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Original Research Article

Evaluation of HydroStimulant 1 on Rubber Trees (PB350) with Tapping Panel Issues

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Abstract: Rubber smallholders often face challenges due to their insufficient training and lack of proper input on tapping techniques, which result in low rubber yield productivity. Non-compliance with tapping frequency guidelines by smallholders further exacerbates yield issues. Additionally, the selection of rubber clones planted affects latex productivity, with issues such as panel dryness being significant contributors. This study focuses on investigating the effectiveness of HydroStimulant 1 on rubber trees with tapping panel dryness. HydroStimulant 1 is a stimulant designed to enhance rubber yield, reduce partial dryness, and promote bark regeneration. The research was conducted in Kampung Padang Chenderai, Kedah, using ten selected 9-year-old PB 350 clone trees. Monthly applications were carried out from February to May, with observations made on several parameters including cup lump weight, panel dryness length, and latex pH value. The trees showed an average increase in cup lump weight of 2 kg/tree. Application of HydroStimulant 1 over four months resulted in complete recovery from panel dryness in 40% of treated rubber trees, with an additional 40% showing reduced dryness length, while 20% remained unresponsive to the treatment. Although the application of the stimulant slightly altered the pH of fresh latex, the change was not significant. Based on ANOVA results, the application of the stimulant significantly increased cup lump weight ($p < 0.05$), resulting in higher latex yield. However, the treatment did not demonstrate statistically significant effects in reducing panel dryness ($p > 0.05$), suggesting the influence of other factors. Nonetheless, the stimulant demonstrated potential in controlling the latex pH within the desired range, thereby improving latex quality.

Keywords: Hevea, yield, brown blast, Cup lump weight; panel dryness; pH of latex; stimulant

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1. Introduction

Currently, Southeast Asia accounts for more than 90% of the world's total production with Thailand, Indonesia, Cote d'Ivoire, Vietnam, China, India, Cambodia, Philippines, and Malaysia being the main producers of natural rubber (Ali *et al.*, 2020). Within these Southeast Asian countries, 85% of rubber production is dominated by smallholder farmers. Malaysia, which was the top producer of rubber in the 1960s, is the ninth-largest producer in the year 2023 (FAOSTAT, 2024). Malaysia plays an important role in the global rubber market, despite its falling contribution.

Recently, there has been a decline in productivity and latex production in major rubber-producing countries. Several factors contribute to this decline, including inadequate training and a lack of input on tapping techniques, which have resulted in lower rubber yield. The reduction in output is primarily attributed to inefficient tapping practices, such as conventional tapping, noontime tapping, and inconsistent tapping frequencies (Budiasih *et al.*, 2020). Various tapping frequency systems are employed for rubber trees, including d1, d2, d3, d4, d5, d6, and d0.5. Tapping with intervals of several days is more effective than tapping daily because it allows the trees to produce more yield at a higher rate (Zhao *et al.*, 2025; Kadir, 1994). Tapping daily can stress the trees and reduce latex production. To address this issue, using stimulants is an alternative method to increase rubber production and reduce labour costs (Yunta & Dede, 2019). Stimulants are designed to increase latex flow and prolong latex yield. Stimulants are a combination of vegetable oils (such as palm oil) plus ethylene or other active substances. Generally, rubber that has reached maturity is treated with stimulants to boost latex yield and provide farmers with extra benefits (Mariani *et al.*, 2019).

There are two types of stimulants: liquid and gas. Both types of stimulants can increase the production of latex by enhancing latex flow. This may have an impact on the reduction of tapping costs (Yunta & Dede, 2019). The key difference between these stimulants lies in their composition. The active element in liquid stimulants is ethephon (2-chloroethylphoshonicacid), which must be hydrolysed to create methylene. On the other hand, gas stimulants are pure ethylene gas (Rouf *et al.*, 2015). The ethylene-producing category includes the stimulant ethephon and 2-chlorethyl phosphonic acid. Ethylene is applied to the plant tissue and ethylene helps maintain the turgor pressure in the latex vessel tissue at a constant level, extending the time that latex flows, enhancing *in situ* latex regeneration, and preventing the occlusion of tapped latex vessels that have been cut off by tapping (Budiasih *et al.*, 2020).

The Rubber Research Institute Malaysia (RRIM), under the Malaysian Rubber Board (MRB), has developed and modernised various types of ethylene-producing stimulants, including Etefon, REACTORRIM, G-FLEX, RRIMFLOW, MORTEX, and others. MORTEX is modified from the Etefon and it also gets the recommendation from MRB to be used. Currently, there is one stimulant called HydroStimulant 1 that is still being researched. HydroStimulant 1 is a stimulant technology that uses a water-based latex booster with a dual function which increases latex production and at the same time minimises the drying out of the tapping panel. This research is conducted to evaluate the effectiveness of HydroStimulant 1 on rubber trees with tapping panel dryness.

2. Materials and Methods

The study was conducted at Kampung Padang Chenderai (6°18'51.2"N 100°40'36.4" E) covering an area of 1.0522 ha located in Kedah. A total of 650 trees with PB350 clone trees were planted on the plantation, with a planting density of 20 x 10 feet between trees. These 9-year-old trees were planted in 2014, and tapping began in 2021. This plantation was selected because it was exposed to several issues such as tapping panel dryness (TPD), which has led to a reduction in cup lump weight. Ten affected trees were selected as samples in this study to evaluate the effectiveness of HydroStimulant 1. It is anticipated that HydroStimulant 1, a self-production stimulant, will address TPD problems in rubber trees and consequently increase the cup lump weight, providing benefits to the tappers. All data were collected from January to May of 2023.

2.1. Application of HydroStimulant 1

HydroStimulant 1 was applied once a month with a single swipe using a size 14 paintbrush (estimated 2 g), except during the leaf-falling season. Two types of application methods were used in this study: groove and lace applications (Yunta & Dede, 2019; Bridge, 2018).

2.2. Tapping System

The tapping system employed was the ½ S d3 method, where tappers performed half-spiral tapping with a two-day interval between each tapping (Zaw, 2023).

2.3. Cup Lump Weight

The weight of the cup lump was measured every two weeks using a weighing scale. Weights were recorded before and after the application of the stimulant, and the results were recorded (Atminingsih *et al.*, 2019).

2.4. The Length of Dryness on the Rubber Tree Panel

The length of dryness on the tapping panel was taken at each tree using measuring tape for each of the trees.

2.5. The pH Value of Latex

The pH value of the latex sample was recorded as one of the physiological parameters. It was measured using a pH meter (Herath, 2021).

2.6. Analysis

Linear regression was used in this study, a widely used statistical technique employed to model and quantify the relationship between a dependent variable and one or more independent variables (Bakar & Tahir, 2019). The dependent variable was the month, while the independent variables were the cup lump weight, the length of the panel dryness, and the pH value of the latex. When the value of R-squared (R^2) is close to 1, it indicates that the linear regression model explains a large proportion of the variance in the dependent variable using the independent variables.

Statistical analysis using one-way Analysis of Variance (ANOVA) was conducted on the data measured: cup lump weight, dryness incidence of the rubber tree panel, and pH value of the latex. ANOVA was performed using data from before and after treatment. The null hypothesis (H_0) for this study proposed that there was no treatment effect on the affected rubber trees, while the alternative hypothesis (H_1) suggested that there was a treatment effect on the affected rubber trees (Killeen, 2005).

3. Results and Discussions

The effectiveness of HydroStimulant 1 on rubber trees was evaluated by measuring the cup lump weight, documenting the length of dryness incidence in the rubber tree panels, and recording the pH value of latex, following the methodology outlined in Section 2.

3.1. Effect on The Results of Cup Lump Weight

To evaluate latex production, the weight data of cup lumps were collected. Table 1 shows the average weight of cup lumps before HydroStimulant 1 treatment and the average weight of cup lumps after the treatment began.

Table 1. Average weight (kg) of cup lump collected from rubber trees before (January) and after (February – May) the HydroStimulant 1 treatment began.

Month	Weight (kg)
Initial weight (January)	2.50
February	2.90
March	3.33
April	3.83
May	4.50

The results indicated that the weight of the cup lump for the ten samples of rubber trees consistently increased over the month. The initial average weight was recorded to be 2.5 kg/tree. In February, the weight was measured at 2.90 kg, followed by 3.33 kg in March, 3.83 kg in April, and 4.5 kg in May. These recorded values showed a large increase compared to the cup lump's weight before the treatment began. There is a clear upward trend in the increment of cup lump weight for each month using initial average weight as a baseline, indicating that the utilisation of HydroStimulant 1 has a positive impact on rubber tree production.

To project the effect of the treatment on the rubber trees, a linear regression plot was created (Figure 1). The R^2 value of 0.9895 indicates that approximately 98.95% of the variability in the average cup lump can be accounted for by the linear relationship with the month. Each application of HydroStimulant 1 in one month can increase the cup lump weight by 0.53 kg. The high R^2 value of this linear regression model suggests a good data fit; thus, this model could be used to accurately predict the average cup lump weight in future months.

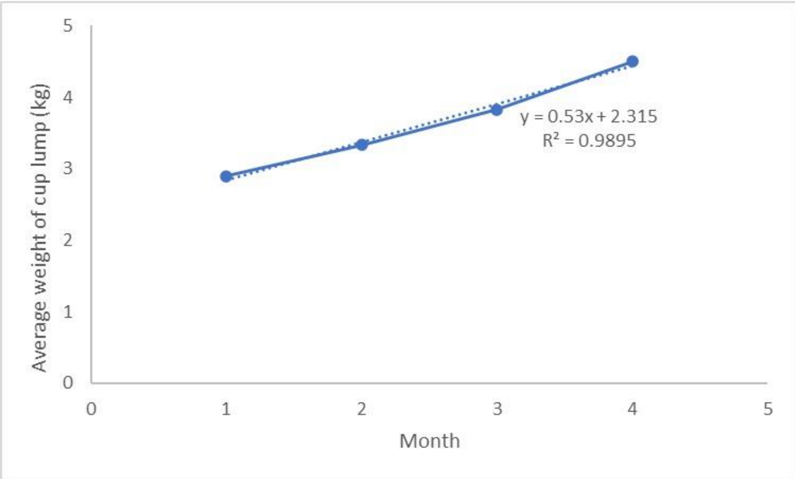

Figure 1. Linear regression model of the month against the average cup lump weight

One-way ANOVA was carried out and the results were shown in Table 2. The p-value recorded was 0.003883, which is smaller than 0.05. Based on the results, there was enough evidence to reject the null hypotheses. This indicated that there were statistically significant effects of the HydroStimulant 1 treatment on the cup lump weight. This is supported by a consistent increment of weight observed and a high-value regression coefficient achieved. The cup lump weight was seen to increase due to the treatment of HydroStimulant 1 based on the statistics. This weight increment is highly due to recovering panel dryness. However, other factors such as environmental conditions (i.e. temperature, humidity, and rainfall) may also affect the cup lump weight (Pyay *et al.*, 2019; Abraham & Tayler, 1967).

Table 2. (ANOVA) of cup lump weight within four months

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	2.56	1	2.56	256.0013	0.003883
Within Groups	0.02	2	0.01		
Total	2.58	3	0.86		

3.2. Outcomes Result of TPD on Rubber Trees

Table 3 shows the data on dryness incidence collected in this study to investigate the effect of HydroStimulant 1 treatment on affected rubber trees. The stimulant was first applied in February and continuously applied once a month until May. Most trees (eight out of ten) gave a positive response by having a reduced length of the panel that does not produce latex. Two trees with 10 cm and 15 cm lengths of panel dryness fully recovered in March, a month after treatment was applied. The length of the panel that is not producing latex starts to decrease from February to March. In April and May, one tree recovered from panel dryness each month. Overall, out of ten sample trees that were treated with stimulants, four trees fully recovered at the end of the observation. Additionally, four more trees showed a reduction in the dryness length while only two trees did not respond to the treatment of HydroStimulant 1. The data indicates that the dryness incidence of the rubber trees decreases over time, which is a positive response to the stimulant.

Table 3. Length of dryness incident for stimulant samples of rubber trees

No. of rubber trees	Overall length of panel (cm)	Length of the panel that does not produce latex (cm)			
		February	March	April	May
1	35	5	5	4	2
2	39	17	11	11	8
3	51	36	36	36	36
4	24	4	3	3	0
5	31	31	31	31	31
6	32	13	2	0	0
7	28	28	25	23	10
8	25	10	0	0	0
9	24	15	0	0	0
10	30	30	13	13	6

Figure 2 shows a simple linear regression model analysis between the average panel dryness length of rubber trees from the months of HydroStimulant 1 treatment applied between February and May. The linear regression equation suggests a negative relationship between the month and the average panel dryness length of the rubber trees (the length of the panel that does not produce latex). As the months progress, the average length of the panels decreases. The high R^2 value indicates that the month is a significant predictor of the length of the panels, explaining a large portion of their variability. Besides, upon observation, a few treated trees began producing latex along their panels, and it can be inferred that the stimulant has a positive effect on the affected trees.

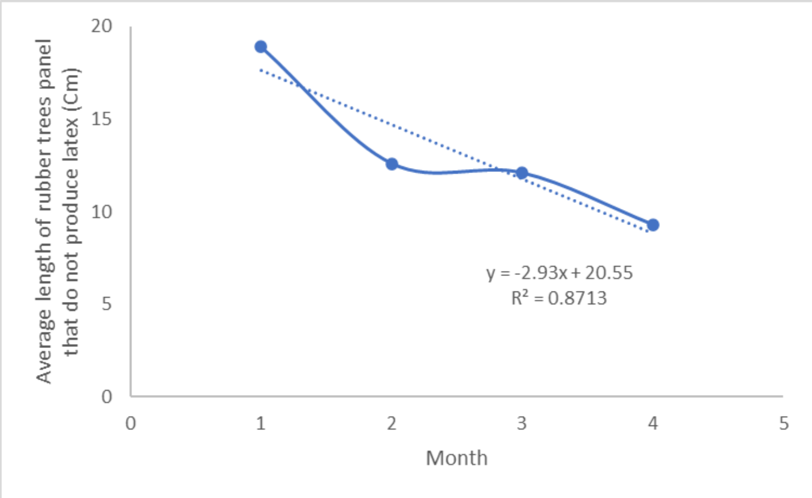

Figure 2. Linear regression of the average panel dryness length of rubber trees against months.

Table 4 shows the one-way ANOVA and the p-value recorded is 0.1017, which is greater than a significance level of 0.05. Therefore, the null hypothesis could not be rejected. This means that the evidence from this study was not strong enough to conclude that there was a treatment effect on the panel dryness length of rubber trees. The results could have been influenced by random variation or other factors that were not related to the treatment like environmental stress such as drought, waterlogging, extreme temperatures, or poor soil conditions which can weaken rubber trees' defence mechanisms, making them more susceptible to fungal infections and TPD (Li *et al.*, 2010). Besides, over-tapping or tapping too frequently can lead to stress on the rubber tree, making it more susceptible to diseases (Naceradska *et al.*, 2019).

It is worth noting that only two trees were not responding positively to the application of HydroStimulant 1. These two trees (trees number 3 and 5) act as outliers in the dataset when ANOVA analysis was performed. If these outliers were removed, the p-value calculated was 0.002191, which resulted in the rejection of the null hypothesis, indicating that HydroStimulant 1 affects panel dryness length. The inability to reject the null hypothesis should not be taken as definitive proof that the null hypothesis is true. Rather, it indicates that the available evidence is insufficient to support the alternative hypothesis. In this study, the data collected did not provide strong enough evidence to conclude that there was a treatment effect on the length of rubber trees without latex production along their panel. Thus, further research is necessary to gather more comprehensive evidence.

Table 4. One-way ANOVA results of rubber trees dryness panel treatment

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	460.8	1	460.8	2.974	0.1017
Within Groups	2788.9999	18	154.9444		
Total	3249.7999	19	171.0421		

3.3. Obtained Results of the pH Levels for Fresh Latex

The purpose of collecting the pH data was to determine whether the application of HydroStimulant 1, which was a chemical solution, could alter the pH value of the fresh latex or not. Table 5 shows the data of pH value collected within the study duration. The pH was recorded to be between 6.05 and 7.73. This range was acceptable. It is stated that a pH range of 6.5 to 7.0 is often considered favourable for natural rubber in terms of latex stability and productivity (Kurian & Mathew, 2011).

Table 5. pH value of the latex samples obtained from rubber trees

No. of rubber trees	**February**	**March**	**April**	**May**
1	6.38	7.12	7.34	6.11
2	6.05	7.07	7.26	6.24
3	6.26	7.00	7.30	6.12
4	6.70	6.83	6.42	6.34
5	6.52	6.68	6.18	6.36
6	6.13	7.08	6.26	6.10
7	6.47	7.04	7.10	7.73
8	6.13	7.08	7.04	6.70
9	6.21	7.06	7.15	6.53
10	6.39	7.01	6.12	6.50

Figure 3 (blue dot and line) shows the average pH of collected latex from February to May. The graph suggests that the application of HydroStimulant 1 could modify the pH of fresh latex. In February, the first application of the stimulant raised the pH from 6.32 to 6.99 by March, indicating its ability to adjust the pH within the desired range of 6.5 to 7.0. Additionally, the pH values recorded in April and May were 6.82 and 6.47, respectively, indicating effective pH control within the required range using this stimulant. The figure also demonstrated the linear regression (dotted line) of the average value of pH latex from February until May. From that graph, an R^2 value of 0.0137 indicates that only approximately

1.37% of the variation in the value of latex pH can be explained by the linear relationship with the month variable. The remaining 98.63% of the variation was likely influenced by other factors not accounted for in the model.

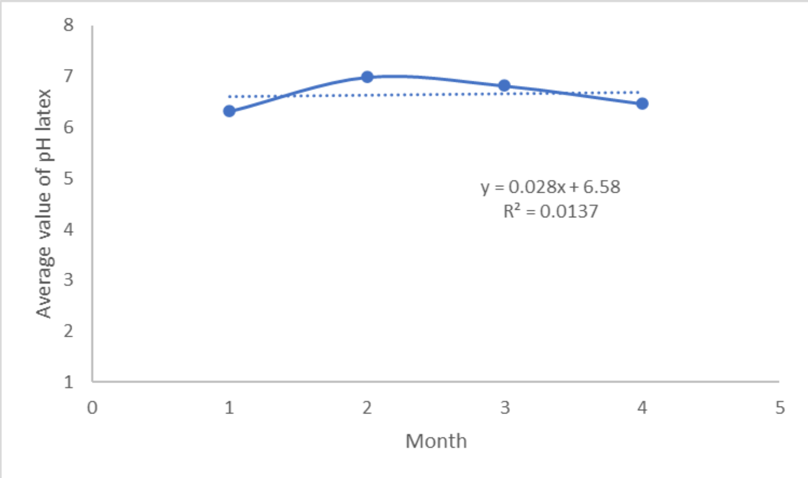

Figure 3. Linear regression of the average value of pH latex from February until May

The interpretation suggests a weak linear relationship between the month and latex pH value. Although there was a slight positive trend, indicating a small increase in latex pH over time, the low R^2 value shows that the month alone is not a strong predictor of latex pH. Other factors not considered in the model likely have a greater influence on the variation in latex pH. Table 6 presents the one-way ANOVA results on latex pH value. The *p*-value =was recorded to be 0.9234, which was greater than 0.05. In this situation, the null hypothesis was accepted, providing strong and statistical evidence that the pH value did not alter due to the application of HydroStimulant 1.

Table 6. One-way ANOVA results for pH value of rubber latex

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	0.0004126	1	0.0004126	0.009527	0.9234
Within Groups	0.7362	17	0.04331		
Total	0.7367	18	0.04093		

4. Conclusions

The application of HydroStimulant 1 demonstrated a significant impact on increasing cup lump weight, with an average gain of 2 kg per tree over the study period, as supported by the ANOVA results. This indicates its potential to enhance latex yield, contributing to increased income and financial stability for smallholders. While the stimulant showed promising results in reducing panel dryness, the effects were not statistically significant, suggesting that other factors may influence panel recovery. However, 40% of the treated trees fully recovered from panel dryness, and an additional 40% showed partial improvement, highlighting its potential benefits for specific cases. Moreover, the stimulant effectively maintained the latex pH within the desired range, ensuring improved latex quality. These findings suggest that HydroStimulant 1 can play a valuable role in improving rubber productivity and quality when used as part of an integrated management approach, although further studies are recommended to optimise its application and evaluate its long-term effects.

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