

Exploitation System Model of *Slow and Quick Starter Clones* under *Oldeman Climate Type*

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Abstract: Slow and quick starter clones were used for long-term productivity stability on rubber plantation. Each clone has different characteristics. Therefore, it is necessary to conduct research on exploitation system according to *Oldeman* climate type in order to increase the latex productivity. The research was conducted in two locations, namely Sungai Putih Experimental Farm, Rubber Research Centre and Sungai Putih Farm, PT. Perkebunan Nusantara III (Persero). Both locations are located in District of Galang, Regency of Deli Serdang on 25 m above sea level with *Ultisol* soil type. Rubber tree material are planting in the year of 1999, with spacing of 2.5m x 5m, clones representing Quick starter K₁ (PB 260) and Slow starter K₂ (BPM1). This research uses primary and secondary data. Primary data is field experiment using Nested Design. Secondary data was obtained from PTPN III Sungai Putih that has the average of monthly rainfall data for 13 years (2002 - 2015). Tapping system was consisted of 2 treatments namely half-spiral downward tapping system (S/2) and upward tapping system (S/2U). The treatments consisted of two levels: P1: *ethepon* 2.5% applied once for 15 days (ET / 15d), P2: gas stimulant applied once and once for 27 days (ETG 27d). Every treatment used 75 trees with girth 65 cm - 70 cm. The results showed that based on *Oldeman* climate type, tapping system S/2U d3 ET/15d is suitable for clone BPM 1 and S/2 d3 ET/15d for clone PB 260.

1 INTRODUCTION

Generally, the area of rubber plantation in North Sumatra, Indonesia is dominated by small farm. The total area of rubber small farm in North Sumatra is 1,127,913.99 hectares, PTPN 375.404,07 hectares, Large National Private Plantation (PBSN) 435,518.90 hectares and Large Foreign Private Plantation (PBSA) is 202,403.60 hectares. The total is 2,141,240,58 hectares (BPS Sumatera Utara, 2017, <http://www.sumutprov.go.id>).

Generally, small farm still uses old rubber tree (15 years and over). Such condition certainly requires an effort to increase productivity through exploitation system technique.

Slow Starter (SS) clones is characterized by low to moderate metabolic clones where the rate of polyisoprene (latex) formation from carbohydrate (sucrose) from photosynthesis is slow to moderate, while Quick Starter (QS) clones are high metabolic

clones in which the process of polyisoprene (latex) formation is faster than SS (Jacob, et al., 1989).

SS clones, among others BPM 1, were selected from crossbreeding between Avro 163 with Avro 308 by the Medan Plantation Research Center, and as recommended clone in 1937. These clones fit in humid to dry areas with relatively moderate growth from TBM to TM, and potentially as a timber producer (Field Handbook, 2005). SS clones have some specific properties such as responsiveness to stimulants, relatively more resistant to exploitation pressures and have a thick recovery bark (Woelan, Sayurandi, and Pasaribu, 2013).

PB clone is the result of crossbreeding selection between PB5/ 51 with PB 49. The most cultivated clones in North Sumatra are clones PB 260. These clones have advantages such as high potential yield, starting to tapped at 5 years. The peak latex

production for QS clones is at the beginning of tapping (7-9 years). The average of latex production can be achieved 2,700-2800 kg ha^{-1} . In other hand, SS clones reach the peak latex production at 12-13 years after planting. Clone PB 260 have thinner bar than GT 1 and susceptible to Tapping Panel Dryness (Siregar et al., 2012).

Climate factor has important role to support the growth and production of plants. One of the important climatic factors is rainfall. (Estiningtyas, et al., 2000). In addition to sunlight, rainfall is determinant for latex productivity (Gireesh et al., 2011). Rainfall affects fall and flowering of the rubber clones. In the dry season, the rubber tree will fall the leaves. Leaf fall will affect the stability of latex productivity (Meenattoor et al., 1989; Soman, et al, 1995).

Exploitation intensity is mainly determined by the length of the incision, tapping frequency, and stimulants application. All these factors interact with clones, tree age and environment, so that each clone has a specific system of exploitation (Kuswanhadi et al., 2009; Sumarmadji et al., 2011).

The choice of exploitation system technique or as an evaluation tool for latex productivity is largely determined by rainfall (Sumarmadji, 2006, Siregar, 2014 and Junaidi, et al., 2015). The average rainfall for 13 years (2002-2015) in Deli Serdang, North Sumatra, according to *Oldeman* climate type is E1 which divided into three (3) criteria ie wet month (WM) with average rainfall > 200 mm on September - November, humid month (HM) with average rainfall 100-200mm in April-August-December and dry month (DM) with average rainfall < 100mm in January-March (Table 1).

Table 1: Average rainfall for 13 years (2002 -2015) in rubber plantation area in Deli Serdang North Sumatra according to Oldeman climate type.

No	Rainfall	Months	Criteria
1	>200 mm	September - November	WM
2	100-200mm	April - August - December	HM
3	<100 mm	January - March	DM

The aim of this study is to obtain suitable exploitation system under *Oldeman* climate type which can improve productivity of slow starter (BPM 1) and quick starter (PB 260) clones.

2 MATERIALS AND METHODS

The research was conducted in two locations, namely Sungai Putih Experimental Farm, Rubber Research Centre and Sungai Putih Farm, PT. Perkebunan Nusantara III (Persero). Both locations are located in District of Galang, Regency of Deli Serdang on 25 m above sea level with Ultisol soil type. Rubber tree material are planting year 1999, with spacing of 2.5m x 5m, clones representing Quick stater K₁ (PB 260) and Slow starter K₂ (BPM1).

This research uses primary and secondary data. Primary data is field experiment using Nested Design (Suhendry 1998). Secondary data was obtained from PTPN III Sungai Putih that is average of monthly rainfall data for 13 years (2002 - 2015). *Oldeman* classification used to establish wet, dry and humid months. The amount of rainfall in the wet month is > 200mm, humid month is 100-200mm, and dry month is <100.

Tapping system was consisted of 2 treatments namely half-spiral downward tapping system (S/2) and upward tapping system (S/2U).

The treatments consisted of two levels namely P₁ *ethepon* 2.5% applied once for 15 days (ET2.5 15d), P₂ gas stimulant applied once and once for 27 days (ETG 27d). Every treatment used 75 trees with girth 65 cm - 70 cm.

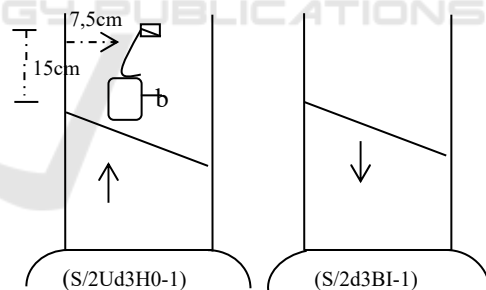


Figure 1: Gas stimulant applicator layout on each tapping system.

3 RESULTS AND DISCUSSION

According to the results of latex production and physiology analysis, the treatment of exploitation system on clone BPM 1 and PB 260 is different both in wet, humid and dry months. The sucrose content of BPM 1 was higher in humid month and higher than PB 260 (Table 2). This is due to different characteristics of each clone (Sumarmadji, 2006).

Clone BPM 1 is SS with slow –moderate metabolism with the peak of latex yield at 12-14 years old (at the time of the study). Such condition causes the latex sucrose of BPM 1 is higher. Clones PB 260 is QS which classified as fast metabolism clones. The peak of latex yield is at the age of 6 - 8 years and at the time of the research has decreased (Sumarmadji, 2008). This is what causes BPM 1 has higher latex sucrose. Herlinawati and Kuswanhadi, (Herlinawati and Kuswanhadi, 2017) state that high production of latex is due to increased plant metabolism such as latex physiology, sucrose content and Pi levels (Table 2).

Rainfall data in Sei Putih farm PTPN III shows that the average rainfall in humid month is 152.04 mm/month with the number of rainy days is 5 days/month. This indicates that the rubber tree in humid months is in sufficient water condition. In humid months, the rubber tree show good ability to photosynthesize, especially in the canopy and leaf (Gunasekera et al., 2013). Kumari and Asthir (Kumari and Asthir, 2016) confirm that the sucrose content and Pi (bioactivity of sucrose) is increases. In sufficient water conditions, the leaves have formed perfectly, the sucrose will be immediately transported elsewhere, and not disturb the balance of sucrose in plant body. Adequate water content leads to an osmotic equilibrium in rubber cells, which imply to the size of plant turgor pressure (Chantuma, et al., 2009). The process of plant metabolism highly depends on the turgor pressure and the process will take place at the maximum turgor pressure. Changes in turgor pressure to minimal (with low water content in the plant body) result in decreased rate of metabolism (Jacob et al., 1989). This study found that the average of sucrose level is higher in BPM 1 than PB 260, either in wet, dry and humid months. This is due to the increase of Pi content as shown by high Pi content in PB 260 (Table 2) which consistent with low levels of sucrose. PB 260 is QS clone with high metabolism so the sucrose content is lower than BPM 1. This is due to active Pi level as energy to converts sucrose to latex. Pi level is low because already used to support the process of metabolism which is related to latex formation (Herlinawati and Kuswanhadi, 2017). In contrast, BPM 1 is SS with low metabolism, high sucrose and Pi levels. The clones are slow to process sucrose to latex so have high sucrose content and Pi. This finding confirmed by Kuswanhadi, Sumarmadji, Karyudi, and Siregar, THS (Kuswanhadi, Sumarmadji, Karyudi, and Siregar, THS, 2009) which states that the SS clones has firm stems growth and thick recovery bark.

4 CONCLUSIONS

Suitable exploitation systems under *Oldeman* climate type for PB 260 in wet, humid and dry months is S2 d3 ET/15d and BPM 1 is S2U d3 ET/15d. During one year of testing, all treatments of exploitation system on PB 260 and BPM 1 have not shown excessive stress as indicated by thiol levels in the range 0.30 - 0.48.

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APPENDIX

Table 2: Latex Production and Physiology of clones BPM 1 and PB 260 with treatment of exploitation system by wet month (WM), dry month (DM) and Humid month (HM).

Treatment	Month											
	Sucrose (mm)			Pi (mm)			Thiol (mm)			Production (g/p/s)		
	BB	BL	BK	BB	BL	BK	BB	BL	BK	BB	BL	BK
BPM1 S/2d3 ET/15d	6.75 c	6.49 b	6.72 a	21.85 c	21.03 bc	20.34 de	0.28 b	0.31 b	0.36 d	30.72 c	13.96 b	21.79 c
BPM1 S/2d3 ETG/27d	9.18 ab	6.58 b	4.37 b	28.02 b	25.24 a	18.99 e	0.34 b	0.41 ab	0.46 b	29.18 c	13.59 b	22.20 c
BPM1 S/2U d3 ET/15d	7.91 bc	9.60 a	7.41 a	27.86 b	23.14 ab	24.63 bc	0.29 b	0.35 b	0.41 c	72.35 a	27.83 a	51.75 a
BPM1 S/2Ud3 ETG/27d	9.43 a	10.2 3 a	7.61 a	31.35 a	23.65 ab	28.11 a	0.32 b	0.42 ab	0.46 b	56.28 b	26.50 a	41.79 b
PB260 S/2d3 ET/15d	3.82 d	7.71 b	2.62 cd	23.68 c	23.76 ab	26.05 ab	0.46 b	0.49 a	0.52 a	72.53 a	27.83 a	51.75 a
PB260 S/2d3 ETG/27d	3.39 de	2.96 c	1.49 d	26.83 b	24.84 a	25.53 abc	0.45 b	0.50 a	0.48 b	56.28 b	26.50 a	41.79 b
PB260 S/2U d3 ET/15d	2.03 e	2.87 c	2.18 cd	23.73 c	19.22 c	26.05 ab	0.47 b	0.48 a	0.47 b	29.18 c	13.59 b	22.20 c
PB260 S/2Ud3 ETG/27d	3.06 de	3.59 c	3.62 bc	21.35 c	19.44 c	17.83 e	0.78 a	0.47 a	0.42 c	30.18 c	13.96 b	21.79 c