inflated percentage of dry trees due to the lower number of trees generally found in these lower girth categories. Thus, girth of trees in the six tapping blocks selected for the study were ranked from the lowest to the highest girth and were separated into 10 groups commencing from the lowest girth tree. Each group had the same number of trees. For each group the average girth and the percentage of fully and total dry trees were calculated. The correlation between the girth class and the fully and total dry trees confirmed that the incidence of dryness is relatively high in trees having a lower girth as well (Figure 6).

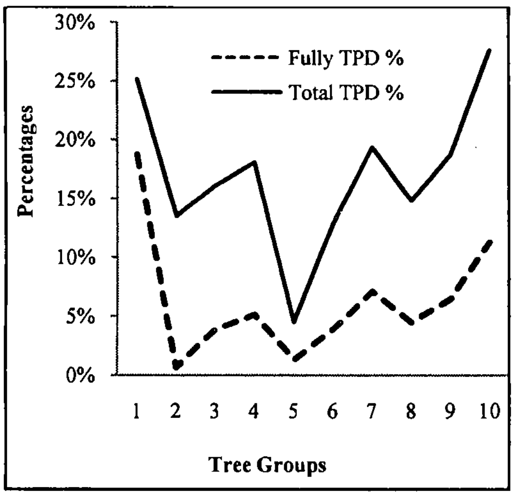

Figure 6. Percentage of fully TPD trees and total TPD trees in differenttree groups based on girth of trees in all tapping blocks of selected for the study

Relationship between Untapped Period and Girth of TPD Trees

To check whether the relationship between TPD and higher girth is due to non-tappingof dry trees or not, the relationship between girth class of fully dried trees and the untapped period was analyzed.Girths of trees did not increase significantly during the untapped period (Figure 7).

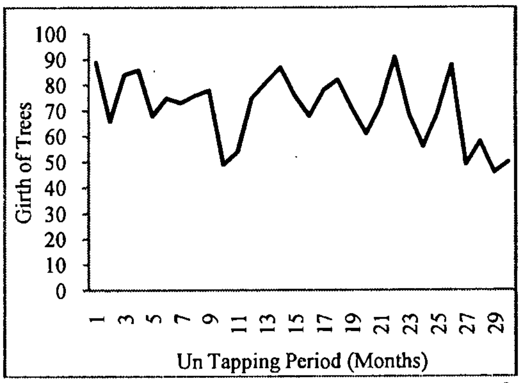

Figure 7. Relationship between untapped period and girth increment

DISCUSSION

The results of the study indicate that the incidence of TPD has increased with the number of years of tapping (Figure 1). The reason for this could be that with increasing period of harvesting the trees can be subjected to over exploitation, i.e., harvesting more than the regeneration capacity. Therefore the condition of tree fatigue could increase with the number of years of harvesting. This study also confirms that the extent of vegetative growth of trees is associated with the incidence of TPD. A higher incidence of fully and partially TPD trees were observed in the highest as well as the lowest girth classes (Figures 2, 3 and 6).Generallytrees with a higher girth yields relatively more than the rest. It is also believed that harvesters tend to over exploit the high yielding trees. Therefore, there is a possibility of higher girth trees to become over exploited leading to fatigue conditions.Also, when trees in the lowest girth classes are tapped at the same intensity as others in same tapping block over exploitation of such trees could occur leading to TPD. Thus it is proposed that trees in both lowest and highest girth classes are tapped at relatively lower tapping intensities than the rest of the trees in the field.

CONCLUSIONS

The study revealed that the incidence of TPD is more prevalent in fields tapped for more number of years. Further, the incidence of TPD was high in trees belonging to the lowest and the highest girth trees. It is argued that the incidence of TPD is high in both higher and lower girth classes due to possible over exploitation. Therefore it is proposed to harvest these trees at a relatively lower tapping intensity using shorter tapping cut.

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