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THE EFFECT OF GAS STIMULANT APPLICATION AND LENGTH OF S4 TAPING GROUND ON THE PHYSIOLOGY AND PRODUCTION OF LATEX IN RUBBER (HEVEA BRASILIENSIS MUELL) CLONE PB 260

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Abstract: *Rubber plants with PB 260 clones are clones that have high productivity potential because they are classified as quick starter clones but their productivity will decrease when they reach the age of 10 years as well as their latex physiology. The research was conducted at PT.Perkebunan Nusantara III Kebun Bandar Betsy, Bandar Huluan II District, Simalungun Regency, North Sumatra with an altitude of 900 meters above sea level and ultisol soil type. Physiological analysis was carried out at the Laboratory of PT. Socfin Indonesia (Socfindo). This research started from January to July 2020. The aim of the study was to determine the physiological effect and yield of latex production on the length of the quarter-spiral tapping groove (S4) and the application of gas stimulants in the Clone PB 260 rubber plant. The research method used a Non-factorial Randomized Group Design with three replications and as an exploitation system treatment with two levels S0G1=S4d4 (Control) and S1G1=S4d4 ETG30d. The results showed that the latex yield in the S1G1=S4d4 ETG30d treatment had a higher latex yield compared to the S0G1=S4d4 treatment (Control). The results of physiological analysis of latex, namely sucrose, Pi, and thiol in the S0G1 and S1G1= S4 d4 ETG30d treatments on rubber clone PB260 showed no difference. In general, the use of stimulant gas S1G1=S4 d4 ETG30d affects the increase in latex yield.*

Keywords: *hevea brasiliensis, klon PB 260, latex physiology, rubber production*

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Introduction

This study used rubber plants with clone PB260, this is due to its productivity which is a quick starter and the amount of latex it can produce, this is in accordance with the statement of Jetro et al., (2013) PB 260 is one of several clone varieties of rubber plants that produce sap which is recommended as superior rubber clones for the period 2010 to 2015. Besides that, this PB 260 clone rubber seed also has advantages in terms of rubber latex production produced in the tapping process, when compared to other types of clones, the drawback is reduced latex production when it enters the age of 10 years and over and must be assisted with stimulants. PB 260 itself is the result of the Malaysian rubber plant research agency, PB itself stands for the Great War which is the name of one of the regions in Malaysia.

Nyukeng et al., (2015) stated that stimulants in rubber plants were initially intended to reduce labor costs, by using stimulants the tapping interval can be reduced from d/2 (every other day) to d/3 (every 3 days) so that the need for tappers will also decrease while the production obtained is relatively the same. However, currently the application of stimulants has become a technical standard in rubber plantations. The stimulant that is widely used is the active ingredient etefon (2-chloroethyl phosponic acid), besides that there are other types of stimulants which have the active ingredients polyethylene glycol and ethylene gas stimulants.

If ethylene gas has entered the phloem tissue through a hydrolysis process or directly. Ethylene tends to stimulate H+/sucrose protons which activates the transport of sugar into the latex vessel cells. Ethylene activates the proton pumps ATPase and Ppase causing acidification of the lutoid serum and basification of the cytosol. Basically, the type of gas used is relatively the same, namely ethylene gas (C_2H_4), it's just that the type of applicator and technique for administering the gas are different so that the effects are also different.

Sucrose, inorganic phosphate and thiol levels are physiological characters in rubber plants which are closely related to the plant's ability to form latex (Purwaningrum et al, 2015). Physiological characters of latex consist of sucrose, inorganic phosphate, thiol content, tapping groove length and production index (Syakir et al, 2010). The purpose of this study was to determine the physiological characteristics of latex and latex production in PB 260 clones after being treated with a gas stimulant system. Studies in the field of physiology and biochemistry of latex in rubber plants are useful for determining the characteristics of plants that are suspected of having high productivity.

Iqbal et al (2012) stated that knowing the levels of sucrose, organic phosphate, and thiol is closely related to the level of exploitation applied. This is because the results of photosynthesis will be translocated to other plant organs in the form of sucrose, if the sucrose level is below 4 mM it will cause a void in the precursor material for latex (isopropene). Likewise (Santoso, 2013). Organic phosphate as an indicator for metabolic activity in rubber plants, if it exceeds the 25 mm limit, it indicates a plant response to stress and disease disturbance high production and has little negative effect on metabolism in latex cells.

Materials And Methods

Place and Time

This research was conducted at PT.Perkebunan Nusantara III Kebun Bandar Betsy, Bandar Huluan II District, Simalungun Regency, North Sumatra with an altitude of 900 meters above sea level and ultisol soil type. This research started from January to July 2020.Coordinate point

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3012'250N 99015'42E. Physiological analysis was carried out at the Laboratory of PT. Socfin Indonesia (Socfindo).

Materials and tools

PB 260 clone plant material aged 15 years, spacing 3 m x 2.5 m, circumference 60-75 cm, circumference between 60-75 cm measured at 130 cm from the soil surface. 150 plant samples with 3 (three) replications. At each study site, 25 plant samples were randomly selected and repeated three times. Variable observations of rubber production and physiological latex (contents of sucrose, inorganic phosphate, thiol).

Experimental design

The experimental design method was a non-factorial Randomized Block Design (RBD) with the following treatments: 1. S_0G_1 = S4 d4 Control, 2. S_1G_1 = S4 ETG 30d (tapping groove length of a quarter of the stem circumference by tapping once 4 days and giving 100% ethepon liquid stimulant every 30 days)

Research Implementation

Physiological analysis of latex was carried out at the Rubber Research Institute Laboratory, Sungai Putih, Deli Serdang, North Sumatra, Indonesia. Physiological analysis was started by taking 1 mL of 10 trees, fresh latex and then adding 9 mL of TCA. Then the sample is pressed manually to obtain latex serum, this is the basic material for physiological analysis. All latex parameters were measured using spektrofotometer Beckman DU 650 (Beckman Coulter, Brea, California, USA).

150 L of sample was taken then added with 2.5% TCA so that the total volume became 500 L. Then 3 ml of anthrone reagent was added and vortexed, heated by immersion in boiling water for 15 minutes and cooled. The next step is the absorbance at 627 nm (nanometers), measured by the anthrone method. Dehydration of sucrose in concentrated sulfuric acid (70% H2SO4) and heating will give furfural derivatives which react with anthrone to produce a blue color. The absorbance measurement was carried out at 627 nm (nanometers) with a Beckman DU 650 spectrophotometer (according to the anthrone Dische method (1962).
Inorganic phosphate is measured based on the principle of binding by ammonium molybdate and reduced by FeSO4 in an acid reaction so that it turns blue. Absorbance measurements were carried out at 750 nm (nanometers) with a Beckman DU 650 spectrophotometer, with Taussky, and Shorr 2010.

Approximately 1.5 ml of sample was taken, and 2.5% TCA was added so that the volume became 1.5 ml), then 10mM 75µL DTNB was added. Add 1.5 ml of 0.5 M Tris buffer and vortex. Leave it at room temperature for 30 minutes. The absorbance was read at 421 nm (nanometers) with a Beckman DU 650 spectrophotometer according to McMullen (1960).

The latex yield was obtained from tapping production data in the morning and then the results were collected in a lump bowl and weighed the next day. Observation of production by taking latex is carried out every month which is the average of each observation with a tapping frequency of once every 3 days (d3). Observed by measuring the volume of latex produced from each plant, which is then converted to $(g^{-1}p^{-1}s^{).}$

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Results and Discussion

The results of the analysis of latex physiology showed that the treatment S_0G_1 = S2 d4 ET 15d and S_1G_1 = S4 d4 ETG 30d had not affected the latex physiology of rubber clone PB 260 Table 1, but when seen from the treatment figures S_1G_1 = S4 d4 ETG 30d had higher latex physiology. The high level of sucrose in rubber plants before entering the gas stimulant treatment on rubber plants is because in the period from January to March the plants experience water drought or lack of water availability due to entering the dry month or the dry season where rainfall in the dry month is very low, causing the plants to drop their leaves.

Table 1: Physiology of latex clone PB260 (Sucrose, Pi, and Thiol)

	Before Treatment			After Treatment		
	Sukrosa	Pi	Thiol	Sukrosa	Pi	Thiol
Treatment	……….Mm…….					
S_0G_1= S4 d4	10,22	23,51	0,25	9,43	18,49	0,15
S_1G_1= S4 ETG 30d	13,88	22,88	0,34	10,28	17,13	0,23

Note: Numbers followed by the same letter in the same column are not significantly different in Duncan's test with a level of 5%
S_0G_1= S4 d4
S_1G_1= S4 ETG 30d : Length of quarter spiral tapping groove with 99% concentration of gas stimulant application given once every 30 days

As a result, it has an impact on photosynthetic results that are not optimal to produce photosynthesis. Because of this, the high sucrose was not synthesized to produce rubber particles because the energy source obtained from the photosynthesis process was not optimal. So that sucrose becomes reserved in plants and is not used because plant energy is not enough for inorganic phosphate (Pi) to process sucrose raw material into rubber particles, namely latex. So that in the dry months the yield of latex decreases and tends to decrease and is unstable.

Table 1 shows that the low levels of sucrose in rubber plants after entering the gas stimulant treatment in rubber plants, namely because during the April-July period the plants experienced enough water or there was water availability due to entering the wet month or rainy season, where rainfall is in April-July very high, resulting in plants starting to grow their leaves because they have received sufficient energy from the results of photosynthesis to produce photosynthates. Because of this, the high sucrose was processed to produce rubber particles due to the energy source obtained from the optimal photosynthesis process. So that sucrose which was previously stored in plants and not used because of plant energy, in April-July rainfall and leaf conditions are sufficient, phosphorus can process the raw material sucrose into rubber particles because it has received energy and produces latex. So that in April-July the yield of latex increases and fluctuates.

Another factor was the low sucrose after treatment because the analysis was carried out for before treatment in January, and after treatment analysis was carried out in July so that during the period after the treatment the sucrose had been used from April to July as a result the sucrose and Pi values were low but the latex yield is high because the raw material sucrose for latex production has been used optimally. Also because this study used PB 260 clones with the advantages of high metabolism clones and belonged to the QS (Quick Starter) clone type and had latex regeneration speed to produce latex quickly so that sucrose and Pi continued to run resulting in low sucrose and Pi in the post-treatment period. Within the latex vascular cells, the

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main form of sucrose is a disaccharide and this compound is a precursor for the synthesis of latex into latex particles. (Purwaningrum, 2015). Sucrose is one of the physiology of latex which functions as a raw material that will undergo a process with phosphorus which will produce latex particles (Jacob et al., 2011). Sucrose is located within the latex vessel cells, and is a precursor for the formation of latex in rubber plants (Sumarmadji et al., 2015).

The rapid intensity of latex formation in the PB 260 clone caused low levels of sucrose and Pi due to tapping with an interval of only 4 days so that the use of latex physiology was continuously used so that sucrose and Pi became low. The faster the tapping interval, the lower the physiological levels of latex will be. According to Sumarmadji (2011), the high physiological sucrose content in rubber plants illustrates that the sucrose raw material for latex formation is higher and only requires Pi which is high enough to convert sucrose raw material into latex particles. Lacote et al., (2010) stated that Pi levels indicated the speed ability of a clone to convert sucrose into latex.

Pi is an indicator of metabolic activity that shows the ability of plants to convert raw materials (sucrose) into rubber particles (Jacob et al., 2011). In general, clones that produce high without stimulants have high Pi levels and low sucrose, indicating high metabolic activity. Preferably, low Pi and high sucrose levels in low-yielding clones indicate low latex metabolic activity (Lacote et al., 2010). PB260 clones responded to stimulants in the S_0G_1 = control and S_1G_1 = S4ETG30d treatments. This condition is supported by the metabolic capacity and levels of latex sucrose in the administration of stimulants. Increased production has the effect of high levels of Pi and sucrose as the plant's ability to activate metabolism in rubber plants (Herlinawati et al., 2017). According to Sumarmadji et al., (2011), the optimal range of Pi levels is 10-30mM. If a plant has Pi levels >30mM, it means that the plant is experiencing over metabolism or indicates that the plant is diseased.

In latex diagnosis, measurement of sucrose and Pi levels is more active when combined with measurement of thiol levels because it reflects the ability of latex vessels to deal with aging mechanisms (Jacob et al., 2014). The availability of thiols in latex is very important for plants because it functions as an enzyme activator and is associated with the stability of the lutoid membrane to extend latex flow (Lo Conte and Carroll, 2013).
The results of research by Herlinawati and Kuswanhadi (2013) showed that the more often the frequency of stimulant administration, the higher the latex thiol levels which would result in a decrease in plant health. Lacote et al., (2010) stated that latex cell metabolism in high metabolism clones such as clone PB260 was very susceptible to stimulants, which could have a negative impact on the health of rubber clone PB 260.

Latex Yield (g/p/s)

The results showed that both the S_0G_1=S4 d4 (Control) and S_1G_1= S4 d4 ETG30d treatments in January, March, May, June, and July affected latex yields, while February and April did not affect latex yields Table 2.

Table 2. Production of PB 260 latex clones in January-July

Treatment	**January**	**February**	**Marcht**	**Apryl**	**May**	**June**	**July**
	Production $g^{-1}p^{-1}s$						
S_0G_1= S4 d4	0,46b	2,96a	3,24b	5,89a	10,95b	9,87b	15,23b
S_1G_1= S4 ETG 30d	0,60a	3,31a	3,73a	8,11a	22,54a	25,46a	55,00a

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Note: Numbers followed by the same letter in the same column are not significantly different in Duncan's test with a level of 5%

S_0G_1= S4 d4 Control

S_1G_1= S4 ETG 30d : Length of quarter spiral tapping groove with 99% concentration of gas stimulant application given once every 30 days

In the S_0G_1 = Control and S_1G_1 = S4 ETG30d treatments in April, June and July, stimulants were administered that the results affected the latex yield, but in the S_1G_1 treatment the latex yield was higher than in the S0G1 treatment. Because the S0G1 treatment did not get stimulant assistance where the ethylene gas stimulant itself helped the rubber plant in providing important compounds such as sucrose to synthesize Pi (Table 2).

Pi is an indicator for metabolic activity that describes the ability of plants to convert raw materials (sucrose) into rubber particles which produce latex. The S_0G_1 = Control treatment had higher Pi levels than the S_1G_1 treatment, but the sucrose content in the S1G1 treatment was higher than the S_0G_1 = Control treatment (Table 1). So that the administration of gas stimulants to the S_1G_1 treatment, which has a high sucrose content, can increase the yield of latex which is higher than the S0G1 treatment, because sucrose is the raw material for making latex, where the higher the sucrose, the higher the yield of latex or latex particles produced.

According to Soumahin et al., (2010), the presence of high sucrose accompanied by relatively high Pi can change sucrose to produce high latex yields. The availability of sufficient sucrose for latex synthesis is an important factor so that rubber synthesis can take place continuously and rubber plants can produce latex optimally and are supported by sufficient Pi levels to be able to support plant metabolic processes, especially those related to latex biosynthesis. According to Lukman (2011) that tapping S4 upwards produces higher production when compared to tapping S2 downwards because in the upper panel tapping S4 the distance between the tapping area and the plant canopy is closer, and is not limited by the former tapping area. In addition, in the S/4 tapping system the flow of latex increases because it is supported by gravity. In addition, the high yield of latex PB260 by administering ethylene gas stimulants S0G1 and S1G1 was caused by several factors, including the nature of the PB260 clone which is a clone with a high metabolism Quick starter (QS) with a latex regeneration system that efficiently produces latex (Purwaningrum, 2018). This caused the PB260 clone to respond to the administration of the stimulant, so that when the ethylene gas stimulant S1G1 was administered, the rubber plants could respond due to the ethylene gas stimulant mechanism which does not require a process to enter the latex vessels such as liquid stimulants which require 4-5 hours to hydrolyze to ethylene gas.

High latex yields in April, May, June and July when the leaves are full and supported by high rainfall of 132mm/month for April, 258mm/month for May, 370mm/month for June, and 378mm/month for July. this causes the process of plant photosynthesis to run optimally so that the latex yield is also higher due to the availability of sufficient water. According to Vinod et al., (2010), the condition of sufficient water and full leaf conditions causes the rate of photosynthesis to run effectively, resulting in maximum assimilate and will further impact on increasing latex yields.

In January, before the S1G1 treatment and in February before the S1G1 stimulant treatment, latex yields decreased and yields were low, and high latex yields were obtained in March-July (Table 2). This is because in January and February the condition of the leaves of the plants which were full in the previous month began to drop their leaves which was also followed by

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low rainfall, resulting in a reduced rate of photosynthesis, so that the yield of latex also decreased. According to Junaidi et al., (2014), minimum rainfall and temperature in an area can be the main factors that influence plant production and growth patterns.
In March, before the S1G1 treatment, the latex yield was higher than in January and February (Table 2).

This is because in March, the leaves of the rubber plant begin to regrow after the leaves fall so that the photosynthesis process starts to slowly improve or starts to be optimal so that the reserved sucrose can be used optimally again so that the latex yield has increased slightly more compared to January and February 2020 Priyadarsan et al., (2011) stated that low rainfall conditions resulted in rubber plants dropping their leaves naturally in response to drought stress that occurs in dry months each year, so latex yields would not be optimal and rubber plants would tend to drop their leaves. to survive environmental stress. This is related to the process of photosynthesis which requires enough water to produce sucrose as a latex forming material. Furthermore Ardika (2011) states that low soil water content is one of the causes of rubber plants dropping their leaves, resulting in a decrease in latex flow rate.

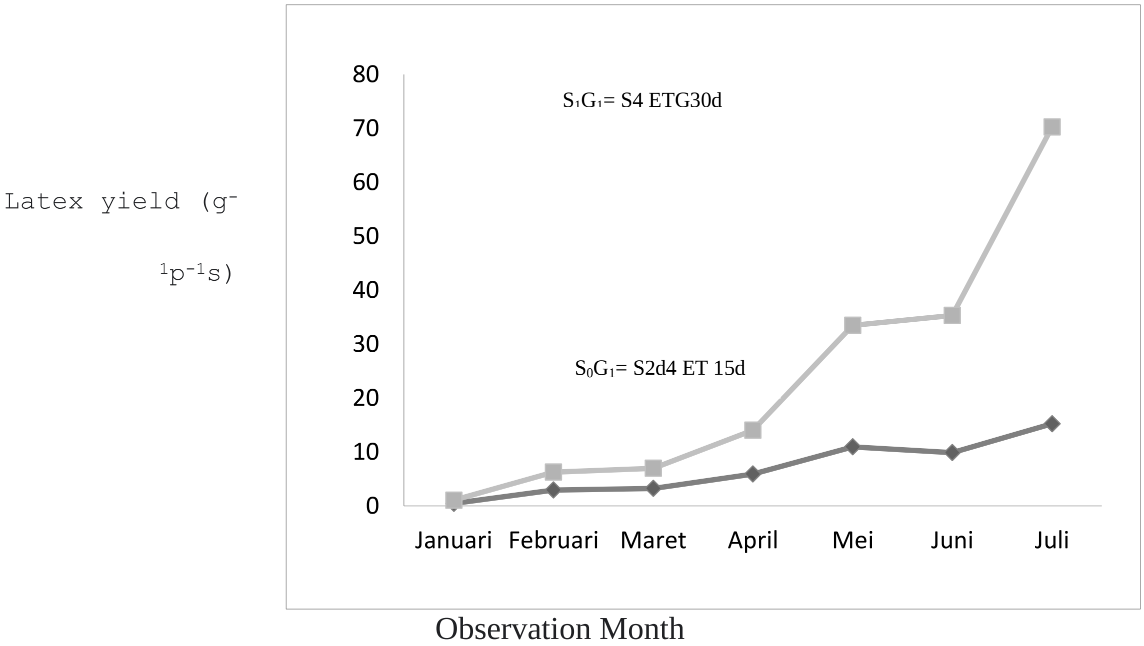

Figure 1: Latex Clone PB 260 with stimulant administration in January-July

Anwar (2010) states that optimal rainfall for maximum latex yields is between 2000-4000 mm/year. However, latex yields in April were still higher than in January-March due to the condition of the leaves of the plants which had started to turn quite a lot and turned green, so that the photosynthesis process started to become more optimal (Table 2). The main product of the rubber plant is its latex, where the formation of latex requires an adequate supply of water. This can be seen from the results of latex clone PB 260 with the administration of gas stimulant S1G1 which fluctuated with the month of observation (Figure 1).

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Conclusion

1. Treatment S0G1 = Control and S1G1 = S4ETG30d did not affect latex physiology (sucrose, Pi, and thiol)
2. Pi levels in the S0G1 = Control treatment showed a relatively higher number compared to the ethylene gas stimulant treatment S1G1 = S4 ETG30d both before and after the treatment.
3. Production of rubber plants with the S0G1 = Control treatment had lower latex production in January-July, compared to the S1G1 = S4 ETG30d treatment.

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