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EFFECT OF PUNCTURE TAPPING SYSTEMS ON YIELD AND SELECTED PHYSIOLOGICAL LATEX PARAMETERS OF RUBBER (*HEVEA BRASILIENSIS* MUELL. ARG.)

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By

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LIST OF ABBREVIATIONS

a. i.	Active ingredient
ANOVA	Analysis of variance
BF'	Bottom fraction
BI	Bursting index
CRD	Completely Randomized Design
DMRT	Duncan Multiple Range Test
DRC	Dry rubber content
DTNB	Dithiobis 2-nitrobenzoic acid
EDTA	Ethylinediaminetetraacetic acid
g/t/t	Grams of dry rubber yield per tree per tapping
kg/ha/year	Kilograms per hectare per year
mM	Milimoles per litre
Mw	Molecular weight
Na2HPO4	Sodium dihydroxide phosphate
NaOH	Sodium hydroxide
nM	Namometers
P*i*	Inorganic phosphorus
PROL	Proline
R-SH	Thiols group

RCBD	Randomized Complete Block Design
rpm	Revolution per minute
RRIES	Rubber Research Institute Experiment Station
RRIM	Rubber Research Institute of Malaysia
SAS	Statistical Analysis System
SSA	Sulfosalicylic acid
SUC	Sucrose
TCA	Trichloroacetic acid
TSC	Total solid content

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Chairman: Associate Professor Dr. Wong Kai Choo

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These studies were carried out to evaluate the effect of puncture tapping system on yield performance of clone RRIM 600 and PR 261 and selected physiological latex parameters of clone RRIM 600. Three main experiments were carried out. The first and second experiments studied the effect of number of punctures, puncture strips and times of tapping on yield performance of clones RRIM 600 and PR 261 during the last five and six years respectively. The third experiment studied the effect of number of puncture strips and panel position on yield as well as on selected physiological latex parameters of RRIM 600 over one year duration.

The rubber yield of clones RRIM 600 and PR 261 was not affected by the number of punctures (3, 6, 9 and 12), puncture strips (single and triple) and times of tapping (7:00, 9:00, 11:00 am and 1:00 pm). However the yield of puncture tapped trees was comparable to that of 1/2S d/2 tapped excision unstimulated control.

Yield performance of clone RRIM 600 was also not affected by either high or low panel position. All puncture tapped trees with three strips produced similar yield as 1/2S d/2 tapped unstimulated control.

Among the physiological latex parameters related to latex flow affected by puncture tapping system were bottom fraction (BF) and thiol (RS-H), while no significant effects were noted on bursting index (BI) and dry rubber content (DRC). Trees puncture tapped with three strips on high panels HO-1 and HO-2 recorded the highest percentage of BF while trees puncture tapped with single strip on panel BO-2 recorded the lowest percentage of BF. However puncture tapping treatments did not result in higher percentage of BF than 1/2S d/2 and 1/4S↑d/2 tapped unstimulated controls. Among puncture tapped trees the highest RS-H was recorded with three strips tapped on panel BO-2. The other puncture tapped treatments recorded similar RS-H to that of 1/2S d/2 and 1/4S↑d/2 tapped unstimulated controls.

Most of the physiological latex parameters (pH, proline, inorganic phosphorus (P_i) and sucrose) related to latex regeneration were affected by puncture tapping, with the exception of total solid content (TSC). On the high panels the values for all these parameters under puncture tapping were higher than those of 1/4S↑ d/2 tapped unstimulated control. However on basal panel BO-2 only proline and sucrose under puncture tapping recorded higher values than 1/2S d/2 tapped unstimulated control. Among puncture tapping treatments the panel position did not affect the mean values of these parameters.

There were better correlations between yield and physiological latex parameters in puncture tapped trees. Among these correlations observed were the positive correlations of yield with proline, P_i, thiol and sucrose. Sucrose was related positively with proline and P_i.

Comparative studies between different seasons in a year show that there were no significant seasonal effects on yields. However in contrast the majority of the physiological latex parameters with the exception of BI were affected by different seasons. High values were recorded for DRC, TSC, RS-H, P_i and sucrose during the high yielding season in the year.

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Universiti Pertanian Malaysia Sebagai Memenuhi
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**KESAN SISTEM TOREHAN
PENGHASILAN DAN PARAMETER FISIOLOGI LATEKS
TERPILIH (*HEVEA BRASILIENSIS* MUELL. ARG.)**

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Kajian dijalankan untuk menilai kesan sistem torehan cucuk ke atas prestasi hasil klon-klon RRIM 600 dan PR 261 dan beberapa parameter fisiologi lateks terpilih ke atas klon RRIM 600. Tiga percubaan telah dilaksanakan. Percubaan pertama dan kedua mengkaji kesan bilangan cucukan, jalur cucukan dan masa menoreh ke atas prestasi hasil klon-klon RRIM 600 dan PR 261 masing-masing untuk tempoh selama lima ke enam tahun. Percubaan ketiga ialah untuk mengkaji kesan bilangan jalur cucukan dan kedudukan panel ke atas hasil dan juga ke atas

beberapa parameter fisiologi lateks terpilih bagi klon RRIM 600 untuk jangkamasa selama satu tahun.

Pengeluaran hasil getah klon-klon RRIM 600 dan PR 261 tidak dipengaruhi oleh bilangan cucukan (3, 6, 9 dan 12), jalur cucukan (satu jalur dan tiga jalur cucukan) dan waktu menoreh (7:00, 9:00, 11:00 pagi dan 1:00 petang). Walau bagaimanapun, hasil dari pokok-pokok yang ditoreh secara cucukan adalah setanding dengan hasildari kawalan (sistem torehan 1/2S d/2 tanpa rangsangan).

Prestasi hasil klon RRIM 600 juga tidak dipengaruhi oleh paras panel torehan sam ada di paras tinggi atau rendah. Kesemua pokok-pokok yang ditoreh secara cucukan pada tiga jalur cucukan memberikan hasil yang setanding dengan hasidari kawalan (sistem torehan 1/2S d/2 tanpa rangsangan).

Di antara parameter fisiologi lateks yang dikaitkan dengan pengaliran lateks dan dipengaruhi oleh sistem torehan cucuk ialah Bottom Fraction (BF) dan Thiol (RS-H), manakala parameter-parameter Bursting Index (BI) dan Kandungan Getah Kering (KGK) didapati tidak dipengaruhi oleh sistem torehan cucuk. Pokok-pokok yang ditoreh pada panel di sebelah atas HO-1 dan HO-2 merekodkan nilai peratus BF yang tertinggi. Sungguhpun demikian, rawatan sistem torehan cucuk tidak menghasilkan peratus BF yang lebih tinggi berbanding dengan kawalan iaitu sistem torehan 1/2S d/2 dan sistem torehan 1/4S↑d/2 tanpa rangsangan. Nilai RS-H yang tertinggi direkodkan oleh pokok-pokok yang ditoreh dengan sistem torehan cucuk pada tiga jalur cucukan di panel BO-2. Rawatan dengan sistem torehan cucuk yang lain merekodkan nilai RS-H yang setanding dengan kawalan sistem torehan iaitu 1/2S d/2 dan sistem torehan 1/4S↑d/2 tanpa rangsangan.

Kebanyakan parameter fisiologi lateks yang dikaitkan dengan pengeluaran lateks dipengaruhi oleh sistem torehan cucuk kecuali parameter Total Solid Content (TSC). Untuk panel sebelah atas, nilai-nilai parameter itu adalah lebih tinggi dari kawalan iaitu sistem torehan 1/4S↑d/2 tanpa rangsangan. Walau bagaimanapun, pada panel di sebelah bawah BO-2, hanya "proline" dan "sucrose" mencatatkan nilai yang lebih tinggi dari kawalan iaitu sistem torehan 1/2S d/2 tanpa rangsangan. Bagi rawatan-rawatan torehan cucuk, kedudukan panel torehan tidak mempengaruhi nilai-nilai parameter tersebut.

Bagi pokok-pokok yang ditoreh dengan sistem torehan cucuk didapati korelasi perkaitan di antara hasil dan parameter fisiologi lateks adalah lebih baik. Keputusan yang diperolehi menunjukkan perkaitan yang positif di antara hasil dengan "Proline", P*i*, Thiol dan "Sucrose". Korelasi yang positif juga ditunjukkan di antara "Sucrose" dengan "Proline" dan juga P*i*.

Kajian perbandingan di antara musim yang berlainan dalam setahun menunjukkan bahawa musim tidak mempunyai kesan yang ketara ke atas hasil. Sungguhpun demikian, kecuali BI, keputusan yang bertentangan diperolehi ke atas majoriti parameter fisiologi lateks. Ini kerana parameter-parameter tersebut dipengaruhi oleh musim yang berlainan. Nilai yang tinggi direkodkan untuk KGK, TSC, RS-H, P*i* dan "Sucrose" ketika musim hasil tinggi dalam tahun tersebut.

CHAPTER I

INTRODUCTION

Natural rubber *Hevea brasiliensis* (Muell. Arg.) is classified as strategic material because it is an important raw material used in the manufacture of a wide range of industrial products such as tyres, engineering components and latex products, which are considered to be the essential ingredients of modern life. In fact among the few economic plants, rubber trees have had the greatest influence on industrial development and human life.

In the early days of the rubber history, rubber trees were exploited for latex by different methods of extraction. These methods, though involving many instruments and complicated techniques, gave poor yields, poor bark regeneration and shortened the economic life of the trees. These methods of latex extraction were improved when Ridley (1890) introduced the continuous excision method of tapping which is considered as one of the most important scientific and economic contributions to the success of the rubber industry (Abraham, 1976).

Excision method is still the main tapping system of latex extraction used by the rubber industry. This technology was developed when labour was plentiful and cost of production was negligible. It is, therefore, evident that this technology is grossly ill equipped and no longer appropriate to overcome the current serious constraints of the rubber industry such as high production cost, shortage of skilled labour and low rubber prices (Sivakumaran, 1991a).

An alternative to excision tapping system is puncture tapping introduced by Tupy (1973), which is an incision method whereby tapping is done by using a special needle mounted on a wooden holder to puncture a vertical strip which has been previously scraped and stimulated. This new technique of latex extraction was only possible with the discovery of ethephon (2-chloroethyl-phosphonic acid) as a yield stimulant (Abraham, 1977). Puncture tapping has the potential to be developed as an alternative system to conventional tapping, with higher yields and less risk of tree exhaustion (Leong and Tan, 1977).

Puncture tapping system with conventional methods of stimulation can be adopted for specific purposes such as exploitation of young rubber trees, allowing longer periods of maturity for bark renewal on tapped panels and prolonging the economic life of a given tapping panel (Sivakumaran, 1991b). In addition, yields obtained with this technique are reported to be similar or higher than that of the unstimulated conventional 1/2S d/2.

However the adoption of puncture tapping systems by the Natural Rubber Industry has not been encouraging although puncturing is a simple and easy method of latex extraction and does not require skilled tappers, because the bark of the tree is not shaved as is the case with excision methods.

Research conducted on puncture tapping has mainly emphasized on mechanical and agronomic aspects such as number of punctures, number of strips, clonal response and puncture tools. There is a lack of adequate information on effect of puncture tapping on the physiological latex parameters with regard to panel position and tapping times. In addition there is insufficient comparisons between conventional and puncture tapping with regard to physiological latex parameters.

Certain physiological latex parameters are correlated to yield (Jacob et al., 1989). These parameters may control production directly or indirectly, and may contribute to a better understanding of the physiological status of the trees, favoring optimization of exploitation by avoiding the exhaustion of the laticiferous system, thus enabling maximum production potential.

In view of this background, this project was initiated with objectives to study the effect of puncture tapping on yield of rubber and physiological latex parameters. It is hypothesized that this technique does not adversely affect latex physiology and rubber yield when compared to conventional excision tapping methods.

CHAPTER II

REVIEW OF LITERATURE

Exploitation of *Hevea brasiliensis*

The history of exploitation of *Hevea brasiliensis* started in Brazil in the 19th century when latex was extracted from wild rubber trees by excision methods. These methods consisted of making a series of cuts on the bark with a long machete. However these methods of tapping damaged the cambium, thus shortening the economic life of the trees. These methods were improved when Ridley (1890) discovered the continuous excision method that was based on the specific characteristic of *Hevea* bark (Abraham, 1975).

Tapping methods have been continuously modified since *Hevea* was introduced in the Far East at the beginning of this century, and today when rubber trees are planted in millions of hectares, exploitation methods are far different from the original one practised in the Amazon jungle.

The tapping cut itself has displayed a whole range of geometrical forms. The earlier system were V cuts vertically under one another, followed later by the half of full herringbone system. In the early part of the 20th century new approaches to tapping were introduced, involving so many factors such as number, type and length