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Effect of exploitation system using a tapping stimulant on the production of four rubber plant clones (*Hevea brasiliensis* Mull-Arg.) in Bulukumba Regency

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Abstract. This study aims to determine the effect of tapping stimulants on the performance of four rubber plant clones. The study was conducted at Palangisang Estate, PT. PP London Sumatera Indonesia Tbk in Tamatto Village, Ujungloe District, Bulukumba Regency, South Sulawesi Province located at an altitude of 0-25 meters above sea level. The study was carried out from September to October 2019 as an experimental research using Nested Design consisted of two factors, rubber clones and exploitation system. Four rubber clones, PB 260, PM 10, RRIM 901, and GT1, were treated with 2.5% ethrel tapping stimulant which repeated on six trees for each clone. Latex weight and dry rubber content were measured compared to the control treatment. The results showed that the application of the tapping stimulants had a very significant effect on latex weight and dry rubber content. Highest latex weight was obtained from the application of the stimulant to GT 1 clone with 226.33 grams. However, clone PB 260 in the control treatment resulted in the highest dry rubber content (34.50%).

Introduction

Rubber plant (*Hevea brasiliensis* Muell Arg.), a plant that belongs to the Euphorbiacea family, is one of the important plantation commodities in Indonesia as a source of non-oil and gas foreign exchanges. Efforts to increase crop productivity continue to be carried out, especially in the fields of cultivation and post-harvest technology. The area of rubber plantations in Indonesia in 2019 is 3.68 million ha with a productivity of 1,158 kg / ha / yr. The production of rubber is 82.78% owned by smallholder estates, 10.41% owned by large private companies and 6.82% owned by large state estates [1].

Rubber plant has a huge potential to be developed, according to the analysis of the IRSG (International Rubber Study Group), the world's need for natural rubber will continue to increase until 2035, so that it can be interpreted that the world's natural rubber production still has a gap when compared to consumption. World rubber consumption has increased from year to year. The Central Statistics Agency [2] explained that in the second quarter of 2014, world consumption of natural rubber increased by 4.2% or by 13.9 million tons. The consumption of natural rubber in the world is directly related to the demand of industrial countries such as China, Japan and America, which develops the tire industry with natural rubber as its main raw material. Broadly speaking, Indonesia's area also has the potential to become a major global rubber producer, if various major problems faced by rubber plantations can be overcome and agribusiness is well developed and managed.

The main problem of rubber plants in Indonesia is the low productivity while the area is increasing every year. This is evidenced by the Ministry of Agriculture data [1] where the productivity of rubber plants in Indonesia has decreased from 2018 to 2019 which is only 1,158 kg / ha / year while the area of the last 5 years has increased namely in 2017 with an area of 3.65 million ha, in 2018 amounted to 3.67 million ha, and in 2019 amounted to 3.68 million ha. This is also consistent with the history of the Palangisang Estate crop history [3] which is a rubber production center in South Sulawesi showing that rubber production in the Palangisang Estate experienced a drastic decline starting in 2018 so that it was very detrimental to the company. Based on the data above, there is an imbalance between production and area that is not in line.

Some factors determine the productivity of a rubber plantation are the type of clone, the age of the plant, the level of land suitability, and the exploitation system that is applied Ismail [4]. According to Boerhendy [5], the availability of superior clones is one of the crucial factors to increase the productivity of rubber plantations in Indonesia. The opinion was further confirmed by Tatik et al. [6] who state that one of the factors of low rubber productivity in Indonesia is caused by the application of plant cultivation technology that is not yet fully in accordance with the recommendations including that many farmers or rubber plant cultivators have not used superior clones with high latex production. In addition to quality of planting materials, low rubber productivity in Indonesia is also thought due to the lack of maintenance of rubber plants by no longer providing fertilizer as plant nutrition due to the high costs required to purchase fertilizers [7]. Therefore, a strategy to improve yield is necessary including the use of stimulants as an alternative to increase production in rubber plants.

Stimulant is a mixture consisting of vegetable oil (for example palm oil) and ethylene hormones or other active ingredients where the use of stimulants aims to increase latex production and prolong latex flow. The use of stimulants must also pay attention to the dose and intensity of exploitation, where excessive use of ethepon can cause tapping to dry out [8]. According to Boerhendy [5] states that Ethrel 10 PA (2.5%) is the best type of stimulant of all other types of stimulants for rubber production, whereas according to Renita et al. research [9] states that the results of latex production indicate that the control treatment is higher than all stimulant treatments.

Based on the problem above, a research on the effect of tapping stimulant (Ethrel 2.5%) on the production of four rubber clones was conducted to obtain the clone that will give the best results for rubber production and the best exploitation system for rubber production to increase the production of rubber plants in Palangisang Estate, Bulukumba Regency, South Sulawesi Province.

2. Methodology

This research was conducted at Palangisang Estate, PT. PP London Sumatera Indonesia Tbk in Tamatto Village, Ujungloe District, Bulukumba Regency, South Sulawesi Province from September to October 2019. The study was conducted as an experimental research based on Nested Design. Two factors used were rubber plant clones and application of tapping stimulant which are repeated 6 times. The rubber clones used were PB 260, PM 10, RRIM 901, and GT 1. Tapping stimulant factor consisted of two levels namely control and the application of 2.5% Ethrel stimulant. Therefore eight treatment combinations were obtained and repeated 6 times resulted in a total number of 48 rubber plants.

2.1. Determination of study site and sample plants

Determination of the location of the study at Palangisang Estate was conducted purposively based on the fact that the estate is the largest rubber production center in South Sulawesi Province. The rubber sample trees were determined by selecting trees in the centre of the plantation, to anticipate the influence of other factors. Rubber tree plants from each clone were selected based on criteria of showing normal growth, free from pest and disease and having uniform size of the inner girth of the stem with an average of the trunk of 65 cm (± 5 cm), the condition of the leafy canopy, the same in the age of the plant that is 12 years (> 10 years), the same tapping formula and the same field tapping conditions. Following determination of the 48 uniformly rubber plant tree samples with the specified criteria, a marker was set on the tree by using a plastic rope and labelled according to the experimental layout.

2.2. Preparation and application of the tapping stimulant

Prior to application, the 10% commercially obtained Ethrel solution was diluted to concentration of 2.5%. Dilution was carried out by mixing the Ethrel with distilled water with a ratio of 1 Ethrel: 3 aquades. The 2.5% Ethrel was then applied on the trees by first pulling scrapp or gum which is in the tapping groove and applying 0.5 cc / tree of the stimulant using ethrel polishing tool evenly. Application of the stimulants was conducted in the morning one day before the scheduled tapping.

2.3. Latex Collection

Following the implementation of the treatment, tapping was carried out in 3 times (up to the third tapping) in order to anticipate other factors outside of research. In this research, the tapping formula in the sample tree was S2D3 67% + 2.5% E + B which means half circle of tapping from the circumference of the trunk and tapping intensity once every 3 days tapping with the tapping field on panel B. Collection of latex from the field was conducted at 11.00 am where the latex collection process was carried out for 3 tapping days.

2.4. Observation Parameters

In this study the observation parameters are as follows:

2.4.1. Latex production. Observations were made by weighing the amount of latex per tree (g) using a scale. Data retrieval was conducted after the latex stops flowing in the tapping groove with ± 3-4 hours after tapping.

2.4.2. Dry rubber content. The dry rubber content was measured using the gravimetric method, based on a ratio of % dry weight and wet weight latex of 5 grams. Calculation of dry weight of latex was done by giving enough vinegar to clot, after that it is ground with a hand mill to form a thin sheet and then dried using an oven at 100 ºC for 3-4 hours. The aerated rubber sheet then dried and weigh using analytical scales. The formula used to measure the processed dry rubber content was as follows:

$$\%Dry\ rubber\ content = \frac{Latex\ wet\ weight}{Latex\ dry\ weight}\ x\ 100\%$$

2.5. Data analysis

Data were analysed using analysis of variance for two factorial design based on nested design. A further test of Tukey's honestly significant difference (LSD) test at level of 5% was conducted if there was a significant effect of the treatments.

3. Results

3.1. Latex weight

Analysis of variance showed that the stimulant application treatment significantly affect the production of four rubber plant clones at the first, second and third tapping times. The response of the rubber clones to the stimulant on the latex weight for each tapping time is presented in table 1.

Table 1. Latex weight of four rubber plant clones on the application of tapping stimulant.

Clone	1st Tapping		2nd Tapping		3rd Tapping	
	Control	Ethrel 2.5%	Control	Ethrel 2.5%	Control	Ethrel 2.5%
PB 260	**116.83e**	189.33c	**125.67e**	174.00c	**123.17e**	162.33c
PM 10	141.83d	188.83c	137.50de	182.83bc	139.17d	178.17b
RRIM 901	146.00d	206.67b	142.33d	189.00b	140.17d	181.83b
GT 1	200.67bc	**233.50a**	192.50b	**225.67a**	186.00b	**219.83a**
Tukey's$_{0.05}$	16.71		13.34		13.06	

Numbers followed by the same letters in the same row and column (a, b, c, d, e) means that they are not significantly different from Tukey's 0.05 test.

The Tukey's test results at 5% level in table 1 shows that the application of tapping stimulant increased the latex weight in each tapping time. Highest average of latex weight for each tapping time is shown by the GT1 clone applied with 2.5% Ethrel one day before tapping schedule. Among all clones, PB 260 showed the lowest latex weight in control treatment.

3.2. Dry rubber content

Analysis of variance show that the application of 2.5% Ethrel tapping stimulant had a significant effect on the dry rubber content of the four rubber plant clones in every tapping time. The average of dry rubber content of the clones is shown in table 2. The Tukey's test results at 5% level in table 2 shows that the average values of the dry rubber content of the rubber clones treated with 2.5% Ethrel were slightly lower compared to control treatment. Highest average dry rubber content in the control treatment showed by GT 1 clone in each tapping time. PB 260 and PM 10 were the clone with the higher value for the parameter in the application of 2.5% Ethrel treatment at first and second tapping. However at thord tapping time, PM 10 and GT 1 were the clone that showed higher dry rubber content compared to the other clones.

Table 2. Dry rubber content (%) of four rubber plant clones on the application of tapping stimulant.

Clone	1st Tapping		2nd Tapping		3rd Tapping	
	Control	Ethrel 2.5%	Control	Ethrel 2.5%	Control	Ethrel 2.5%
PB 260	33.50c	35.50b	34.00b	34.50b	34.00bc	31.50cd
PM 10	36.50ab	34.00c	36.00ab	34.50b	35.50b	33.00c
RRIM 901	32.00d	31.00d	33.00bc	31.50c	34.50bc	31.00c
GT 1	37.00a	32.00d	37.50a	33.00bc	37.50a	33.00bc
Tukey's$_{0.05}$	1.39		1.8		2.36	

Numbers followed by the same letters in the same row and column (a, b, c, d, e) means that they are not significantly different from Tukey's 0.05 test.

3.3. Accumulated latex weight and dry rubber content

Analysis of variance on average data of latex weight and dry rubber content from all tapping times show that there was a highly significant effect of the interaction between the clones and stimulant treatments (table 3 and 4). Table 3 shows the total latex weight from three tapping times of four rubber clones treated with 2.5% Ethrel compared to control. The highest increment in latex weight as a response to the application of the stimulant shown by PB260 clone, while the lowest increment was shown by the GT 1 clone. The stimulant increased the productivity of the rubber plant about 15% to 40% of the latex production in three times of tapping.

Table 3. Total average of latex weight (g) of four rubber plant clones on the application of 2.5% Ethrel stimulant.

.Clone	Total Latex weight (g)		% increase
	Control	Ethrel 2.5%	
PB 260	121.89e	175.22c	43.75
PM 10	139.50d	183.28bc	31.38
RRIM 901	142.83d	192.50b	34.77
GT 1	193.06b	226.33a	17.23

Values are averages from three tapping times. Numbers followed by the same letters in the same row and column (a, b, c, d, e) means that they are not significantly different from Tukey's 0.05 test (p=13.13).

Table 3 shows that the rubber clones varied in responding to the tapping stimulant given. Some clones has shown genetically superior characters in latex production, such as GT 1 clone, compared to other clones. The exploitation system such as application of tapping stimulant seemingly did not significantly increase the productivity. The GT 1 clone resulted in the highest latex weight in each tapping time (table 1), however, the use of 2.5% Ethrel increase the latex weight for only about 17.23% of the latex weight compared to the control trees. On the contrary, latex production of other clones such as the PB 260, PM 10, and RRIM 901 showed higher increment when treated with the stimulant.

Table 4 shows the total average of dry rubber content of the four rubber clones as response to the application of 2.5% Ethrel tapping stimulant. Interestingly, the use of the stimulant did not necessarily increase the dry rubber content of the clones. A slightly higher value in the parameter shown by PB 260, but the rest did not show any higher percentages of the dry rubber content when treated with tapping stimulant.

Table 4. Total average dry rubber content (%) of four rubber plant clones on the application of 2.5% Ethrel stimulant.

Clone	Dry rubber content (%)	
	Control	Ethrel 2.5%
PB 260	33.83bc	**34.50b**
PM 10	35.83ab	33.83bc
RRIM 901	33.00bc	31.33c
GT 1	**37.17a**	32.67c

Numbers followed by the same letters in the same row and column (a, b, c) means that they are not significantly different from Tukey's 0.05 test (p=1.51).

4. Discussion

The results from the recent study reveal that the productivity of rubber trees responded very well to the use of tapping stimulant such as 2.5% Ethrel and the response were varied between clones. From latex production in each tapping time, GT 1 seems to be the best clone for the parameter. Siregar and Suhendry [10] states that the GT 1 clone is a superior clone that has the potential to produce high latex. The pedigree of the GT 1 clone itself is a primary clone that has long been developed. This has been shown also in the control treatment data. Based on Latex Diagnosis (LD), the response of clones to the stimulants can be divided into three metabolic traits, namely high, medium and low metabolism. GT 1 clones are classified as rubber plants with moderate metabolism so that they have a good response to the use of stimulants while in PB 260 clones is classified as high metabolism which is less responsive to stimulants.

According to Eka et al [9], PB 260 skins are thinner than GT 1 so that the differences in the thickness of the bark of each clone determine the amount of latex that comes out. The thicker the bark of a tree automatically the deeper the bark of the tree can be tapped where this is in accordance with the opinion of Heru and Andoko [11] that the thicker into the skin of a clone, the more latex vessels will be found on the skin of plants the rubber will produce more and more latex. According to Balittri [12] states that the superiority of a clone in one place will be different in another place, although both have a wet climate, for example PB 260 clone is superior to IRR 107, but in other locations in North Sumatra IRR 107 clone shows higher production than PB 260.

In addition to clone factors, stimulant administration is an important factor that makes the clones produced the higher latex. All trees samples treated with stimulants (Ethrel 2.5%) produced higher latex weight than those control trees without stimulant treatment. This is also in accordance with the opinion of Boerhendy [5] which states that Ethrel stimulants contain active ingredients 2-chloroethyl-phosphonic acid (ethepon) which will break down into ethylene in plant tissues and function to increase osmotic

pressure and turgor pressure which can result in delayed blockages end of the latex vessel thereby extending the latex drainage period. This is also supported by the opinion of Tistama [13] which states that stimulants made from etephon can cause the cytosol to become alkaline and affect the stability of the rubber so that the rubber does not clot quickly, if combined with an adequate water supply it causes longer latex flow.

On the contrary, the use of tapping stimulant did not increase the dry rubber content in latex produced by all clones. The superior GT 1 clones with highest latex production when applied with the stimulant showed a lower dry rubber content. In fact, the dry rubber content of all clones treated with the stimulant showed lower percentage. This indicates that quality of the latex in control trees are slightly higher then treated ones. This might be due to the active ingredients of etephon in the stimulant that can increase the influx of water in the rubber plant into the latex vessel system so that they come out when the tapping process occurs [14]. This is also supported by the opinion of Wulandari [15] which states that the active ingredient of stimulant given emits ethylene gas which seeps into the latex vessels. The gas absorbs water from cells around it. This water absorption causes turgor pressure to increase accompanied by heavy latex flow. This causes the latex that comes out to contain more water so that the dry rubber content of rubber plants that are given a low stimulant because the processed dry rubber content is a measured parameter that shows the ratio of the percentage of the amount of rubber compared to the amount of water in latex, the higher the water content in the latex vessels, the lower the percentage pf the dry rubber content.

5. Conclusions

Based on observations and discussions, it can be concluded that:

- Application of stimulants has a very significant effect on rubber plant production in the parameters of latex weight and dry rubber content.
- In the latex weight parameter, the best results were obtained for administration of 2.5% ethrel stimulant in GT 1 clone.
- In the parameters of dry rubber content, the best results were obtained in the treatment without stimulants in GT 1 and PM 10 clones.

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References

[1] Kementerian Pertanian 2019 *Produktivitas Karet Menurut Provinsi di Indonesia 2015-2019* (Jakarta: Kementan).
[2] Central Statistics Agency 2015 Luas Areal Tanaman Perkebunan Rakyat Menurut Jenis Tanaman, 2000-2013 (Jakarta: Badan Pusat Statistika).
[3] Palangisang Estate 2019 Profil Kebun Palangisang Estate (Bulukumba: Estate Office Palangisang Estate).
[4] Ismail M 2016). Penyadapan tanaman karet (*Hevea brasiliensis* Muell Arg.) di kebun sumber tengah, Jember, Jawa Timur *Bul. Agrohorti* **4** 256-265.
[5] Boerhendhy I 2013 Penggunaan stimulan sejak awal penyadapan untuk meningkatkan produksi klon IRR 39 *J. Pen. Karet* **31** 117-126.
[6] Tatik A, Matondang N & Nusifera S 2018 Pengaruh pemberian stimulan etefon dan pemupukan terhadap hasil lateks tanaman karet (*Hevea brasiliensis* Muell. Arg) klon PB 260 *J. Floratek* **13** 23-36.
[7] Nugraha I S, Alamsyah A, & Sahuri S 2018 Effort to increase rubber farmers' income when rubber low prices *J. Perspektif Pembiayaan dan Pemb. Daerah* **6** 345-352.
[8] Siswanto 1997 *Penyadapan Dan Pengobatan Tanaman Karet Terserang Brown Bast (KAS)*

(Bogor: Bioteknologi Perkebunan).
[9] Renitasari E, Fatimah T, & Madjid A 2019 Pengaruh penggunaan beberapa stimulansia terhadap produksi berberapa klon karet (*Hevea brasilliensis* Muell Arg.) *Agriprima J App. Agricult. Sci.* **3** 62-70.
[10] Siregar I T H & Suhendry I I 2013 *Budi Daya & Teknologi Karet* (Jakarta: Penebar Swadaya Grup).
[11] Heru D S & Andoko A 2010 *Petunjuk Lengkap Budidaya Karet* (Jakarta (ID): PT. Agomedia Pustaka).
[12] Balittri 2013 Keragaan awal 10 klon karet dikebun percobaan Pakuwon Sukabumi *Warta Pen. dan Pengemb. Tan. Ind.* **19** No 3.
[13] Tistama R 2013 Peran seluler etilen eksogenus terhadap peningkatan produksi lateks pada tanaman karet (*Hevea brasiliensis* Muell Arg) *Warta Perkaretan* **32** 25-37.
[14] Atminingsih A, Napitupulu J A, & Siregar T H 2016 Pengaruh konsentrasi stimulan terhadap fisiologi lateks beberapa klon tanaman karet (*Hevea Brasiliensis* Muell Arg) *Indonesian J. Nat. Rubb. Res.* **34** 13-24.
[15] Wulandari T, Sampoerno, & Khoiri M A 2015 Pemberian stimulan etofon dengan teknik bark application pada produksi lateks tanaman karet (*Hevea brasiliensis* Muell. Arg) *JOM Faperta* **2** Okt**.**

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