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POLYETHYLENE GLYCOL (PEG) AND SALICYLIC ACID AS
ALTERNATIVE STIMULANTS

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Abstract

The purpose of this study is to determine the effect of PEG (Polyethylene glycol) and salicylic acid in increasing rubber latex yield of clone PB260. The research was carried out in PTPN III, District of Galang, Regency of Deli Serdang, Province of North Sumatra, located 25 m above sea level. This study uses a factorial Randomized Block Design with two factors and three replicates. The first factor is PEG which consists of 0 %, 3 %, and 6 %. The second factor is salicylic acid application which consists of 0 g/L, 1 g/L, 2 g/L and 3 g/L. The parameters observed are latex production (g/p/s), total solid content (TSC), duration of latex flow and plugging index. Results show that application of PEG as an alternative stimulant has a significant effect in increasing the latex yield and latex flow rate whilst reducing plugging index. The application of salicylic acid has a significant effect in increasing the latex production and TSC but has no significant effect on latex flow rate and plugging index. PEG has a potential to be used as an alternative stimulant but further research is still needed to determine the long term effects of PEG on rubber plants.

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1. Introduction

Rubber tree (*Hevea brasiliensis* Muell.Arg) is a source of natural rubber producers and one of the important contributors for foreign exchange in the plantation sector as well as a source of employment for the community (Dirjenbun, 2016). Data from The Ministry of Trade shows that the value of foreign exchange generated by rubber trees in 2014 amounted to 4.7 billion US dollars.

1.1. Stimulants

Stimulants are usually used to increase latex yield. The aim is to optimize the production of rubber trees. Stimulants application is more effective for high response clones (Sumarmadji, 2005). Clone PB 260 is one of the superior clones classified into Quick starter clones with specific properties including high initial production, less responsive to stimulants and susceptible to tapping dry grooves (KAS) (Sumarmadji, 2011).

Currently, stimulants that are widely used are etephon based stimulant (2-chloroethylphosphonic acid) which functions to increase endogenous ethylene production in rubber trees and increasing latex yield. Such stimulant application however must be managed carefully because excessive use will disturb tree health which is marked by increasing tapping dry grooves incidence. Therefore, it is necessary to look for alternative stimulants that can increase latex yield, and is feasible to the characteristics of rubber clones and safe for rubber trees.

1.2. Polyethylene glycol (PEG)

PEG is one of the potential ingredients to be used as an alternative stimulant. Rahayu, Siregar, Purba, and Tistama (2016) reported that application of PEG 3 % as a stimulant to rubber plants could increase latex yield by 40.42 %. Besides PEG, salicylate is another potential ingredient to be used as a stimulant. Salicylate is a phenolic compound which regulates plant growth especially physiological activities such as photosynthesis, flowering, nitrate metabolism, ethylene production and protection against biotic and abiotic stresses. Ali and Adel (2013) reported that leaf application of salicylates can significantly increased plant height, number of branches, seed pods, seed growth per pod, and weight of 1000 seeds compared to the controls. In addition, Wicaksono, Irwan, Wahyudin, and Setianingrum (2015) also reported that application of salicylic acid and calcium chloride showed the best growth and yield for wheat at 9-day intervals.

Based on previous research findings, it is known that salicylates have the potential to be used as a stimulant to increase the production of latex by increasing stem growth of the rubber trees. Therefore, the purpose of this study is to determine the effect of PEG and salicylic acid in increasing rubber latex yield.

2. Problem Statement

Although Indonesia is a country with the largest rubber plantation in the world with 3.4 million hectares, the production still lags behind Thailand which only has 2.4 million hectares but with production about 1,600 kg/ha/yr.

3. Research Questions

Are PEG and salicylic acid able to increase latex yield of PB 260 clone at Deli Serdang rubber plantation in Indonesia?

4. Purpose of the Study

The purpose of this study is to determine the effects of PEG and salicylic acid on rubber latex.

5. Research Methods

This research was conducted at PT. Perkebunan Nusantara III, Sungai Putih Farm, District of Galang, Regency of Deli Serdang, Province of North Sumatra at altitude of ± 25 m above sea level with a flat topography. This research was conducted from April to July 2017, using a factorial Randomized Block Design with two factors and three replications. The first factor was PEG 0 %, 3 % and 6 %. The second factor was salicylic acid application at 0 g/L, 1 g/L, 2 g/L and 3 g/L. The parameters observed were latex production (g/p/s), total solid content (TSC), duration of latex flow and plugging index.

6. Findings

6.1. Production of latex

Table 01 shows that PEG application had a significant effect on latex yield. The highest production of latex was found in PEG 6% with 98.92 g/p/s while the lowest is PEG 0% (control) with 89.81 g/p/s. There was an increase in latex yield by 10.14 % with PEG 6 %. Salicylate application also had a very significant effect on latex yield whereby the highest yield was found in 3 g/L salicylic acid with 100.82 g/p/s, whilst the lowest was in 0 g/L salicylic acid (control) with 87.76 g/p/s. Combination of PEG and salicylic acid did not have a significant effect on the latex production.

Table 01. Latex production (g/p/s) by PEG and salicylic acid applications

Salicylic acid (g/L)	PEG (%)			Mean
	0	3	6	
0	85.73	93.23	84.33	87.76 B
1	85.88	75.29	97.87	86.35 B
2	96.34	102.96	101.76	100.35 B
3	91.27	99.48	111.71	100.82 A
Mean	89.81 b	92.74 ab	98.92 a	

*Note: Numbers followed by not the same letters in the same treatment group are significantly different at 5% (lowercase letters) and very significantly different at 1% (uppercase) based on DMRT test.

6.2. Total solid content (TSC)

Table 02 shows that the application of PEG did not have a significant effect on TSC value, whilst salicylic acid gave a significant effect. The highest TSC percentage (87.64 %) was found in the treatment of 3 g /L salicylic acid and the lowest (86.36 %) was in 0 g/L salicylic acid (control) treatment.

Table 02. Total solid content (%) by PEG and salicylic acid applications

Salicylic acid (g/L)	PEG (%)			Mean
	0	3	6	
0	86.31	86.40	86.37	86.36 b
1	86.76	86.63	86.86	86.75 b
2	86.94	87.27	87.03	87.08 ab
3	87.41	87.55	87.94	87.64 a
Mean	86.86	86.96	87.05	

*Note: Numbers followed by not the same letters in the same treatment group are significantly different at 5% (lowercase letters) and very significantly different at 1% (uppercase) based on DMRT test.

6.3. Flow of latex

Table 03 shows that PEG application had a significant effect on the rate of latex flow. The most rapid was found from PEG 6% at the rate of 17.68 cc/minute whilst the slowest was from PEG 0% (control) at 12.40 cc/minute. In this case there was an increase in the latex flow rate by 42.58 % with PEG 6 %. The treatment of salicylic acid had no significant effect on the rate of latex flow but increased with increased concentration compared to the control.

Table 03. Latex flow rate (cc/minute) by PEG and salicylic acid applications

Salicylic acid (g/L)	PEG (%)			Mean
	0	3	6	
0	10.86	14.26	15.40	13.51
1	13.58	19.16	13.71	15.49
2	11.88	17.98	17.15	15.67
3	13.30	15.75	24.46	17.83
Mean	12.40 b	16.79 a	17.68 a	

*Note: Numbers followed by not the same letters in the same treatment group are significantly different at 5% (lowercase letters) and very significantly different at 1% (uppercase) based on DMRT test.

6.4. Plugging index

Table 04 shows that PEG application had a significant effect on plugging index. The lowest percent plugging index was found at PEG 6% which was 7.40 whilst the highest percent was at PEG 0 % with 15.19. Plugging index was inversely proportional to latex production. In such case, there was a decrease in plugging index by 102.7 % with PEG 6 %. The application of salicylic acid however did not significantly affect the plugging index.

Table 04. Plugging index by PEG and salicylic acid applications

Salicylic acid (g/L)	PEG (%)			Mean
	0	3	6	
0	18.80	13.94	8.51	13.75
1	14.63	14.58	6.20	11.80
2	12.40	10.46	8.88	10.58
3	14.92	10.39	6.00	10.44
Mean	15.19 a	12.34 b	7.40 c	

*Note: Numbers followed by not the same letters in the same treatment group are significantly different at 5% (lowercase letters) and very significantly different at 1% (uppercase) based on DMRT test.

Production is the most important response from any treatment given to rubber trees. In this study, the clone used was PB 260 which is characterized by high initial production and limited response to stimulants. Results found that the interaction of PEG and salicylic acid applications did not show any significant effect. On the contrary, individual treatment showed a significant effect on the latex production. This was because PEG was able to maintain the stability of osmotic potential and water content in plant cells (Roohi & Surki, 2011). Water levels in plant cells will increase the turgor pressure, and in turn increase the latex yield because latex flow is influenced by turgor pressure. Rahayu, Siregar, Purba, and Tistama (2017) stated that PEG application could increase the latex yield by 49.96 % at 5 months after application. Andriyanto and Darajat (2016) reported that there was an increase in the volume of latex and dry production with PEG stimulant applications.

Application of salicylic acid also increased the latex yield and total solid content (TSC). This was because salicylic acid is a fatty acid that will be converted into acetyl coenzyme A (acetyl-CoA) to form tricarboxylic acid (TCA) as an energy producer. Acetyl CoA is an important molecule participating in both primary and secondary metabolism whereby in the latter, Acetyl CoA is a precursor to build terpenoid compounds among polyterpenes (latex) (Dewiek, 1979; Rahayu et al., 2016). Therefore, the application of salicylic acid could increase latex yield. Rahayu et al. (2016) also reported an increased latex yield with the application of palmitic acid, a saturated long chain fatty acid.

In addition to latex production, application of PEG also had a significant effect in reducing the plugging index and increasing the rate of latex flow. Sumarmadji (1999) stated that plugging index correlated negatively with the production in which decreased in the plugging index increased the production of latex.

7. Conclusion

Application of PEG as an alternative stimulant had significant effects in increasing latex yield and latex flow rate, whilst reducing plugging index. Meanwhile, application of salicylic acid had significant effects in increasing latex production and Total Solid Content (TSC) and no significant effects on latex flow rate and plugging index. In conclusion, PEG has the potential to be used as an alternative stimulant but further research is still needed to determine the long term effect of PEG on rubber plants.

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