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EFFECTS OF TAPPING AND STIMULATION FREQUENCY ON PERFORMANCE OF YIELD AND SELECTED LATEX PHYSIOLOGICAL PARAMETERS OF RUBBER (HEVEA BRASILIENSIS MUELL.ARG.) CLONES RRIM 600 AND GT 1

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by
DO KIM THANH

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LIST OF ABBREVIATIONS

a.i.	Active ingredient
ANOVA	Analysis of variance
BF	Bottom fraction
DRC	Dry rubber content
ET	Ethephon
Ga	Groove application
GT	Gondang Tapeng
g/t/t	Grams of dry rubber yield per tree per tapping
IFR	Initial flow rate
IRCA	Institut des Recherches sur le Caoutchouc
Kg/ha	Kilograms of dry rubber per hectare
mM	Milimoles per litre
MW	Molecular weight
Pi	Inorganic phosphorus
PI	Plugging index
RCBD	Randomized Complete Block Design
RRIES	Rubber Research Institute Experiment Station
RRIM	Rubber Research Institute of Malaysia
R-SH	Thiol group
TSC	Total solid content

Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Agricultural Science

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August, 1995

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Faculty: Agriculture

Three experiments were conducted on two rubber clones to study the effects of tapping and stimulation frequency on performance of yield and some selected latex physiological parameters. The first experiment studied the long-term effects of various frequencies of 2.5% ethephon stimulation on yield performance of RRIM 600 over 14 years duration. The second experiment investigated the various combinations of tapping and stimulation frequency on the yield performance of GT 1

over 14 years duration. A short-term experiment of four years constituted the third experiment which studied the effects of tapping and stimulation frequency on performance of yield, some selected latex physiological parameters and bark characteristics of RRIM 600.

Low tapping frequencies of third-daily (d/3) and fourth daily (d/4) generally produced higher mean dry rubber yield per tree per tapping (g/t/t) than the conventional tapping frequency of alternate daily (d/2). This was true for both clones RRIM 600 and GT 1 irrespective of duration of yield recording and frequency of stimulation application. However, variable results were obtained with regard to mean dry rubber yield per hectare per year (kg/ha/year). With clone GT 1 under no stimulation or when stimulated at low frequency of two rounds per year (2/y), low tapping frequencies (d/3 and d/4) resulted in lower mean yield (kg/ha/year) than the d/2 tapping frequency. However, with increased stimulation frequency of 4 - 6 rounds per year, mean yield (kg/ha/year) were comparable among the three tapping frequencies. With clone RRIM 600, low tapping frequency (d/4) always resulted in lower mean yield (kg/ha/year) than d/2 tapping frequency irrespective of stimulation.

Long-term responses to stimulation were governed by clonal differences as well as frequency of tapping and

stimulation application. With RRIM 600 tapped on low frequency of d/3, stimulation at eight rounds per year resulted in higher mean yields (g/t/t and kg/ha/year) than the unstimulated control. With GT 1, stimulation at four rounds per year was sufficient to give significant response when tapped at low tapping frequencies of d/3 and d/4. However, when tapped at high frequency of d/2, no positive response to stimulation was obtained. Low frequency of stimulation application was necessary for sustained and positive response. When very high stimulation frequency of 30 rounds (30/y) or 60 rounds (60/y) per year were applied, the bulk of the increase in response was only recorded in the first year of tapping , with increase thereafter being marginal when compared to the control. No significant differences were obtained between stimulation frequencies of 30/y and 60/y. Frequency of stimulation up to as high as 30 rounds per year did not result in significant incidence of dryness.

Trees tapped on d/4 frequency in contrast to d/2 recorded consistently higher readings of latex physiological parameters such as plugging index (PI), initial flow rate (IFR), total solid content (TSC) and dry rubber content (DRC). However, d/4 tapping frequency resulted in lower bottom fraction (BF), thiol content (R-SH) and inorganic phosphorus content (Pi) than d/2 tapping frequency. Intensive stimulation (30/y and 60/y)

produced lower values of PI, IFR, TSC and DRC but higher values of BF and Pi when compared to unstimulated control or low stimulation frequency of four rounds per year.

Bark thickness and number of latex vessels were not affected by tapping and stimulation treatments.

Abstrak tesis dikemukakan kepada Senat
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KESAN PENOREHAN DAN FREKUENSI PERANGSANGAN KE ATAS PRESTASI HASIL DAN PARAMETER FISIOLOGI LATEKS TERPILIH GETAH (*HEVEA BRASILIENSIS* MUELL. ARG.) KLON RRIM 600 DAN GT 1

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Tiga percubaan telah dilaksanakan ke atas dua klon, untuk mengkaji kesan-kesan penorehan dan frekuensi perangsangan ke atas prestasi hasil dan beberapa parameter fisiologi lateks terpilih. Percubaan pertama mengkaji kesan jangkamasa panjang beberapa frekuensi perangsangan etefon 2.5% ke atas prestasi hasil RRIM 600

untuk tempoh 14 tahun. Percubaan ke dua mengkaji beberapa kombinasi frekuensi torehan dan perangsangan ke atas prestasi hasil GT 1 untuk tempoh 14 tahun. Percubaan jangkamasa pendek selama empat tahun merupakan percubaan ke tiga yang mengkaji kesan frekuensi penorehan dan perangsangan ke atas prestasi hasil, beberapa parameter fisiologi lateks terbilih dan sifat kulit klon RRIM 600.

Torehan berfrekuensi rendah tiga hari sekali (d/3) dan empat hari sekali (d/4) secara amnya menghasilkan purata hasil kering yang tinggi per pokok per torehan (g/t/t) berbanding dengan frekuensi torehan konvensional selang sehari (d/2). Ini adalah nyata pada kedua-dua klon RRIM 600 dan GT 1 tanpa mengira tempoh hasil direkodkan dan frekuensi amalan perangsangan. Sungguh pun demikian, hasil yang berbeza diperolehi apabila mengambil kira purata hasil kering se hektar setahun (kg/ha/tahun). Bagi klon GT 1, samada tanpa perangsangan atau apabila dirangsangkan dengan frekuensi rendah dua pusingan setahun (2/y), serta ditoreh dengan torehan berfrekuensi rendah (d/3 dan d/4), akan memberikan purata hasil (kg/ha/tahun) yang kurang menggalakkan berbanding dengan frekuensi torehan d/2. Walau bagaimanapun, dengan peningkatan frekuensi perangsangan ke 4-6 pusingan setahun, purata hasil (kg/ha/tahun) adalah setanding di antara tiga frekuensi torehan. Bagi

klon RRIM 600, torehan berfrekuensi rendah (d/4) selalunya memberikan purata hasil yang rendah (kg/ha/tahun) berbanding dengan torehan berfrekuensi d/2 tanpa mengira perangsangan.

Respon perangsangan jangkamasa panjang dipengaruhi oleh perbezaan sifat klon dan juga frekuensi torehan dan amalan perangsangan. Klon RRIM 600 apabila ditoreh dengan frekuensi rendah d/3 dengan perangsangan lapan pusingan setahun, menberikan purata hasil yang tinggi (g/t/t dan kg/ha/tahun) berbanding dengan kawalan tanpa perangsangan. Bagi klon GT 1, perangsangan empat kali setahun adalah memadai untuk memberikan respon yang signifikan apabila ditoreh dengan torehan berfrekuensi d/3 dan d/4. Sungguhpun demikian, apabila ditoreh dengan kekerapan yang lebih tinggi d/2, tiada respon positif yang dihasilkan. Amalan perangsangan berfrekuensi rendah adalah perlu untuk respon yang positif dan berpanjangan. Apabila frekuensi perangsangan yang terlalu tinggi, 30 pusingan (30/y) atau 60 pusingan (60/y) di amalkan, sebahagian besar peningkatan respon hanya direkodkan pada tahun pertama penorehan, dengan peningkatan seterusnya adalah setara apabila dibandingkan dengan kawalan. Tiada pebezaan yang signifikan dihasilkan di antara frekuensi perangsangan 30/y dan 60/y. Frekuensi perangsangan sehingga 30 pusingan setahun tidak mengakibatkan kejadian kekeringan yang ketara.

Pokok-pokok yang ditoreh dengan torehan berfrekuensi d/4 setiasa menunjukkan bacaan parameter fisiologi lateks yang tinggi berbanding dengan d/2, seperti indeks palam (PI), kadar pengaliran awal (IFR), kandungan jumlah pejal (TSC) dan kandungan getah kering (DRC). Walau bagaimanapun, frekuensi torehan d/4 mengasilkan bacaan yang rendah ke atas bahagian bawah getah (BF), kandungan thiol (R-SH) dan kandungan posforan bukan organan (Pi) berbanding dengan frekuensi torehan d/2. Perangsangan yang intensif (30/y dan 60/y) memberikan nilai PI, IFR, TSC dan DRC yang rendah tetapi menunjukkan nilai BF dan Pi yang tinggi apabila dibandingkan dengan kawalan tanpa perangsangan atau frekuensi perangsangan yang rendah empat pusingan setahun.

Ketebalan kulit dan bilangan saluran lateks tidak dipengaruhi oleh rawatan penorehan dan perangsangan.

CHAPTER 1

INTRODUCTION

The planting of rubber trees as a plantation crop in the early part of the century provided the impetus for extensive studies on development of exploitation systems for latex production. The exploitations used today besides various tapping systems include several stimulation practices. The half spiral alternate daily tapping system has been a widely used and popular system over the years (RRIM, 1957; Edgar, 1958; Ng et al., 1969; Lukman, 1992). The use of this system which results in high yields per hectare, generally gives lower yields per tree per tapping when compared to less frequent tapping systems, viz. half-spiral third daily tapping system (de Jonge, 1961; Paardekooper et al., 1976; Gan et al., 1986). It is assumed that the higher yield per tapping with less frequent tapping is due to the longer duration between tappings available for regeneration in the latex vessels (Gener and du Plessix, 1976; Jacob et al., 1989).

Although extensive research had been carried out on stimulation nevertheless Abraham et al. (1968a) was the first to report the use of a very potent stimulant, namely 2-chloroethyl phosphonic acid (ethephon) on rubber trees. It was reported that with this stimulant yield can be increased two to three folds compared to unstimulated trees. Since then, extensive research has been carried out on the effective use of ethephon to improve the productivity of *Hevea* trees (Abraham et al., 1971a; 1971b; 1972). Ethephon has consequently become a very wide and extensively used stimulant in most of the rubber growing countries of the world (d'Auzac, 1989).

In the early stages of ethephon use, the primary objective was to enhance the yield production on existing moderate to intensive tapping systems with high concentrations of ethephon. However, it was established that there was yield depression after two to three years of continuous stimulation. In the face of these developments, ethephon stimulation was re-examined and emphasis placed on the application of lower concentrations at less frequent intervals for moderate to intensive tapping systems (Abraham and Ismail, 1983). It was apparent that the interactions between tapping and stimulation frequency would be of critical importance in terms of the long term productivity of *Hevea* trees (Eschbach and Lacrotte, 1989; Paardekooper, 1989).

In the light of this scenario, studies were also carried out simultaneously to establish the effects of stimulation on latex physiological parameters. These studies have provided a better understanding of the physiological condition of the laticiferous system in relation to tapping and stimulation (Jacob et al., 1986).

Studies were consequently concentrated to develop appropriate judicious methods of stimulation, that would allow for the uniform and sustained yield productivity over the long term. Thus several long-term experiments were established to study these various aspects. The parameters concerned in these experiments include reduced frequency of tapping in combination with the application of low concentrations of ethephon at less frequent intervals. The scope of the present investigation was to examine and analyse in depth the data obtained from two such long-term experiments to establish the long-term effects of judicious methods of exploitation on yield productivity and related aspects over successive tapping panels of two widely planted clones, viz. RRIM 600 and GT 1. In addition, the effects of intensive stimulation over limited duration on latex physiological parameters and bark anatomy were examined on clone RRIM 600.