Production and Physiology Characteristics of Some Rubber Clones in Early Tapping with Growth Regulator

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Abstract. The study was aimed to study latex production and physiology character of some rubber clones in early tapping with the use of Plant Growth Regulators (PGR) and the relationship between production and latex yield characters. The research was conducted in Karanglnong Farm, PTP-N I Kso PTP-N III, East Aceh. The research was prepared using two factors Nested Design, namely 5 clone factors and 7 hormone factors. The treatment was repeated twice, but nested in the clone factor, so the number of experimental units was 7 x 5 x 2 = 70. Each experimental unit consists of 4 plants with the total is 280 plants. The results showed that response of each clone and hormone was different for production parameters and latex yield character. Treatment of clone PB 340 and hormone H6 (600 ppm IAA + Kinetin 60 ppm) yield the highest production (g/p/s). The best Interaction of clone and hormone treatment is K4H4 (IRR 107 clone with IAA 500 ppm + Kinetin 60 ppm) as indicated by production parameters (38.04 g/p/s), sucrose content (9.14 mM, phosphoric acid (6.84 mM), Thiol (0.50 mM) and plugging index (16.34%)

1. Introduction
Rubber is export commodities which contribute to increase Indonesia’s foreign exchange. Indonesia has the largest rubber plantation area in the world, namely around 3.40 million ha in 2007, but the production is only in the second position after Thailand which is 2.76 million tons [13]. Indonesia government has established a National Rubber Development Policy with a long-term target of national rubber production of 3.80 to 4.00 million tons in 2025. Such policy aimed to develop the potency and exploit long-term opportunities of world natural rubber demand that will continue to grow [7]. The effort is performed by increasing the use of high yield clones to more than 85%, with an average productivity at least 1,500 kg/ha [12].

In addition, the presence of natural rubber that is not easily substituted by other products causes the consumption of natural rubber will increase in the future due to human mobility and goods that require components made from rubber such as vehicle tires, conveyor belt, transmission belt, fender dock, shoes and sandals [5]. Increased production and productivity of Indonesian rubber commodities needs to be steadily driven to realize Indonesia as the biggest producer of natural rubber.

In plant metabolism, photosynthesis is an early process to produce glucose and then other processes occurs such as sucrose or carbohydrate formation, lipids, proteins, and secondary metabolites through various paths coordinated by the respiration process (glycolysis, tricarboxylic cycle). Secondary metabolites, such as phenolic compounds, terpen and secondary products containing N have specific paths such as sikimat, malonat and mevalonat path [27].
Latex contains rubber particles (isoprene) produced by the rubber plant and a secondary product classified as a terpencer (politerpen) which synthesized through mevalonic acid path (MVA). Acetylco A or acetic acid act as isoprene precursor but in the tissue is prepared in the form of easy-to-transport sucrose [19; 31; 18]. Physiologically, latex production is influenced by two main factors, namely biosynthesis or latex regeneration among two tapping and the duration of latex flowing after tapping [19].

Rubber biosynthesis takes place in latex vessels with sucrose (result of photosynthesis) as base material [9; 21 and 33]. The ongoing metabolism is primarily oriented to the formation of rubber particles (cis-polyisoprene or (C5H8)n) which representing 35-50% of latex fresh weight or 90% of dry weight. Scheme of rubber synthesis in latex vessel cells can be seen in Figure 2.3 [16]. There are two main stages of rubber formation namely glycolysis and cis-polyisoprene anabolism. In latex vessel cells, most saccharine is sucrose. The activity of latex vessel tissue is depending on the sucrose availability [29]. In the analysis, sucrose content is the residue of the amount of available sucrose minus in situ use. Penetration or sucrose influxes in latex vessels is complex, involving cell membrane level mechanisms requiring biochemical energy [17]

Latex metabolism process begins with sucrose and ends with separation of isopentenyl pyrophosphate, a monomer of polyisoprene chain. Sucrose molecule is converted into pyruvate molecules to allow the occurrence of acetate molecules as actual anabolism of isoprene. Glycolysis is also providing biochemical energy (ATP) as energy source for other mechanisms such as Kreb cycle. Such biochemical energy contributes in the whole synthesis in the form of NAD regeneration (P) to NAD(P)H [18]. Acetyl CoA from glycolysis will forms an isoprene monomer that is isopentenyl pyrophosphate (IPP). This IPP formation process requires energy; especially ATP and NADH reduced energy which generated from glycolysis. From the IPP, then increasingly larger rubber particles (polyisoprene) will be formed. Latex biosynthesis is controlled by among other pH and ionic composition in the Latex cytosol

![Figure 1. Rubber synthesis in Latex Vessel Cells][16]

1.1. Physiology Character of Latex

Physiologically, latex production is determined by the length of latex flow after tapping and the rate of latex regeneration among two tapping [19]. Tapping is done on the bark to near the cambium. Latex is in latex vessels at turgor pressure around 10-14 atmospheric. As soon as the tree is tapped, turgor
pressure decreases and water from neighboring cells penetrates the cell wall of the latex vessels so that the latex flows along the tapping girth. Latex obtained from tapping is not only comes from wounded latex vessel cells but a collection of latex that flows from the latex flow area.

The duration of latex flow is determined by turgor pressure in the latex vessels and coagulation rate of the tapping groove. High osmotic content in latex such as sucrose, mineral ions, and coupled by the availability of adequate water is an ideal condition for maximum turgor pressure. Such conditions allow for long latex flow and relatively low plugging indices, resulting in increased production [24]. Thus, latex biosynthesis is determined by the availability of the latex-forming base material such as sucrose and enzyme activity which has direct function in glycosis and anabolic stages of the rubber particles (cis-polyisoprene) [9; 18; 33]. By considering latex as cytoplasmic collection of latex vessel cells, the analysis is a representation of metabolic mechanisms as well as the overall physiological mechanism of the plant. Latex analysis performed by Archer, Bernard, Cockbaib, Dickenson and Mc. Mullen in 1963 was assessed as a basis for evaluation of latex formation and determining factors [8].

In the next developments, [19] classified latex content into three organelles namely tonoplastuloid, plastid-like Frey Wyseling particles and ribosome. The rubber particles themselves are dispensed in cytoplasmic serum. Composed physiological characters in two groups. The first is latex flow and the second is latex metabolism process. In latex flow group, the variables are Plugging Index (PI), Initial Flow Rate(IFR), dry rubber content (DRC), total solids content (TSC), and bottom fraction (BF). In latex metabolic process group, the variables are phosphate inorganic (PI), pH, and thiol (R-SH). Variables such TSC, DRC, and thiol may reflect the dual function of latex flow and latex metabolism [18].

Physiologically, auxin can stimulate cell enlargement and stem growth, stimulate cell division in the cambium and stimulate differentiation of xylem and phloem [32 and 10]. Such physiological influence is closely related to the growth of immature rubber tree, to stimulate stems growth in order to increase the girth size.

Stem enlargement is the result of secondary growth caused by cambium division into xylem and phloem. The cambium activity is influenced by IAA (15; 3; 4; 30). Exogenous application of Auxins (hormonal) will increase cell walls permeability that will enhance elements absorption including N, Mg, Fe, Cu to form chlorophyll which is necessary to enhance photosynthesis [11]. Increasing photosynthesis will support for latex production. Rubber age and clones also affect the Auxins content in leaves [20].

The role of IAA and kinetin is very supportive for stem enlargement in immature rubber tree so nonproductive period can be shortened. In other hand, cytokines can also affect branching, which also shortened nonproductive period. Accelerating the growth of branches means leaf splitting and for optimum photosynthesis. The result is a healthy growth so the girth will quickly increase and rubber trees can be tapped [14].

2. Methodology

2.1. Research Site and Time
This research was conducted in KSO Karanglnong Farm, PTPN-I and PTPN-III, East Aceh Regency, around ± 70 km from head office in Langsa. Karanglnong Farm located at an altitude of 51 m above sea level, with flat to rolling topography

2.2. Materials and Tools
Plant material used is 28 month of rubber stand (planting year December 2010), with spacing 5 mx 3,333 m or with initial amount of stand of each clone 600 tree/ha. The clones is consisted of five recommended clones (PB-260, PB 340, PB 330, IRR 5 and IRR 107).

The chemicals used are IAA, Kinetin, Alcohol, Formalin, KOH, HNO2, Glycerin, Sudan III, Aquadest and lanolin. While non-chemical is cotton, panel fabric, tissue paper, paint.
Equipment used is sand paper, hand sprayer, brush, meter, scalper, cork borer, scales, glass pipettes, razor blades, bamboo, microscope and other laboratory equipment as well as necessary stationery.

2.3. Research Method
This research is based on two factors Nested Design, namely clone factor and hormonal factor. Clone factor (K) consisted of 5 levels i.e; K1 = Clone PB 260, K2 = Clone PB 330 and K3 = Clone PB 340, K4 = Clone IRR 107 and K5 = Clone IRR 5. Hormone Factors (IAA and Kinetin (H)) is consisting of 7 levels namely H0 = IAA (400 ppm) + Kinetin (50 ppm), H2 = IAA (400 ppm) + Kinetin (60 ppm), H3 = IAA (500 ppm) H5 = IAA (600 ppm) + Kinetin (50 ppm) and H6 = IAA (600 ppm) + Kinetin (60 ppm). Treatment is repeated twice, but nested in clone type factor, so the number of experimental units is 7 x 5 x 2 = 70 units. Each experiment unit consisted of 4 trees, then the number of rubber tree is 280 trees.

2.4. Research Implementation

2.4.1. Experimental Plot Preparation. Making experimental plots on selected rubber planting areas relatively close among the clones each other.

2.4.2. Early Observation. After the experimental plots were made in accordance with the treatment, an initial observation was made on each sample of each treatment according to response variables, i.e. plant height, girth, bark thickness, anatomical observations such as number of latex vessels, diameter of latex vessels and wide per leaf area.

2.4.3. Application of IAA and Kinetin. IAA and Kinetin applied by mixing with lanolin (pasta) and smeared on bark circles that have been rubbed with sandpaper as wide as 2.5 cm around the stem at two positions for each tree. The first position lies at 70 cm above ground and the second is above the first position. Application interval is once a month for 8 applications.

2.5. Observation

2.5.1. Production (gram per tree per tapping, g p-1 s-1). This variable was measured by latex volume produced by the tree, which was then converted into g p-1 s-1. Production observation is based on mature age of tapping.

2.5.2. Physiological Character. Latex diagnosis, especially sucrose, inorganic phosphate, and thiols, is measured using sample of TCA (trichloro-acetic acid) latex serum. Such serum is made by mixing 1 ml of latex and 9 ml of TCA in a film bottle. Rubber clump is removed and TCA serum is filtered with filter paper, then the serum is stored in the freezer before analyzed.

2.5.3. Dry Rubber Content (KKK). This variable is measured by dropping fresh latex 2 g on glass plate, flattened and the wet weight (Bwet) weighed, then oven at 100°C for 2 x 24 hours to produce a stable weight (Bdry). Calculation of DRC = Bwet/ Bdry x 100%.

2.5.4. Sucrose Content (mM). This variable was observed using anthron method (Dische, 1962). Sucrose dehydration in concentrated acid (H2SO4 70%) and heating will give a furfural derivative which reacts with anthorone to produce a blue reaction. The absorbance is measured at λ 627 nm.

2.5.5. Phosphate Inorganic Content (FA) (mM). This variable is measured on the binding principle by ammonium molybdate and then reduced by FeSO4 in the acid reaction to form a blue color. The absorbance is measured at λ 750 nm.
2.5.6. Thiol Content (mM). This variable was measured on the principle of reaction with DTNB (Dithiobis-nitrobenzoic acid) to form a yellow absorbent TNB (Thio-nitrobenzoate) absorbed at 412 nm.

2.5.7. pH Latex (pHL). This variable was observed using pH meter, which was done immediately when latex dripped after tapping. The pH was reading in the first 2-5 minutes.

2.5.8. Plugging Index (IP). This variable was observed by measuring the latex volume in the first 5 minutes produced immediately after tapping, then compared with the total volume of latex. The plugging index is determined based on Milford,

\[ IP = \frac{\text{volume at the first 5 minutes}}{\text{Total Latex Volume}} \times 100\% \]

3. Result and Discussion

3.1. Results

3.1.1. Latex Yield and Physiological Character. Data on average latex yield per tree and physiological parameters of sucrose latex, inorganic phosphate (FA), thiol, dry rubber content (DRC), pH latex and plugging index (IP) can be seen in Table 1.1. Table 1.1 shows that single factor of clones and hormones significantly affect latex yield per tree and latex physiological parameters.

| Treatment          | Latex yield and latex physiological parameters |  |
|--------------------|----------------------------------------------|--|
|                    | Latex Yield (g/p/s) DRC (%) Sucrose (mM) FA (mM) Thiol (mM) pH IP (%) |  |
| Clone (K)          |                                              |  |
| K1 = PB 260        | 15.51 c 34.60 c 3.75 d 3.62 c 0.32 b 6.80 c 22.00 d |  |
| K2 = PB 330        | 12.87 d 34.23 c 3.96 c 3.29 d 0.31 cd 6.79 c 31.31 a |  |
| K3 = PB 340        | 20.63 a 33.49 d 5.45 b 4.47 b 0.37 a 6.93 b 25.28 c |  |
| K4 = IRR 107       | 18.76 b 36.25 a 6.92 a 4.80 a 0.37 a 6.93 b 25.28 c |  |
| K5 = IRR 5         | 12.51 d 35.18 b 3.63 d 3.26 d 0.31 c 6.82 c 30.23 b |  |
| Hormone IAA+Kineticin (H) |                  |  |
| H0= Control        | 10.01 f 32.97 c 3.55 d 3.24 d 0.26 c 6.86 b 34.18 a |  |
| H1= 400 ppm+50 ppm | 17.27 c 34.86 ab 4.82 c 4.00 b 0.33 c 6.93 a 24.43 c |  |
| H2=400 ppm+60 ppm  | 15.44 d 35.04 ab 4.76 c 3.85 c 0.31 d 6.92 a 24.45 c |  |
| H3= 500 ppm+50 ppm | 14.51 c 35.02 ab 4.73 c 3.73 c 0.32 c 6.84 b 28.13 b |  |
| H4= 500 ppm+60 ppm | 18.48 b 35.27 a 5.36 a 4.54 a 0.37 a 6.89 ab 25.21 c |  |
| H5=600 ppm+50 ppm  | 16.66 c 34.72 b 5.08 b 4.08 b 0.35 b 6.94 a 21.71 d |  |
| H6=600 ppm+60 ppm  | 20.02 a 35.37 a 4.89 bc 3.79 c 0.32 cd 6.74 c 21.32 d |  |

Note: Number followed by the same lowercase in the same column is not significant different at 5% level based on DMRT Test.

Table 1 shows that each clone has significant effects on latex yield per tree. Clones PB 340 (K3) produce higher latex yield per tree (20.63 g/p/s) and significantly different with IRR 107 (K4), PB 260 (K1), PB 330 (K2) and IRR 5 (K5), Clone IRR 105 and PB 330 doesn’t show significant different on latex yield per tree.

Latex yield per tree with hormone IAA 600 ppm + Kinetin 60 ppm (H6) was higher (20.02 g/p/s) and significantly different than other hormone treatments, whereas control (H0) has the lowest latex yield per tree.
Table 1 also show that the highest DRC, sucrose, Fa and thiol were found in clone IRR 107, while the highest pH was found in PB 340 and the highest plugging Index found in PB 330.

The application of hormone IAA 600 ppm + Kinetin 60 ppm (H6) produce higher DRC (35.37%). The highest sucrose, FA and thiol levels were found in Hormone IAA 500 ppm + Kinetin 50 ppm (H4) and the lowest is control (H0). The highest pH was found in application of hormone IAA 600 ppm + Kinetin 50 ppm and the highest IP were found in control (H0).

The interaction of clone and hormone factors is significantly affect latex yield per tree and latex physiological character. Mean difference test of latex yield per tree due to hormone and clone is presented in Table 2.

### Table 2. Mean Different Test of Latex Yield per Tree and Physiological Character of Latex by Clone and Hormone Treatment

| Clone (K) | Hormone  | Latex yield and latex physiological parameters | Yield (g/p) | KKK (%) | Sucrose (mM) | FA (mM) | Thiol (mM) | pH | IP (%) |
|----------|----------|---------------------------------------------|-------------|---------|-------------|---------|------------|----|--------|
| K1 = PB 260 | H0 = Control | 14.35 jk | 32.82 ijk | 3.03 op | 3.02 no | 0.25 m | 6.79 ghi | 33.51 cd |
| H1 = 400 ppm+50 ppm | 17.95 gh | 35.68 bcd | 4.39 ijk | 3.86 g-j | 0.35 cde | 6.79 gh | 15.21 no |
| H2 = 400 ppm+60 ppm | 21.05 ef | 35.65 cde | 3.82 k-n | 3.58 i-j | 0.30 h-k | 6.79 gh | 26.09 j |
| H3 = 500 ppm+50 ppm | 15.35 ij | 36.92 ab | 3.50 no | 3.54 jkl | 0.30 h-k | 6.88 d-i | 30.13 gh |
| H4 = 500 ppm+60 ppm | 9.65 g-s | 34.21 fg | 3.53no | 3.91 g-j | 0.34 def | 6.76 hij | 19.69 l |
| H5 = 600 ppm+50 ppm | 8.12 s | 32.59 kl | 3.51 no | 3.08 mno | 0.34 def | 6.80 f-i | 13.59 op |
| H6 = 600 ppm+60 ppm | 22.11 de | 34.36 fg | 4.46 hij | 4.35 ef | 0.38 b | 6.77 g-j | 15.77 n |
| K2 = PB 330 | H0 = Control | 8.26 rs | 33.47 g-k | 3.09 op | 2.75 o | 0.28 jkl | 6.88 d-i | 36.84 b |
| H1 = 400 ppm+50 ppm | 11.10 m-q | 32.52 kl | 3.35 no | 2.87 o | 0.27 klm | 6.78 g-i | 32.72 c-f |
| H2 = 400 ppm+60 ppm | 9.44 p-s | 34.40 efg | 4.75 hij | 3.78 g-k | 0.31 gh | 6.77 g-j | 33.42 cde |
| H3 = 500 ppm+50 ppm | 14.21 jk | 33.57 f-k | 4.14 j-m | 3.86 g-j | 0.34 def | 6.75 ijk | 33.34 cde |
| H4 = 500 ppm+60 ppm | 11.04 m-q | 34.76 def | 3.55 mno | 3.01 no | 0.30 h-k | 6.89 c-i | 31.40 d-h |
| H5 = 600 ppm+50 ppm | 12.62 k-n | 34.09 fgh | 3.77 fmn | 3.33 lmn | 0.32 fgh | 6.92 b-g | 29.21 hi |
| H6 = 600 ppm+60 ppm | 23.44 cd | 36.78 abc | 5.04 gh | 3.47 kl | 0.35 c-f | 6.56 l | 22.22 k |
| K3 = PB 340 | H0 = Control | 10.35 o-r | 33.00 h-k | 3.48 no | 3.37 h-k | 0.25 m | 7.08 ab | 39.53 a |
| H1 = 400 ppm+50 ppm | 29.37 b | 33.32 g-k | 6.20 de | 4.94 c | 0.31 gh | 7.09 a | 14.98 no |
| H2 = 400 ppm+60 ppm | 21.98 de | 32.72 jk | 5.75 ef | 4.45 de | 0.28 jkl | 7.08 ab | 11.25 q |
| H3 = 500 ppm+50 ppm | 16.02 hji | 33.72 f-k | 4.95 ghi | 4.13 efg | 0.28 jkl | 6.90 b-h | 17.00 m |
| H4 = 500 ppm+60 ppm | 23.09 cde | 34.18 fgh | 6.25 de | 5.54 b | 0.37 bc | 6.96 a-f | 24.81 j |
| H5 = 600 ppm+50 ppm | 24.69 c | 33.93 f-j | 5.46 fg | 4.48 de | 0.32 fgh | 7.07 ab | 16.11 n |
| H6 = 600 ppm+60 ppm | 18.91 cd | 33.54 f-k | 6.07 def | 4.05 fg | 0.28 jkl | 6.95 b-f | 11.75 pq |
| K4 = IRR 107 | H0 = Control | 9.26 grs | 33.99 f-i | 5.53 fg | 3.29 lmn | 0.28 jkl | 6.66 jkl | 28.47 i |
| H1 = 400 ppm+50 ppm | 16.32 hij | 36.41 abc | 6.68 d | 4.76 cd | 0.37 bcd | 6.99 a-f | 29.94 ghi |
| H2 = 400 ppm+60 ppm | 11.76 l-o | 36.28 bc | 5.79 ef | 4.46 de | 0.36 bcd | 7.02 abc | 29.15 hi |
| H3 = 500 ppm+50 ppm | 14. jkl | 36.59 abc | 7.53 c | 4.36 ef | 0.38 bc | 7.00 a-e | 29.10 hi |
| H4 = 500 ppm+60 ppm | 38.04 a | 36.73 abc | 9.14 a | 6.84 a | 0.50 a | 7.08 ab | 16.34 n |
| H5 = 600 ppm+50 ppm | 23.16 cde | 36.16 bc | 8.28 b | 5.55 b | 0.39 b | 7.01 a-d | 19.16 lm |
| H6 = 600 ppm+60 ppm | 18.75 fg | 37.60 a | 5.51 fg | 4.35 ef | 0.31 ghi | 6.79 ghi | 24.82 j |
| K5 = IRR 5 | H0 = Control | 7.82 s | 31.56 l | 2.63 p | 3.44 km | 0.26 lm | 6.87 c-e | 32.57 c-f |
| H1 = 400 ppm+50 ppm | 11.60 m-p | 36.35 abc | 3.48 no | 3.56 i-l | 0.33 efg | 6.98 a-f | 29.32 hi |
| H2 = 400 ppm+60 ppm | 13.01 klm | 36.15 bc | 3.70 mn | 2.98 no | 0.30 h-k | 6.93 b-f | 22.32 k |
| H3 = 500 ppm+50 ppm | 12.96 klm | 34.33 fg | 3.53 no | 2.78 o | 0.33 cef | 6.66 jkl | 31.08 e-h |
| H4 = 500 ppm+60 ppm | 10.59 n-q | 36.45 abc | 4.33 jkl | 3.43 km | 0.34 def | 6.77 g-i | 33.82 c |
| H5 = 600 ppm+50 ppm | 14.70 ijk | 36.85 abc | 4.39 ijk | 3.94 gh | 0.36 bcd | 6.89 c-h | 30.50 f-i |
| H6 = 600 ppm+60 ppm | 16.87 ghi | 34.55 d-g | 3.36 no | 2.72 o | 0.29 ijk | 6.64 kl | 32.04 c-g |

Note: Number followed by the same lowercase in the same column is not significant different at 5% level based on DMRT Test
3.2. Discussion

3.2.1. Clone Response to Latex Yield and Physiology. The results of statistical analysis showed that the tested clones were significantly different for production parameters, dry rubber content, sucrose, thiol, inorganic phosphate, pH and plugging index. Given the types of clones is the most important aspects of production which related to the productivity levels per unit area, the duration of immature tree, production stability during immature tree, the maintenance costs that must be incurred, and the quality of the rubber yield, then clone selection should become very important consideration for every plantation [6; 5].

The results of the 5 clones tested for 18 months show that PB 330 (K2 = 46.28 cm) is the fastest clone in term of girth circle, followed by IRR 5 (K5 = 46.15 cm), PB 340 (K3 = 45.48 cm), IRR 107 (K4 = 45.21 cm) and PB 260 (K1 = 45.20 cm) at the age of 46 months in the field (Koryati, 2016). Thus, girth circle of the tested clones has meets the criteria of mature tapping. It is suspected that the tested clones are commercially recommended clones grouped into two namely PB 330, PB 260 and PB 340 as latex-producing clones and IRR 5 and IRR 107 as latex and wood producing clones [5].

Based on the mature tapping criteria, the tested clones already meet such criteria but less than 60% of stand has reach girth circle 45 cm. Thus, tapping is performed on plant age 4 years 7 months (circle girth has reached ≥ 47 cm). In addition, the number of latex vessels and the diameter also determine the production of a clone.

The most important response of each rubber clone to the treatment is reflected in the production although as long as the research, actual production cannot be used as benchmark because it has not been routinely tapped. However, the data is still collected from the fourth knife tapping. The results showed that from the 5 clones tested, the highest production was obtained in PB 340 (± 20.63 g/p/s) followed by IRR 107 (± 18.76 g/p/s). It is suspected that clone PB 340 is a latex-producing clone, characterized by high initial production, increased production and slow stem growth and IRR 107 ia latex-wood producing clone, characterized by low-moderate and advanced production is increasing [1]. In addition, plant physiology analysis is also a useful way to determine the tree condition such as health, potential production and tapping time.

The differences among clones indicate differences in responsiveness of each clone to the treatment. This is reasonable given that the genetic differences among clones causing physiological differences. [28] and [26] states that plant growth is highly competitive with latex production. But the amount of competition varies among clones. In general, the higher the production increases the lower of girth development. This is in accordance with the research finding that higher production clone is IRR 107 while the largest girth is PB 330. Clones with high Latex tend to have low inorganic phosphate levels. This is because more assimilates distributed for latex production. The decrease of girth is negatively correlated with the initial sucrose content [23]. This is confirmed by [16] which found that each clone can be grouped into high, medium and low metabolized clones based on levels of sucrose and inorganic phosphate.

3.2.2. Effects of Clone and Hormone IAA + Kinetin Combination Treatments on Latex Yield and Physiology. The results of statistical analysis showed that the combination between clone and hormone treatment had significant effect on the production parameters (g/p/s) and latex physiological character dry rubber content (DRC), sucrose content, inorganic phosphate (FA), thiol, pH and plugging index (IP). Each clone and hormone give the best latex production. Combination of IRR 107 and IAA 500 + Kinetin 60 ppm (K4H4) ppm gave the highest production (g/ p/s) followed by PB 340 + IAA 400 ppm hormone + Kinetin 50 ppm (K3H3).

It is thought that exogenous auxin (hormonal) application will increase cell wall which in turn enhance elements absorption such as N, Mg, Fe, Cu to form chlorophyll for photosynthesis (Dewi, 2008). Increasing photosynthesis will support latex production because photosynthesis is the initial process of glucose-producing and then the formation processes of sucrose or other carbohydrates, lipids, proteins, and secondary metabolites through various paths which coordinated by respiration process.
(glycolysis, tricarboxylic cycle). Secondary metabolites such as phenolic compounds, terpen and secondary products containing N, specifically have a certain path among other sikimat path, malonat and mevalonat [27].

Rubber biosynthesis takes place in latex vessels (laticiferous cells) with sucrose as base material transported from leaves as a result of photosynthesis [9; 21 and 33]. The ongoing metabolism is primarily for rubber particles formation (cis-polyisoprene or (C5H8)n) representing 35-50% fresh weight or 90% dry weight of latex [16].

3.2.3. Latex Physiological Characteristics and The Relationship with Latex Yield (g/p/s). The increased production of latex per plant (g/p/s) in early tapping by IAA + Kinetin treatments is associated with a highly complex and specific physiological character balance in the latex-producing system. Treatment of growth regulators (stimulation) under certain conditions may activate latex regeneration among two tapping and may be influenced by latex physiological characters such as DRC, IP, PH, sucrose, inorganic phosphate and thiols.

The limiting factor in the latex-producing system is the duration of latex flow after tapping and the duration of latex regeneration among two tapping [18]. Application of hormones at various levels can increase the latex production per plant (g/p/s). Of the five clones tested, clone IRR 107 with IAA 500 ppm + Kinetin 60 ppm (K4H4) show higher production per plant and latex physiological characters such as sucrose content, inorganic phosphate, pH and thiol levels, while DRC and IP are moderate. It is suspected that clone IRR 107 is more responsive than other clones. The lower IP means latex flow rate is longer and more latex production. At 90th minutes, clone IRR 107 is still flowing latex (0.75 ml / min of H4 treatment)

[1] states that IRR 107 has strong growth, both before and after tapping. Clone IRR 107 shows a good adaptation in dry agro climate (rainfall 1,200-1,500 mm/yr) [25; 22]. Latex from clone IRR 107 is good and suitable for RSS products (Ribbed Smoked Sheet), SIR (Standard Indonesian Rubber) such as SIR 5 and SIR 3L [2]. The results showed each clone has different responses to hormonal treatment and increase the production and latex physiological character, except pulggung index became lower.

4. Conclusions and Suggestion

4.1. Conclusions
Response of each clone with application of hormone IAA + Kinetin is different in term of production and physiological character at early tapping. Combination of clone IRR 107 with hormone IAA 500 ppm + Kinetin 60 ppm show higher production per plant (g/p/s) and better physiologic characters compared to other clones as indicated by decreased plugging index, high latex flow rate and increased sucrose content, inorganic phosphate and thiols.

4.2. Suggestion
Application of hormone IAA 500 ppm + Kinetin 60 ppm is recommended to improve production per plant and physiology character of latex, especially for clone IRR 107 (K4H4)

Further research is needed to find optimal physiological and production characteristics.

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