The Application of Concentration and Stimulation Techniques of Polyetilene Glycol on the Production of Rubber Plant PB 260 Clone

Yunta G A* and Dede M

*yunta_gombang@yahoo.co.id

Abstract. Natural Rubber (Hevea brasiliensis Muell Arg.) is one of the important plantation commodities in Indonesia. As source of employment, this commodity provides a significant contribution as one of non-oil and gas foreign exchange sources, supplies for rubber raw material and plays a vital role in encouraging the growth of new economic centers in the rubber plantation areas. Indonesia has the largest rubber plantation area in the world but its productivity is still lower than Thailand. The productivity of rubber in Indonesia has not been maximized due to most of rubber plants (85%) are managed by smallholder plantations with low of productivity. The efforts to increase the productivity of rubber plants in Indonesia are the right steps to take. To increase rubber production, proper management and cultivation are needed. The use of stimulants is an alternative way to increase the production of rubber and it benefits in reducing lead costs caused by higher labor costs. Research on the Application of Concentration and Technique of Giving Polyetilene Glycol Stimulants to Rubber Crop Production PB 260 clones shows that the application technique and the concentration of PEG stimulant significantly affected the latex volume, latex weight and Pre-processed Rubber (bokar) weight, but did not significantly affected on dry rubber. The application technique and 2% of PEG stimulant with the bark application (BA) technique on PB 260 clones gave the best results on the parameters of latex volume (61.28 ml), latex weight (57.60 gr), and Pre-processed Rubber (bokar) weight (57.90 gr). It is considered as the best treatment. It is recommended to apply topical system tapping technique (Bark Application) with concentration of 2.5% PEG stimulant in rubber plants PB 260 clone. Further research need to investigate the technique and the concentration of PEG stimulant to rubber plants with different clones.

1. Introduction

Natural Rubber (Hevea brasiliensis Muell Arg.) is one of the important plantation commodities in Indonesia. As source of employment, this commodity provides a significant contribution as one of non-oil and gas foreign exchange sources, supplies for rubber raw material and plays a vital role in encouraging the growth of new economic centers in the rubber plantation areas (Fahmi, 2015). The Ministry of Trade (2015) released the value of foreign exchange generated in Indonesian in 2014 is 4.7 billion US dollars with a total production of 3.1 million tons.

Indonesia has the largest rubber plantation area in the world but its productivity is still lower than Thailand. The productivity of people’s rubber is 700-900 kg / ha / year. This productivity is still very
low compared to the productivity of large state plantations, which are an average of 1,299 kg / ha / year and private plantations 1,542 kg/ha/year or people's rubber productivity in other countries such as Thailand which reaches 1,600 kg/ha/year (Boerhendhy, 2011).

In 2015 rubber production in Indonesia reached 3,145,398 tons with an area of 3,621,102 ha, rubber production increased in 2016 to 3,157,780 tons with an area of 3,639,092 ha and in 2017 it was estimated that rubber production was 3,229,851 tons with an area of 3,672 .123 (Directorate General of Estate Crops, 2016). The area of rubber plantations in Jambi Province in 2015 was 379,011 ha, increased in 2015 to 379,886 ha and estimated to change to 383,208 ha in 2017. Jambi Province became the lowest productivity area in Sumatra. It is recorded in 2015 produced rubber 842 kg/ha/year; In 2016 it increased to 851 kg/ha/year and is expected to increase to 860 kg/ha/year in 2017 (Directorate General of Estate Crops, 2016, 2016).

The national rubber productivity has not been maximized because most of rubber plants (85%) are managed by smallholder plantations with low productivity. Efforts to increase the productivity of rubber plants in Indonesia are the right steps to take. To increase rubber production, the management and cultivation are needed properly (Muhtaria, 2015).

One of the efforts to overcome this problem is by increasing rubber products. The use of stimulants is an alternative way to increase the production of rubber and it benefits in reducing lead costs caused by higher labor costs. Stimulants is the mixture consisting of vegetable oils and ethylene hormones or other active ingredients to increase latex production. Stimulants is used to grown plants to increase its production (Sinamon et al, 2015).

Latex stimulants has been used in rubber tapping. In large plantations, stimulants ise commonly used by using active ingredients of ethephone (2- chloroethyl)phoshonic acid). One of the potential stimulant ingredients is Polyethylene Glycol (PEG). Andriyanto and Darojat (2016) acknowledge Polyethylene Glycol was proven to increase latex production when compared with ethephony treatment (control). The PEG treatment for 9 months had an average production of 50.88 g/p/s and control (ethephones) of 34.36 g/p/s.

According to Rouf et. al. (2015), the use of stimulants is not proper in accordance with the physiological characteristics; It affects on the reducing of rubber health and production, but if the stimulant is used according to the correct procedures and the plant health is maintained, a high production capacity can be reached.

Some rules for giving stimulants that must be considered to get optimal production by considering plant health, the dosage and application technique. Giving a dose of stimulant must be accompanied by the right application technique. The correct dosage of a stimulant must be accompanied by the right application technique. It aims at ensuring the stimulants provision becomes more effective. The technique of giving stimulants is divided into 3 namely application groove, lace application and bark application (Wulandari et al, 2015).

Wulandari et. Al. (2015) concluded that the provision of ethyl stimulants of 0.9 cc tree-1 by applying bark techniques increased the highest achievement on the latex rate parameters and the volume of latex compared with other treatments. Fahmi (2015), on the other hand, reports that the provision of etephone stimulant gives real effect toward the increasing of latex flow rate and latex volume.

The study aims to know stimulant technique to increase high production of rubber, with good quality of latex and do not specifically damage the rubber growth

Specifically, this research aims to:
1. To know the concentration of PEG stimulant that gives a good response to the increasing of rubber production PB 260.
2. To know a proper PEG stimulant technique to increase production of latex rubber PB 260 clone.
3. To produce a recommendation for a combination of concentrations and PEG stimulant technique that can be used in rubber plantations PB 260 clone.
2. Literature Review

2.1 Rubber PB 260 Clone

PB 260 clone is a commercial recommended clone for latex producers which is widely endeavored to people’s plantation. The metabolic character is included in the quick starter (QS), which is the clone that peaked in mid-production. The production of PB 260 dry clones in the fifth year was 8,942 kg/ha and 30,795 kg/ha in the ninth year with total of average is 2,053 kg/ha. The production patterns at the beginning and follow-up are set in good category and the criteria is categorized good for mature plants; while in immature plants and from the thickness of the skin, it is categorized into medium. PB 260 clones are not suitable in wet areas with rainfall of 2500-3000 mm/yr, highlands with an altitude of 300-600 m asl as well as wind-prone clones with speeds of 30-50km/h; it is suitable with dry areas with 1500-1000 rainfall mm/yr, 2-4 dry months and wavy areas to hilly. PB 260 clone has good resistance to Corynespora and Oidium, and low resistance to KAS, Stimulant provision, and Upas Mushroom and are susceptible to Colletotrichum (Sembawa Research Institute, 2014). According to Sakiroh's (2014) PB 260 clones are relatively resistant to drought sustainable. This is proved when the water supply is stopped for 47 days and has the best growth when re-watering. This clone is recommended for planted on the marginal land with the texture of sandy clay soils to clay sand.

2.2 The Role of Polyethylene Glycol Stimulants toward the Increasing of Latex Production

Stimulants are the mixtures containing vegetable oils and ethylene hormones or other active ingredients. The use of stimulants on rubber tapping has been done on rubber. There are two types of stimulants chosen, namely liquid stimulants and gas stimulants. Indonesia recognized liquid stimulants in the 1970s while gas stimulants were used in the 1990s.

Both of the stimulants have the same benefit in increasing the production of latex by extending the flow of latex. This may affect on the reducing of the tapping cost. The difference between the two stimulants lies in the material used. The liquid stimulant active ingredient is etephone (2-chloro ethylphoshonicacid) which must go through hydrolysis to produce methylene, while gas stimulants are pure ethylene gas (Rouf et al, 2015).

High latex production is not always viewed in positive consideration. There is a concern that plants are attacked by KA. The increase of production with stimulants is also inversely proportional to the value of Rubber Dryness (KKK), which is considered as one of the indications of latex quality. The addition of stimulants causes turgor pressure to rise that affect on the water content in the tissue comes out until finally the KKK decreases. The KKK value threshold is categorized as dangerous if it is below 25%. The use of stimulants that are not in accordance with plant physiology causes plant health to decline, but if it is balanced with good care, the sustainability of production will be maintained (Andriyanto, 2016).

Sumarmadji (2000) mentions there are two main pathways for the role of ethylene to increase rubber yield by increasing rubber biosynthesis and extending the duration of latex flow. Ethylene treatment in the skin tissue will disappear several hours later, but ethylenedogenus increases. The role of ethylenexogenus is maintained to three times tapping or equal to 9 days after basting. During the span time of tapping, it took three days for the regeneration of latex at replacing the latex to flowing down.

In the early stages ethylene triggers H^+ATPase activity to pass H^+ from cytosolkedalam vacuole. The transfer of H^+ causes the changes in cytosol and lutoid. The concentration of H^+ ions in cytosol decreases so its characteristic becomes alkaline, while lutoid becomes more acidic. The pH change triggers an increase in enzyme activity and the availability of important compounds such as sucrose as raw material, nitrogen as a source of protein and phosphorus as a source of ATP material so that the biosynthesis process of rubber in latex vessel cells increases and progresses faster (Tistama, 2013).

Beside rubber biosynthesis, cytosolic activity will increase the water supply around the tapping field through gene expression, namely the aquaporium gene. It has the ability to maintain the stability of latex (lutoid) so latex is not easy to clot. On the other hand, ethylene that applied to plant tissue affects latex vessel cells into sinks, in water form, sugar and nutrients so these compounds are channeled into
latex vessels which results in the increase of elasticity of the latex vessel cell wall followed by the increase of turgor pressure. Stable latex and water supply in the network cause long flow of latex that affect on the increase of latex volume (Rouf et al., 2015).

One alternative ingredient that can be used as a stimulant is Polyethyleneglycol (PEG). By definition PEG is a polymer consisting of several monomer bonds. Monomer can be categorized into compound that can be polymerized. PEG has good solubility in water and similar chemical structural due to the presence of primary hydroxyl groups at the ends of polyether chains which containing oxyethylene. PEG chemical structure can be seen as follows:

\[
\text{HO} \quad \text{CH}_2 \quad \text{CH}_2 \quad \text{O} \nabla \quad \text{H}
\]

**Figure 1.** PEG chemical structure

PEG is characterized in a stable, easily soluble in warm water, non-toxic, non-corrosive, odorless, colorless, high melting point (580° F), evenly distributed, hygroscopic (volatile) and can also bind pigments. The PEG appearance like a white candle that resembles paraffin. It is solid at room temperature and; melted at a temperature of 104° F. PEG stimulant products contain additional organic ingredients such as vitamin C and vitamin K. In addition, plant openings through tapping causes plants stressful. It require them to induce ethylene. The formation of the endogenous ethylene and the PEG application caused the flow of latex became longer and increased. The active ingredients of PEG in the vitro media increased prolina accumulation and posmolite compounds so as to maintain cell turgor pressure, water absorption and physiological continuity in cells (Southom, 1969 in Andriyanto, 2016).

Andriyanto (2016) reports that 2.5% PolyethyleneGlycol substances proved to be able to increase latex production when compared with ethephony treatment (control). The PEG treatment for 9 months had an average production of 50.88 g/p/s and control (ethephones) of 34.36 g/p/s. This value indicates that the PEG treatment can increase production (g/p/s) by 16.52 or 148.1% towards the control. Dry rubber content (KKK) of PEG stimulants has a higher value than the KKK stimulant value of etephones that is equal to 30.26% and 28.89%. The physiological conditions of the plant showed a safe condition in the PEG stimulant treatment with sucrose levels, inorganic thiol and phosphate were at normal limits. In general, the use of PEG stimulants can increase the production of latex and does not interfere the plant health conditions.

### 2.3 Technique of Applying Polyethylene Glycol Stimulants

Proper techniques for the stimulant use is named groove application, lace application and bark application. The use of stimulant is not recommended if it is predicted to rain to 4-6 hours later.

a) **Groove application**

Groove techniques are applied in advance by raising the dried latex from the tapping grooves or known as scrap. After the tapping grooves is removed, the stimulation is applied precisely to the tapping grooves.

b) **Lace application**

Lace technique is applied by directly rubbing the dipped of the toothbrush tip into stimulants towards the tapping grooves without pulling the scrap. Thus, this technique does not require the work of pulling in advance.

c) **Bark application**

The bark technique is applied by initially scraping more than one plank of virgin bark with a width of 2-3.5 cm. The scraping is utilizing special tools (commonly called scapper), is only above the sandy bark. Avoid deep scrapings that cause the latex production.
3. Research Methodology

3.1 Research Site
This research was conducted in farmer’s land in Jl. Lintas Jambi-Muara Bulian, Pulau Betung Village, Pemayung District, Batang Hari Regency. This research was conducted for 4 months in 2018.

3.2 Materials and Equipments
The materials used in the study were PB 260 clone (description of clones presented in appendix 1) 11 years age and mature plant, name plate, aquadest and Polyethylene Glycol (PEG). The equipments used in this study are toothbrushes, measuring cups, cup, tapping bowls, scapper, jars, plates, digital scales, analytical scales, meters, tapping knives, ovens and stationery.

3.3 Experiment Design
The research was conducted in an owned farm in Seresah Village, Pemayung Subdistrict, Batang Hari Regency without intercropping with space of 3 m x 6 m. Therefore this study used field design by placing treatment randomly in experimental units. The treatment was given to rubber plants that had been selected as samples in the study based on the trunk, age of the plant. The effect of the treatment tested on the latex production of rubber plant (*Hevea brasiliensis* Muell Arg) 260 clone was described as follows:

\[ K_1P_1: \text{Concentrations of 2.5% PEG with groove application technique} \]
\[ K_2P_1: \text{Concentrations of 3% PEG with groove application technique} \]
\[ K_1P_2: \text{Concentrations of 2.5% PEG with lace application technique} \]
\[ K_2P_2: \text{Concentrations of 3% PEG with lace application technique} \]
\[ K_1P_3: \text{Concentrations of 2.5% PEG with bark application technique} \]
\[ K_2P_3: \text{Concentrations of 3% PEG with bark application technique} \]

Each of the treatment was given to 5 rubber plants. Indeed, all samples tested were 30. To test the similarity of the median of the treatment effect, a nonparametric test was used, namely the H Kruskal-Wallis test. The formula is:

\[ h = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{r_i^2}{n_i} - 3 (n + 1) \]  

Note:
- \( n = \sum n_i = \text{Total number of observation} \)
- \( K = \text{Total of the sample} \)
- \( n_i = \text{Total observation in the sample -i} \)
- \( r_i = \text{Total rank dalam in the sample -i} \)
- \( v = k-1 \) to the distribution of qhi-square \((x^2_v)\). If value of \( h > x^2_v \) it can be concluded that the effect of treatment is significantly different (Suliyanto, 2014).

3.4 Research

Plant Material Preparation, Rubber plants were selected based on uniformity of the stem bundles which average 60 cm width, plant age 11 years, and tapping type B1-1 (recovery bark).

3.4.1 Sample Labeled
The sample labeled is carried out after conforming to the uniformity of the plants. The trunk uniformity was measured 100 cm from the highest occlusion link. To label the sample plants, the researcher wrote the treatment applied on the rubber stem using a signboard.
3.4.2 Polyethylene Glicol (PEG) stimulants
The PEG concentration is 10%, the concentration is formulated according to the treatment with the dilution formula. (calculation of the treatment concentration is attached appendix 2).

3.4.3 The Application of PEG stimulants
PEG stimulant was applied in accordance to the treatment technique. PEG stimulant was given 3 days before tapping. It is applied in the morning at 07:00 - 09:00 WIB to avoid the air temperature and high water evaporation.

3.4.4 Tapping
The tapping system used is ½ S d/3 K. PEG. (2w) which is a ½ spiral tapping system, tapped in 3 days, the concentration is in accordance to the treatment, the application interval is in every 2 weeks. Tapping is carried out 3 days after the application of PEG stimulant and tapped at 6:00 to 7:30 a.m.

3.5 Parameter Observed

3.5.1 Latex volume (ml)
The latex volume is obtained by measuring liquid latex using a measuring cup. The data was gained after the latex flow in the tapping grooves stops after tapping.

3.5.2 Latex Weight (g)
Each sample of latex weight was weighed using a scale. The data was gained after the latex flow in the tapping grooves stops after tapping.

3.5.3 Rubber Material Weight (g)
Weighed rubber material is a lump derived from sample latex that has been coagulated in a container/bowl. The lumps was collected a day after tapping.

3.5.4 Dry Rubber Level (KKK)
KKK measurements are carried out after tapping. The production of rubber is weighed as latex and lump bowl. KKK was measured by the gravimetric method, based on a comparison of the percentage of dry weight and 5 grams of wet weight of latex. It is dried by oven at a temperature of 100°C until the weight is fixed. The formula used in the KKK measurement is:

$$KKK = \frac{Dried \ weight}{Web \ weight} \times 100\%$$

3.6 Data Analysis
To see the effect of treatment on parameters observed using the Kruskal-Wallis H test analysis. Then, the further testing used the Paired T-Test.

3.7 Supplementary Data
The supplementary data obtained at the end of this study are temperature, rainfall and humidity.

4. Result and Discussion

4.1 Discussion
Based on the results of the Kruskal Wallis H test, the application technique for the PEG stimulants in PB 260 clone showed an increase to the treatment of 2.5% concentration of the tested parameters including latex volume, latex weight, and Pre-processed rubber (bokar) weight, whereas the KKK was not significantly different.
The result is in line with the research conducted by Andriyanto and Darojat (2016). The result shows that 2.5% concentration of Polyethylene Glycol was proven to increase latex production when compared with ethephon (control) treatment. The PEG treatment for 9 months had an average production of 50.88 g/p/s and control (ethephones) of 34.36 g/p/s. This value indicates that the PEG treatment can increase production (g/p/s) by 16.52 or 148.1% towards the control.

The overall graphic images of the observations presented show that the treatment of various concentrations of PEG given to rubber plants PB 260 clone significantly affected the results of latex with the highest results in observations 1 and 5 or 3 days after the PEG application with the tapping system $\frac{1}{2}$ S D/3. This is consistent with Sumarmadji's (2000) statement that acknowledges two main pathways for the role of ethylene to increase rubber production by increasing rubber biosynthesis and prolonging the duration of latex flow.

Ethylene treatment in the bark tissue will disappear several hours later, but an increase in ethylene endogenous. The role of exogenous ethylene is active to three times tapping or equal to 9 days after basting. During the tapping time span, it took three days to regenerate latex in situ to replace the latex production. Research results report that the environmental factors (agroecosystem) that are dominant in increasing the productivity of rubber plants are rainfall (number and frequency), altitude, and the effect of disease generally is leaf disease (Daslin, 2014). Some observations on the decrease of latex production are predicted due to the PEG stimulant given that vanished by rain. Thus, the PEG stimulants are absorbed in a small amount. Rainfall and temperature support data taken from the Meteorology, Climatology and Geophysics Agency and Climatology Station of Jambi report that the number of rainy days in May and June is 19 and 18 with the highest rainfall intensity of 98 mm (Appendix 3). The weather condition during the research conducted in May and June showed an average rainfall of 308 mm and 225 mm (Appendix 4), average air temperature of 27.3°C and 27.2°C (Appendix 5), average humidity 86-85 (Appendix 6). The weather condition had not disrupted the experiment because rubber plants need air temperatures ranging from 25-28°C and irradiation 5-7 hours (Setiawan & Andoko, 2008).

4.2 Latex Volume

The treatment of applying stimulant and PEG concentration significantly affected the results of rubber latex volume of PB 260 clone. The 2.5% PEG BA concentration treatment showed the highest volume of latex which was 30.90 ml. This is presumably due to the physiological balance of the formation of latex in rubber plants by giving a concentration of 2.5% PEG BA. Latex contains 25-40% raw rubber ingredients and 60-77% serum (water and solute). Raw rubber contains 90-95% of pure rubber, 2-3% protein, 1-2% fatty acid, 0.2% sugar, 0.5% salt from Na, K, Mg, P, Ca, Cu, Mn, and Fe. This result is in line with Sumarmadji at. al., 2008 in Purwaningrum et. al. (2016) who state that the increase of latex production due to exploitation treatment related to physiological character balance is very complex and specific in producing latex. The treatment to apply 3% of different PEG BA is not significant with the concentration of 2.5% PEG LA and 2.5% BA. This is presumably caused by the extend of the given PEG concentration which interferes the physiological formation of latex or excessive latex extraction processes. This result supported by Jacob et. al., (1989 in Rouf et. al. (2015). They report that if the extraction speed is faster than biosynthesis and replenishment (regeneration) of latex in the latex flow area, there will be an increase in the volume of latex in each tapping. At the first time, excessive application of ethylene will cause the increase lutoid fragility. Lutoid is an organ in the cells of latex vessels containing acid material wrapped in membranes. This lutoid fragility occurs because the membrane is damaged. This damage is caused by NADP(H)-oxidase activity which promotes toxic oxygen, destroys lutoid cells and lutoid membranes. If the lutoid breaks, then the material inside the lutoid will exit into the cytosol. This cytosolic liquid spill causes cytosolic acidity to increase, so that rubber particles will clot and clog the latex vessels.

At a later stage, the blocked latex vessel cells will die, then affected on thickening of the cell wall, thickening of the tough skin layer and stimulating the formation of tachoid tissue. The formation of tachoid tissue causes the latex vessels around it become inactive because they are pressed and blocked.
by the tacilloid tissue, thus the movement of latex flow is disrupted (Gomez, 1982; Siswanto, 1994; Indraty, 2002). Another impact is an increase in the activity of free radical compounds such as reactive oxygen species (ROS) which can damage the function of the aquaporin gene. Aquaporin damage causes the process of translocation of water and nutrients into latex vessel cells to be disrupted. The impact affects the physiological balance in latex vessel cells which can lead to dry tapping grooves (KAS) (Tistama, 2013).

4.3 Latex Weight
The treatment of stimulants and PEG application techniques had a significantly different effect on the results of rubber latex weight of PB 260 clone. The average of tested latex weight on 2.5% of PEG BA treatment showed the highest latex weight; while the treatment on 2.5% PEG GA concentration showed the lowest latex weight. This is presumably due to an increase of ethylene which is hydrolyzed in the plant tissues that produce ethylene gas. This is in accordance with the Mutharia (2015) statement who reports in her research that that the increase of ethylene is hydrolyzed in plant tissues which then produces ethylene gas. In principle, the Ethylene gas, delays clumping of latex vessels so the mass of the latex flow stay longer. The stimulant active ingredient releases ethylene gas. If it is applied, it will seep into the latex vessels. Inside the latex vessels, the gas absorbs water from the cells around it. This water absorption causes turgor pressure to rise which is accompanied by the swift flow of latex.

The treatment of 2.5% PEG with the different GA technique was not significant with the concentration of 3.0% PEG with the GA technique. This is hypnotized that PB 260 clone has a quick starter metabolic type and excessive concentration can disrupt the physiological processes of rubber plants. This hypothesis is supported by Jacob et. al., 1989 in Herlinawati & Kuswanhadi (2013) who report that without stimulants, PB 260 clone produces high production with high inorganic phosphate content and low sucrose content. However, PB 260 clone has flow resistance so it is possible to provide stimulants with low frequency.

4.4 Pre-processed Rubber (Bokar) Weight
The treatment of technique and the concentration of PEG stimulant had a significant effect on the Pre-processed Rubber (Bokar) Weight of PB 260. The highest weight of Pre-processed Rubber (Bokar) was shown in the 2.5% of PEG BA concentration treatment. This is presumably because PEG is able to increase turgor pressure. The result is in line with Southorn’s (1969) in Boerhendhy (2013), who state that the stimulants given will increase turgor pressure on the stem so the water in the surrounding tissue seeps into the latex vessels. It causes the production higher when compared to tapping without using stimulants. Thus, it increases the production of latex.

The increase of latex concentration to 3.5% causes a decrease in latex production. this is due to the dosage given is higher than the dosage needed to produce the maximum latex flow rate. In this condition, luxury consumption occurs and can damage the plant. The 3.0% PEG LA treatment was different from the treatment of 2.5% PEG BA concentration, 3% PEG BA. Due to the amount of produced latex is influenced by several factors, one of factors is ethylene and its constituent genes. Naturally, rubber plants have a mechanism of ethylene formation in response to the presence of openings. Acc oxidase enzyme is the directly involved enzyme in the formation of ethylene which will affect the duration of latex flow (Mathooko, 1996 in Fahmi et al, 2015).

4.5 Level of dried rubber
The level of sried rubber is one parameter that describes the condition of rubber particle in each volume and in situ biosynthesis process. The highest KKK was shown in the treatment of 2.5% GA PEG which was 44.12%, while the application of stimulant using various techniques reduced KKK. The lowest KKK was on the 3.0% PEG BA treatment, which was 42.61%. This situation occurs because PEG stimulants are able to absorb serum latex (water and solutes) that affect on the reducing the pure rubber content. This is in line with Wulandari (2015) who states that applied stimulant active ingredient emits ethylene gas that seeps into the latex vessels. The gas absorbs water from the cells around it. This water absorption causes the rise in turgor pressure which is accompanied by heavy latex flow. This causes the
produced latex contains more water so the dry rubber content of the stimulated rubber plants is low. The use of PEG stimulants is relatively safe because the KKK value threshold is categorized as dangerous if it is below 25% (Sumarmadji and Tistama, 2004).

5. Conclusion And Recommendation

5.1 Conclusion

Based on the results of the study about the Application of Concentration and Stimulation Techniques of Polyethylene Glycol on the Production of Rubber Plant PB 260 Clone, it can be concluded that:

1. The application technique and PEG stimulant concentration is significantly affected on the volume of latex, latex weight and Pre-processed Rubber (Bokar) Weight, but it does not significantly affected on the dry rubber content.
2. The application technique and 2.5% concentration of PEG stimulant with the bark application (BA) technique in PB 260 clone gave the best results on the parameters of latex volume (61.28 ml), latex weight (57.60 gr) and Pre-processed Rubber (Bokar) Weight (57.90 gr). It is considered as the best treatment.

5.2 Recommendation

It is recommended to apply topical system tapping technique (Bark Application) with concentration of 2.5% PEG stimulant in rubber plants PB 260 clone. Further research need to investigate the technique and the concentration of PEG stimulant to rubber plants with different clones.

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