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Testing of ethylene stimulation to enhance latex yield of *Hevea brasiliensis* clone RRIM 600 in Southern Thailand

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Abstract. Recently, latex price has continuously increased, This motivates rubber smallholders in southern Thailand to increase latex productivity. Then, ethylene stimulation has been introduced in tapping systems. Therefore, it needs to be tested before recommendation to the smallholder. An experiment was established at Thepa Research Station, Songkhla province. Rubber clone RRIM 600 (20 year-old) was used in the experiment. The experiment was designed as one-tree-plot design with 20 replicates. There was 6 treatments: 1) 1/3S↑ 2d/3 (C), 2) 1/8S↑ 1d/3, 3)1/8S↑ 1d/3 + RRIMFLOW (RF), 4)1/8S↑ 1d/3 + LET (LET), 5) 1/8S↑ 1d/3 + Double Tex (DT) and 6) 1/8S↑ 1d/3 + Ethyphon 5% (E). The experimental period was during June 2010 to February 2011. It was found that the RF treatment provided the highest rubber productivity (137.7 g/tree/tapping and 5.9 kg/tree/year), and it was significantly different from the remaining treatments. According to latex diagnosis, sucrose in the RF treatment trended to decrease, but inorganic phosphate and thiol trended to increase.
Keywords: *Hevea brasiliensis*, ethylene stimulation, latex production, latex diagnosis.

Introduction

Rubber *(Hevea brasiliensis)* is an important economic crop of Thailand, the majority of plantation is in southern Thailand (RRIT, 2011). Moreover, the trend of natural rubber production increases higher than synthetic rubber leading to high demand of natural rubber with the higher price. This inspires the rubber smallholder to increase income by using high tapping frequency, or using ethephon stimulation (Leconte *et al.*, 2006). According to the innovation of tapping system evolved from conventional tapping with using ethylene (2-chloroethylphosphonic acid) generator, it is applied to tapping panel to increase latex yield with reducing tapping frequency (Lacote *et al*., 2010). Ethylene has been reported as a major stimulating factor for natural rubber production in the rubber tree and it is applied in both forms of ethephon and ethylene gas stimulations (Coup and Chrestin, 1989). d' Auzac (1989) reported that ethylene reaction at the inner bark, which increases latex flow while increasing pressure and elasticity of laticiferous cell, decreases the coagulate of latex. Sainoi and Sdoodee (2012) reported that ethylene gas application tended to cause an impact on latex physiology. Jetro and Simon (2007) found that the use of ethylene stimulation affected latex yield and latex physiology varied with seasons. Ethylene gas stimulation is recommended for the application over 15-year-old rubber trees. Sivakumaran *et al*. (2007) reported that RRIMFLOW tapped trees provides a practical avenue for maintaining high yield productivity over the long term by exploitation of different drainage through process of periodic panel changeover.

Normally, there have been many products of ethylene gas stimulation in commercial such as RRIMFLOW, LET and Double Tex. Although, it is commercial adoption: It needs to be tested before recommendation to rubber smallholders. The objective of this study was to investigate the effect of the application of RRIMFLOW, LET, Double Tex and Ethephon stimulation on latex yield and latex physiology of the rubber clone RRIM 600 with the purpose of enhancing latex productivity.

Materials and Methods

The trial was conducted during June 2010 to March 2011 at Tepha Research Station (100°56' E 6°48' N) in Songkhla province. The trees were selected before opening for homogenous girth in clone RRIM 600 currently used in Thailand. The trial was planted in 1989 at 7×3 m spacing (476 trees/ha). The soil texture in the experimental plot was sandy loam with pH 5.5 (Coated, isohyperthermic, Typic Quartzipsamments). In this study, tapping implant was done on the panel with upward tapping cut at about 170 cm from the ground. The treatments of ethylene stimulations (RRIMFLOW, LET, Double-tex and Ethephon) with the short – tapping (1/8S) was compared with the conventional tapping system (1/3S). Therefore, the experiment was designed as "one-tree-plot design". The stimulation

treatments were stimulated with ethylene gas application and 5% ethephon. The 5% ethephon was applied on tapping panel. Ethylene gas applications were injected on RRIMFLOW, LET and Double Tex system. There were 6 treatments (20 trees per treatment) as follows: T1 = 1/3S↑ 2d/3 (The trees were tapped with a third spiral upward cut, two days tapping by day rest, cut corners 30 degree.); T2 = 1/8S↑ 1d/3 (The trees were tapped with an eighth spiral upward cut, every three days, cut corners 45 degree.); T3 = 1/8S↑1d/3+RRIMFLOW (The trees were tapped with an eighth spiral upward cut, every three days, stimulated with ethylene gas application of RRIMFLOW system, cut corners 45 degree.); T4 = 1/8S↑ 1d/3+LET (The trees were tapped with an eighth spiral upward cut, every three days, stimulated with ethylene gas application of LET system, cut corners 45 degree.); T5 = 1/8S↑ 1d/3+Double Tex (The trees were tapped with an eighth spiral upward cut, every three days, stimulated with ethylene gas application of Double Tex system, cut corners 45 degree.); T6 = 1/8S↑ 1d/3+Ethephon 5% (The trees were tapped with an eighth spiral upward cut, every three days, cut corners 45 degree, stimulated with 5% ethephon, 12 applications per years.); Yield was collected from cup lumps. Studied parameters were dry rubber production (kg/tree/year, g/tree/tapping). Latex diagnosis was carried out during July to October 2010 to determine sucrose, inorganic phosphorus and thiol content (Gohet and Chantuma, 1999).

Results and Discussion

Rubber production per tapping

During the experimental period, there was a significant difference of average cup lump (gram/ tree/ tapping or g/t/t) among the treatments. The T3 treatment provided the highest cup lump yield (137.70 g/t/t) but the T2 treatment showed the lowest average cup lump (45.54 g/t/t). The RRIMFLOW treatment could enhance cup lump yield per tapping around three fold comparing with the conventional tapping system. Similarly, Sivakumaran (2002) also reported that the RRIMFLOW system could increase latex yield and income of tappers around two to three fold due to the increased tapper productivity. Besides, the ethylene gas stimulation treatments (T3, T4 and T5) expressed significantly higher yield than the remaining treatments (T6, T1 and T2) (Figure 1).

Rubber production per year

The result showed that cumulated cup lump in the six treatments during June 2010 to March 2011 period was significantly different. The T3 treatment provided the highest cumulated cup lump (5.92 kg/t), where as the lowest cumulated cup lump was found in the T2 treatment (1.95 kg/t). The ethylene gaseous stimulation treatments (T3 T4 and T5) were higher cumulated cup lump than the conventional treatment (T1) and ethephon stimulation treatment (T6). The T1 treatment provided higher cumulated cup lump than the T6 (Figure 2). It was evident that RRIMFLOW, LET and Double Tex techniques could increase rubber yield with significantly higher yield than the ethephon smearing, the short–tapping (no ethylene gas) and the conventional tapping system. This supports that ethylene gas stimulation is effective in clone RRIM 600, particularly with RRIMFLOW provided the significant highest latex yield. However, this study was only short period. Traore *et al.* (2011) suggested that the effect of ethylene stimulation has to be investigated in long term.

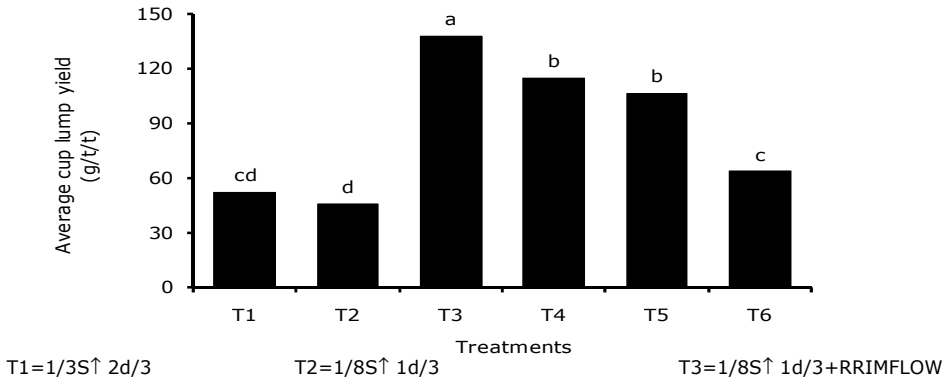

Figure 1. Average cup lump yields (g/t/t) of rubber trees in the all treatments during June 2010 – March 2011

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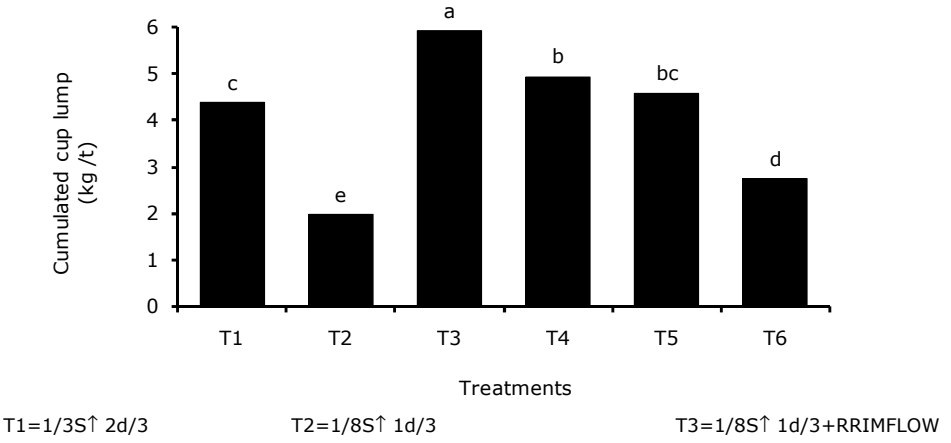

Figure 2. Comparison of cumulated cup lump (kg/t) of rubber trees in the all treatments during June 2010 – March 2011.

Latex physiology

During July to October 2010, Table 1 shows the average sucrose, inorganic phosphorus and thiol contents. Sucrose in the treatment T3 tended to be the lowest compared with the other treatments. There was no significant difference of inorganic phosphorus content among the treatments. However, the ethylene stimulation with RRIMFLOW treatment (T3) tended to express higher inorganic phosphorus content than the remaining treatments. The moment of thiol expressed that there was no significant difference among the treatments except in July and October. Chantuma *et al*. (2003) also reported that ethylene application in clone RRIM 600 caused a decrease of sucrose, but increase of inorganic phosphorus and thiol.

According to the positive response on yield of the rubber trees to the RRIMFLOW treatment, negative impact should be considered because of sucrose decrease. This implied that there was over exploitation of sucrose in latex regeneration particularly under the RRIMFLOW treatment or T3. This may lead to tapping panel dryness in long term. It implied that amount and concentration of gas ethylene application should be optimized to increase latex yield without an adverse impact on latex physiology of the rubber tree. Njukeng *et al.* (2011) also suggested that the frequency and concentration of stimulation should be adapted with the clone, tree age and tapping system. Besides, LET and Double Tex also caused the damage of bark because of equipment installation. Therefore, it needs to be investigated further to improve the equipment for ethylene gas stimulation.

Table 1 Sucrose, inorganic phosphorus and thiol (mmol/L) of latex in the six treatments during July – October 2010.

Treatments	Sucrose				Inorganic phosphorus				Thiol			
	Jul	Ag	Sep	Oct	Jul	Aug	Sep	Oct	Jul	Aug	Sep	Oct
T1 : 1/3S↑ 2d/3	10.14^{d}	11.46^{bc}	10.71^{b}	12.61^{a}	8.95^{ns}	9.76^{ns}	8.55^{ns}	10.36^{ns}	0.37^{b}	0.40^{ns}	0.38^{ns}	0.37^{b}
T2 : 1/8S↑ 1d/3	17.51^{a}	13.03^{ab}	16.63^{a}	13.93^{a}	7.80	10.56	8.04	10.56	0.48^{ab}	0.45	0.44	0.48^{a}
T3 : 1/8S↑ 1d/3 + RRIMFLOW	10.60^{c}	8.91^{c}	10.28^{b}	9.00^{b}	12.31	12.07	12.06	12.07	0.48^{ab}	0.50	0.41	0.53^{a}
T4 : 1/8S↑ 1d/3 + LET	13.05^{b}	14.24^{ab}	14.36^{a}	13.96^{a}	7.55	10.26	8.31	10.26	0.47^{ab}	0.24	0.42	0.52^{a}
T5 : 1/8S↑ 1d/3 + Double Tex	13.74^{b}	12.01^{abc}	14.42^{a}	11.77^{ab}	8.84	12.54	9.28	12.54	0.40^{b}	0.23	0.53	0.40^{b}
T6 : 1/8S↑ 1d/3 + Ethephon 5%	14.35^{b}	14.84^{a}	14.06^{a}	15.06^{a}	8.98	12.79	9.87	12.79	0.53^{a}	0.28	0.49	0.52^{a}

Different letters in the same column indicate a significant difference ($P \leq 0.05$) by DMRT
ns = non-significant difference

Conclusions

Ethylene gas stimulation in the 21-year-old rubber tree clone RRIM 600 using RRIMFLOW provided the highest latex productivity, comparing with the other stimulation treatment of LET, Double Tex and Ethephon. Average yield per tapping (g/t/t) in the RRIMFLOW treatment was around three fold of the conventional tapping. Besides, latex diagnosis in the RRIMFLOW treatment showed that sucrose tended to decrease, whereas inorganic phosphate and thiol tended to increase.

Acknowledgements

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