
Effect of Ethephon and Ethylene at the Different Concentrations and Tree Ages on Yield of Rubber Tree Clone RRIM 600 (*Hevea Brasiliensis*)

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Effect of ethephon at different concentrations and ethylene 99.99 % with different taping method for different ages of rubber trees clone RRIM 600. The experiment was conducted at the rubber orchards of Krung Yan Rubber Estate Organization, located in Krung Yan sub-district, Thong Yai district, Nakhon Si Thammarat province, Thailand from August, 2014 to February, 2015. The experimental design was used a 3 x 6 factorial in the CRD, composed with 3 ages of rubber tree : 10, 15 and 20 year-old of rubber trees clone RRIM 600 ; and difference concentrations of ethephon: 0, 2.5, 5 and 10 percent, ethylene 99.99 percent was used by tapping method and ethylene 99.99 percent was used by drill method. The result showed that the effect of ethephon and ethylene to the ages of rubber tree at 10-year-old and 15-year-old had significant difference of latex production, the rubber tree at 10-year-old and 15-year-old was provided the highest latex production (245.50 and 226.56 gram/tree/taping) and the rubber tree at 20-year-old provided the lowest latex production (154.95 grams/tree/taping). The average of the percent of dry rubber content (%DRC) there was a significant difference of average % DRC among the difference tree age. The rubber tree at 10-year-old and 15-year-old was provided the highest % DRC (38.31 and 37.89) and the rubber tree at 20-year-old provided the lowest % DRC (35.96). The average of net weight dry rubber content there was a significant difference of average net weight dry rubber content between the different tree ages. The rubber tree at 10-year-old and 15-year-old was provided the highest average of net weight dry rubber content (94.06 and 85.84 grams/tree/taping) and the rubber tree at 20-year-old provided the lowest of net weight dry rubber content (55.73 grams/tree/taping). The result of differing concentrations of ethephon and ethylene showed the significant among means, the ethephon at 2.5 percent and ethylene 99.99 percent used with tapping method had the highest of average latex production (gram/tree/taping) and the lowest of average latex production (gram/tree/taping), was presented in control, the ethephon at 5 and 10 % had the highest of the average of percent dry rubber content (gram/tree/taping) and the lowest of the average percent dry rubber content (gram/tree/taping) was shown in the control. The average of net weight dry rubber content (gram/tree/taping), the ethephon at 2.5% and ethylene 99.99% using taping method showed the significant among means, there was provided the highest of the average net weight dry rubber content (gram/tree/taping) and the lowest of average net weight dry rubber content (gram/tree/taping), was presented in control.

Keyword : rubber tree clone RRIM 600, ethephon, ethylene

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Introduction

The rubber tree (*Hevea brasiliensis*) is a commercially important crop of Thailand with a production in the year 2015 of 4.46 Million tons from 3.04 Million hectares of cultivation area, the majority of rubber plantation is in the southern part of Thailand (Office of Agricultural Economics, 2015). During the year 2011 to 2014, the trend of natural rubber production increases and high demand of natural rubber with the high price. This cause is motivated to the rubber smallholder to increase income by using ethephon and ethylene stimulation to increase of latex production. Coup and Chrestin (1989) has been reported the effect of ethylene it is a major stimulating factor for natural rubber production in the rubber tree and it is applied in the both forms of ethephon and ethylene gas stimulations. Apirak and Sdoodee (2012) reported that ethylene gas stimulation in the 21-year-old rubber tree clone RRIM 600 using RRIMFLOW method provided the highest latex productivity, compared with the other stimulation treatment of LET, Double Tex and Ethephon. Average yield per tapping in the RRIMFLOW treatment was around three fold of the conventional tapping. However, it caused a significant decrease of dry rubber content. Latex diagnosis in the RRIMFLOW treatment showed that sucrose tended to decrease, whereas inorganic phosphate and thiol tended to increase. Besides, the impact of RRIMFLOW of a significant decrease of girth increment was found. Jetro and Simon (2007) reported that 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. The objective of this study was to investigate the effect of ethephon at the different concentrations and ethylene at 99.99% with different of taping method could be stimulated on the latex yield of the rubber clone RRIM 600 and what ages of the rubber clone RRIM 600 was affected to ethephon and ethylene.

Materials and methods

Plant materials

The experiment was conducted at Krung Yan Rubber Estate Organization, located in Krung Yan sub-district, Thong Yai district, Nakhon Si Thammarat province, Thailand from August, 2014 to February, 2015. 10-year-old, 15-year-old and 20-year-old of field-grown rubber trees in clone RRIM 600 were used in this study. The rubber trees under this investigation were grown in the same location and were subject to rigorously similar cultural practices.

Treatments

3x6 factorial in completely randomized design (CRD) with single tree plots replicated twenty times was used. The treatments included the difference ages of rubber tree : 10-year-old, 15- year-old and 20- year-old and different concentration of ethephon: 0 2.5 5 10 percent and ethylene 99.99 percent with tapping method and ethylene 99.99 percent with drill method

Data recording and analysis

For very week were collected latex production (gram/tree/taping), percent of dry rubber content (%) and net weight of dry rubber content (gram/tree/taping), The relationship between rainfall and latex production. The data analysis was used program-R and treatment means were statistically compared using Duncan’s Multiple Range Test (DMRT).

Results

Weather condition

In 2014-2015, the drying period was during January – February (Figure 1). However, there was heavy rainfall at the start of the rainy season of the year 2014 in April with the highest monthly rainfall (627.2 mm.). The rainfall turned to fluctuate from May-December. Early period in the year 2015 the rainfall turn to reduce and start to heavy rainfall in April-November.

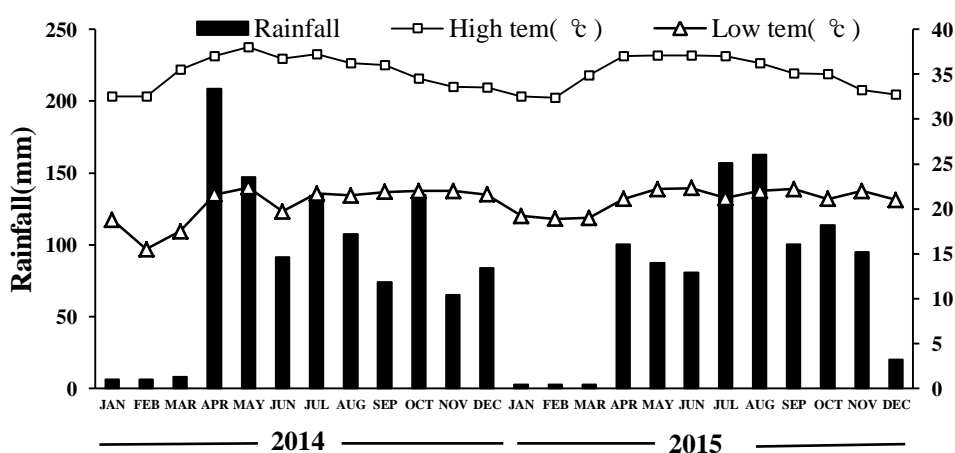


Figure 1. Average monthly rainfall, maximum temperature and minimum temperature during January, 2014- December, 2015 at Chawang Meteorological Station, Nakohn Si Thammarat province, Thailand

Effect of ethephon and ethylene to the difference rubber tree ages on rubber production and % DRC

During the experimental period of seven months (August, 2014 - February, 2015), there was a significant difference of average latex production (gram/tree/taping) among the difference tree age. The rubber tree at 10-year-old and 15- year-old was provided the highest latex production (245.50 and 226.56 gram/tree/taping) and the rubber tree at 20-year-old provided the lowest latex production is 154.95 gram/tree/taping, when treated with ethephon and ethylene. The average of the percent of dry rubber content (% DRC) there was a significant difference of average % DRC among the difference of tree age. The rubber tree at 10-year-old and 15-year-old was provided the highest % DRC (38.31 and 37.89) and the rubber tree at 20-year-old provided the lowest % DRC (35.96) when treated with ethephon and ethylene (Figure 1).

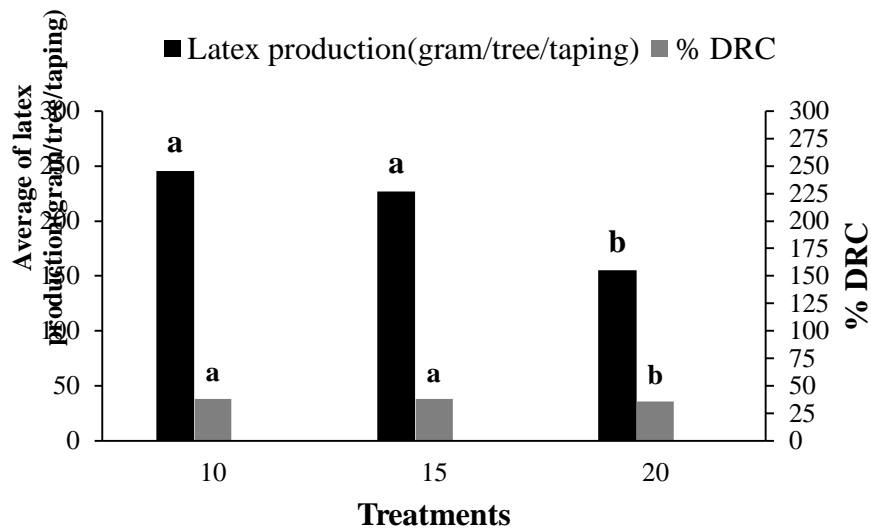


Figure 2. Average of latex production (gram/tree/taping) and percent of dry rubber content (% DRC)

Effect of ethephon and ethylene on latex production and percent dry rubber content (%DRC)

The effect of ethephon and ethylene on the different concentrations on the latex production, there was showed a significant difference in average latex production (gram/tree/taping) among the treatments, the ethylene at 99.99 % with taping method and ethephon at 2.5 % provided the

highest of average latex production were 271.47 and 241.48 grams/tree/taping. The treatment at 99.99 % with drill method, ethephon at 5 10% and the control provided the average latex production are 193.79 193.46 and 179.14 grams/tree/taping, respectively (Figure 3).

The effect of ethephon and ethylene on the different concentrations on the percent dry rubber content (%DRC), there was showed a significant difference of average % DRC among the treatments. The ethephon at 10 % and 5 % provided the highest of average % DRC were 38.46 and 38.29 percent. The treatment of ethephon at 2.5%, ethylene at 99.99 % with drill method, ethylene at 99.99 % with taping method provided average % DRC were 37.64 36.61 and 36.47%, respectively. The control was showed the lowest of average % DRC is 35.23 percent (Figure 3).

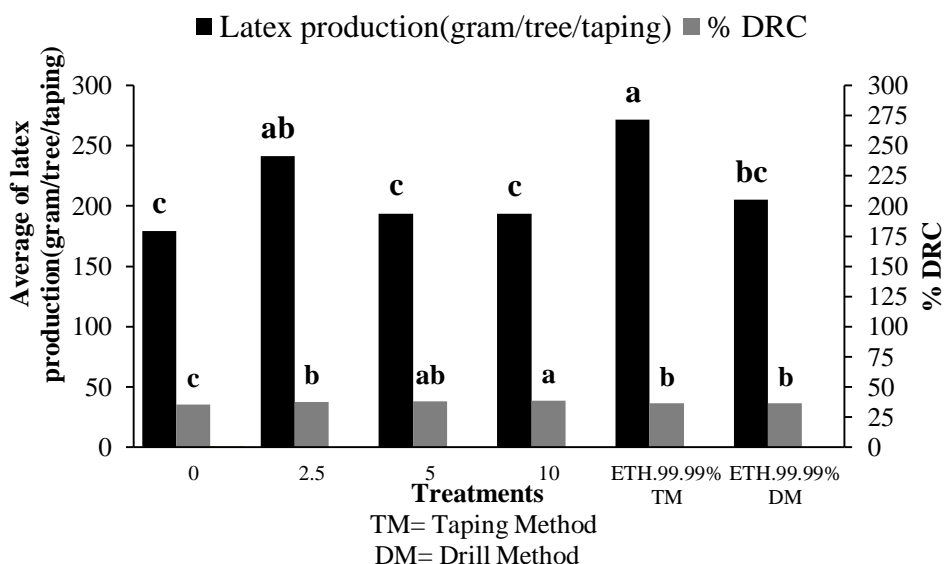


Figure 3. Average of latex production (gram/tree/taping) and percent of dry rubber content (%DRC)

Relationship between the rainfall and latex production

The relationship between the rainfall and latex production during the experimental period (August, 2014 – February, 2015), there was shown the relationship with the volume of rainfall, when the high value of rainfall the latex production (gram/tree/taping) is also high (Figure 4).

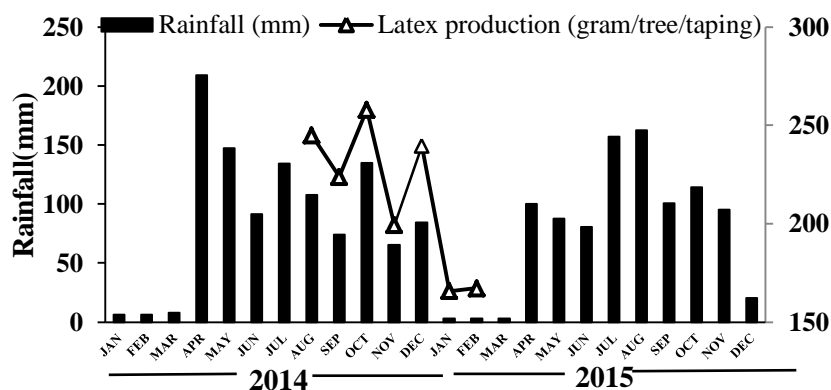


Figure 4. The relationship between the rainfall (mm) and latex production (gram/tree/taping) during the experimental period

Net weight of dry rubber content

The effect of ethephon and ethylene on the net weight of dry rubber content, there was a significant difference of average net weight of dry rubber content among the difference tree age. The rubber tree at 10-year-old and 15- year-old was provided the highest of net weight of dry rubber content were 94.06 and 85.48 grams/tree/taping and the rubber tree at 20-year-old provided the lowest of net weight of dry rubber content is 55.73 grams/tree/taping (Figure 5).

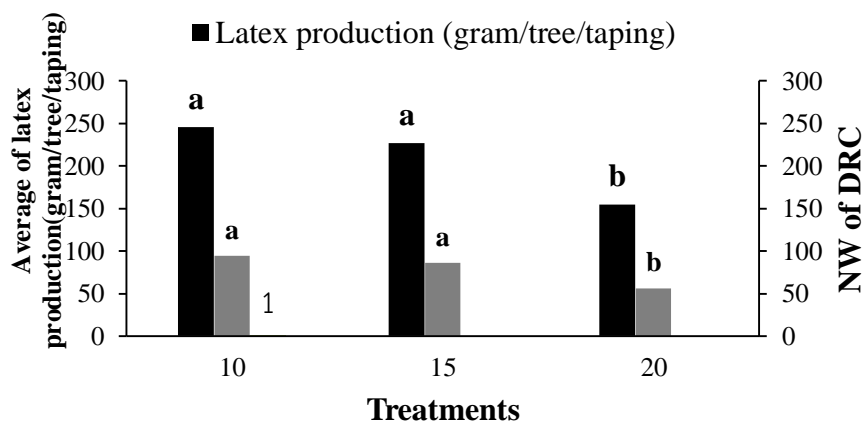


Figure 5. Effect of tree age on average of latex production (gram/tree/taping) and net weight of dry rubber content (gram/tree/taping)

The effect of ethephon at different concentrations and ethylene on difference taping method on the net weight of dry rubber content, there was showed a significant difference on the net weight of dry rubber content among the difference of ethephon concentration and ethylene 99.99 % with different methods of taping system. The ethephon concentration of 2.5 % and ethylene 99.99 % with taping method provided the highest of net weight of dry rubber content were 95.64 and 90.73 grams/tree/taping, respectively. The ethephon at 10 5 % and ethylene 99.99% with drill method provided an average net weight of dry rubber content were 76.29 75.64 and 73.04 grams/tree/taping, respectively. The control was provided the lowest of the net weight of dry rubber content is 63.12 grams/tree/taping (Figure 6).

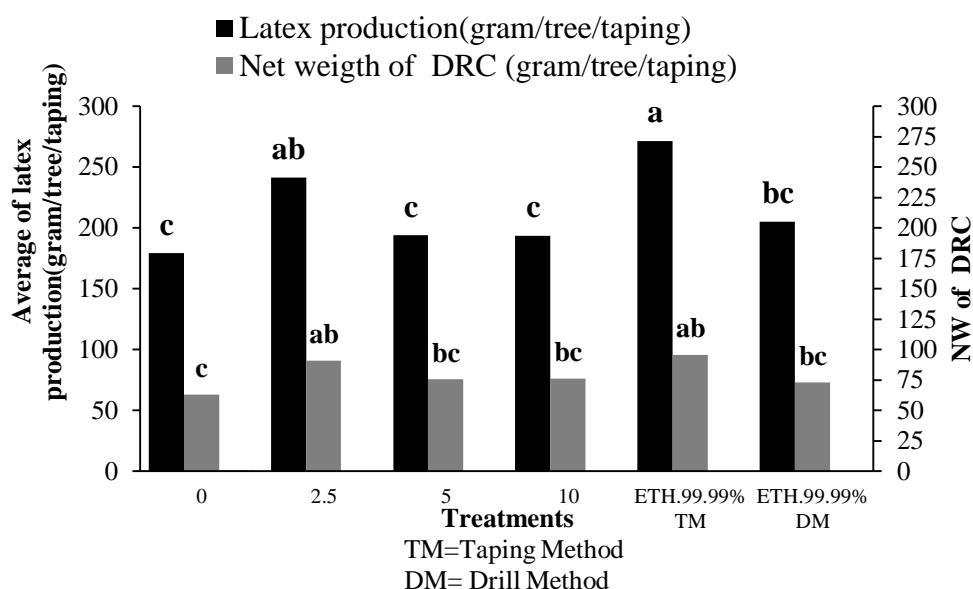


Figure 6. Effect of ethephon on the difference concentration and ethylene difference taping method on average of latex production (gram/tree/taping) and net weight of dry rubber content

Discussion

The effect of ethephon and ethylene to the tree age of rubber clone RRIM 600 at 10-year-old, 15-year-old and 20-year-old during the experimental period of seven months (August, 2014 to February, 2015), there was showed, that rubber tree at 10-year-old and 15-year-old, there are provided the higher yield, in term of latex productivity, percent of dry rubber content and net weight of dry rubber content than the rubber tree at 20-year-old. The Rubber Research Institute of Thailand had been reported the photosynthesis of rubber tree in the daylight, rubber tree received the

sunlight for photosynthesis and accumulated carbohydrate in starch and sucrose from, rubber tree it will be used starch and sucrose for synthesis the end-product it is latex. The bio-chemistry process and rate of latex production are depend on time of daytime, the highest rate of latex production of the rubber tree is 6.00 pm. The taping time of rubber tree it is the best at 1.00 to 6.00 am in every day, and then rubber tree cab be synthesis a new latex in 48-72 hours. (Rubber Research Institute of Thailand, 2007). In this case the older rubber tree age had the lower potential of the photosynthesis rate than the young rubber tree, it is related to latex productivity of rubber tree at 20-year-old.

The effect of ethephon on the different concentrations (0 2.5 5 and 10 %) and ethylene 99.99 % with the difference taping method in rubber trees clone RRIM 600, the result was shown that ethephon at 2.5 % and ethylene 99.99% with taping method provided the highest of average of latex production (gram/tree/taping). The result of this experiment was the same suggestion from the Rubber Research Institute of Thailand was suggested to the farmer in the rate of ethephon should be using 2.5 % with taping system is 1/3S d/2. Rubber Research Institute of Thailand (2007) and Khunthong (2015) was reported the effect of ethylene on the latex yield of rubber tree, ethylene 99.99% with RRIMFLOW system tend to have the highest yield per tree per taping. This implied that amount and concentration of ethephon and gas ethylene application should be optimized to increase latex yield without an adverse impact on the growth and latex physiology of the rubber tree. Njukeng *et al.* (2011) was suggested the frequency and concentration of ethephon stimulation should be adapted with the clone, tree age and tapping system.

Conclusion

This study shows that ethephon and ethylene was effected to rubber tree clone RRIM 600 at 10-year-old and 15-year-old there was showed higher the average latex productivity, average percent of dry rubber content and average net weight of dry rubber content than the rubber tree at 20-year-old. The effect of ethephon at 2.5 % of concentrations and ethylene 99.99 % with taping method provided the highest of average latex production and average net weight of dry rubber content and ethephon at 10 and 5 % of concentrations provided the highest average of percent dry rubber content. The control treatment was provided the lowest of average latex productivity, average percent of rubber content and average net weight of dry rubber content.

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References

- Apirak Doungmusik and Sayan Sdoodee (2012) Enhancing the latex productivity of *Hevea brasiliensis* clone RRIM 600 using ethylene stimulation. *Journal of Agricultural Technology* 8(6) : 2033-2042.
- Office of Agricultural Economics. (2015). Data of agricultural product : Fruit / trees : Rubber tree.[updated 1015 July 2; cited 2015 July 2]. Available from:<http://www.oae.go.th>
- Coup, M. and Chrestin, H. (1989). Physico-chemical and biochemical mechanisms of hormonal (ethylene) stimulation. *In: Physiology of Rubber Tree (Hevea brasiliensis) Latex*. d'Auzac, J., Jacob, J.L., Chrestin, H. (Eds.), CRC Press Inc., Florida, USA, pp. 295-331.
- Doungmusik, A. and Sdoodee, S .(2012). Enhancing the latex productivity of *Hevea brasiliensis* clon RRIM 600 using ethylene stimulation. *Journal of Agricultural Technology* Vol. 8(6): 1459-1468
- Jetro, N.N. and Simon, G.M. (2007). Effects of 2- chloroethylphosphonic acid formulations as yield stimulants on Heveabrasiliensis. *Africanl of Biotechnology* 6: 523 – 528.
- Khunthong, S. (2015). Response of rubber tree to ethylene gas stimulation during the three consecutive years. Master's Thesis in Plant Science, Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University.
- Njukeng, J.N., Muenyi, P.M., Ngane, B.K. and Ehabe, E.E. (2011). Ethephon stimulation and yield response of some *Hevea* clones in the humid forests of south west Cameroon. *International Journal of Agronomy* 2011:1-5.
- Office of Agricultural Economics. (2015). Data of agricultural product : Fruit /trees : Rubber tree.[updated 1015 July 2; cited 2015 July 2]. Available from:<http://www.oae.go.th>
- Rubber Research Institute of Thailand.(2007). The rubber taping and chemical use for latex stimulation. The Federation Savings and Credit Cooperatives of Thailand Limited Printing, Bangkok. (in Thai)